The Determinants of Corporate Growth

Rosique, Francisco

University of St Andrews

23 June 2010

THE DETERMINANTS OF CORPORATE GROWTH

Francisco Rosique Gil

**A Thesis Submitted for the Degree of PhD
at the
University of St. Andrews**

2010

The Determinants of Corporate Growth

Francisco Rosique Gil

Submitted for the degree of

Doctor of Philosophy (Management, Economics and Politics)

at the University of St Andrews

11 September 2009

I, Francisco Rosique, hereby certify that this thesis, which is 72471 words in length, excluding appendixes and bibliography, has been written by me, that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

Date: 11 September 2009. Signature of candidate:____________________________.

I was admitted as a research student in September 2002 and as a candidate for the degree of PhD Management, Economics and Politics in September 2009; the higher study for which this is a record was carried out in the University of St. Andrews between 2002 and 2009.

Date: 11 September 2009. Signature of candidate:____________________________.

I, Francisco Rosique, received particular assistance in the writing of this thesis in respect of matters of style, idiom, grammar, syntax or spelling, which was provided by Miss Nicola Searle.

Date: 11 September 2009. Signature of candidate:____________________________.

I hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of PhD Management, Economics and Politics in the University of St. Andrews and that the candidate is qualified to submit this thesis in application for that degree.

Date:________________. Signature of supervisor:____________________________.

In submitting this thesis to the University of St. Andrews we understand that we are giving permission for it to be made available for use in accordance with the regulations of the University Library for the time being in force, subject to any copyright vested in the work not being affected thereby. We also understand that the title and abstract will be published, and that a copy of the work may be made and supplied to any bona fide library or research worker, that my thesis will be electronically accessible for personal or research use, and that the library has the right to migrate my thesis into new electronic forms as required to ensure continued access to the thesis. We have obtained any third-party copyright permissions that may be required in order to allow such access and migration.

Access to Printed copy and electronic publication of thesis through the University of St Andrews

Date: 11 September 2009. Signature of candidate:______________________________.

Date:_______________. Signature of supervisor:______________________________.

Address for correspondence:
School of Economics & Finance
University of St. Andrews
St. Andrews, Fife, UK
KY16 9AL
Email: fr6@st-andrews.ac.uk
Web: http://selene.uab.es/frosique/

To my family:

My wife Montserrat, and our daughters

Clara and Glòria

My parents, Pilar and Martin

Abstract

Corporate Growth is a concept that has been widely treated in a specific way or as part of strategy theories, in definition and in econometric models and has also been studied in many different aspects and approaches. The author describes in depth the main variables affecting corporate growth and the underlying business processes.

This empirical research has focused on Sales, Profit-Cash Flow, Risk, Created Shareholder Value, Market Value and Overall Performance econometric models. These panel data models are based on the 500 Companies of the Standard & Poor's 500. The methodology used has been very strict in identifying exogenous variables, walking through the different alternative econometric models, discussing results, and, in the end, describing the practical implications in today's business corporate management.

We basically assume that the Functions/Departments act independently in the same company, many times with different objectives, and in this situation clear processes are key to clarify the situations, roles and responsibilities. We also assume that growth implies interactions among the different functions in a company and the CEO acts to lead and coach his immediate Directors as a referee of the key conflicts through his Operating Mechanism.

The objective of this PhD Dissertation is to clarify the business priorities and identify the most relevant variables in every process leading to the highest efficiency in reaching a sustainable and profitable growth. It covers the lack of academic studies on the nature and specific driving factors of corporate growth and provides a working framework for Entrepreneurs and Management leading to the Company's success.

JEL Classifications: C33 ; D24; D92; G30; L21; L25; L60; L70; L80; L90; M21; O32.

Keywords: Models with Panel Data, Capital, Productivity, Firm Choice, Growth, Investment, Corporate Finance, Firm Objectives, Firm Performance, Industry Studies, Manufacturing, Primary Products and Construction, Services, Transportation and Utilities, Business Economics, Research and Development

Acknowledgements

First of all, I would like to thank my supervisors, Felix FitzRoy and Gavin Reid. Felix has been providing a patient and generous guidance in econometrics and strategy along the whole period of the thesis. Gavin was very helpful and mainly focused on the econometrics and firm performance in the first three years of the thesis. Without their support this PhD thesis would have not been written.

The annual presentations of the work done at the School of Economics and Finance of the University of St. Andrews have been very challenging and motivating. I am very grateful to John Beath, Arnab Bhattacharjee, Vladislav Damjanovic, Jim Y. Jin, Laurence Lasselle, Peter Macmillan, Charles Nolan, Kaushik Mitra, Gary Shea, Christoph Thoenissen, Alex Trew and others for their comments, and contributions to make my work and this PhD thesis much richer. I cannot forget Chris Jensen-Butler, who was always very interested in my work. A few words and minutes with him meant a lot for me.

Manuel Arellano was very important in the understanding of the outcomes of the different Panel Data models, especially in the estimates comparisons. He was also personally providing me a sample of his famous "*Panel Data Econometrics*" book far before its publication.

David Roodman was very supportive in dealing with the large files and additional tools in Stata. Gustavo Sanchez and Brian Poi have been contacted many times with relation to the implementation of model estimators, special commands and the cleaning of the main databases in Stata.

Manuel Delfino and María Paz de Andrés were deploying special PC's with 3.5 MB RAM memory to run the large panel data Arellano-Bond estimators at the Autonomous University of Barcelona.

I am also grateful to the Support Staff: Eliana Wilson, Caroline Moore, Liz Pert-Davies Angela Hodge, and others for their help.

I am deeply indebted to my wife Montserrat, and our daughters Clara and Gloria for their understanding of my work.

Brief Contents

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 The Problems

There are several problems which impact performance and, specifically, corporate growth. This set of problems has been collected from the academic literature on corporate growth. They are:

- Lack of studies on the nature and driving factors of corporate growth. AT Kearney (2000), Canals (2000), Roberts (2004), Slywotzky and Wise (2004) and Coad (2007) have been trying to address this issue, but none of them through an econometric empirical research.
- Lack of practical frameworks for CEO's to better understand the main processes specially the Value Creation one. Corporate Finance is very well structured, but the fact of the existence of several set of measures like the SVA-Shareholder Value Added, EVA-Economic Value Added, CFROI-Cash Flow Return on Investment, etc.., which have been created with corrections on the accounting metrics, has developed, at the CEO's level, a fear of its implementation. They try to avoid complexity in their Organizations.
- Lack of alignment between the global strategy and the performance management agendas of the Sales, Operations, Technology, Finance, and Mergers & Acquisitions teams. It is very important to close the loop between the global strategy at the Headquarters level and the different layers lower in the organization, otherwise it results in a lack of information and coordination, which is a never ending problem.
- Lack of studies on the advantages and disadvantages of large scale operations.
- Compatibility of IT Management Systems in the organization due to the integration of companies with different systems.
- Issues related to CEO leadership and problems in the chain of command.

The above mentioned list shows the most important problems that arise due to the increase in global complexity. It has been collected from the academic literature, but it must be considered as an open list.

1.2 The Objectives

The main Objectives to be undertaken in this Dissertation are listed in the first two problems, and two critical items related to the quality must be added due to the methodology of the work to be conducted. These are:

- Study the nature and driving factors of corporate growth discriminating among the Sales, Profit-Cash Flow, Risk, Created Shareholder Value, Market Value, and the Overall Performance Models through an econometric empirical research.
- Define layouts of actions belonging to the main drivers impacting the business processes for each model.
- Undertake the following methodological stages to secure the quality of the econometric work. These are: (1) formulating a model, (2) gathering the data (clean the databases, and identification of outliers), (3) first elimination of variables (correlation matrix, and first estimation), (4) first estimation of the model, (5) hypothesis testing, (6) unit root tests, cointegration test, vector error correction models, (7) re-estimation of the model and (8) interpreting the results.
- Perform a Project Management approach for the whole process of the academic research.

1.3 The Basic Framework

A sound balance of the main strategic concepts is required to reach growth in a company, and they are never isolated one from the other. At the same time, each one is supported by different key functions shared by different Departments in the company. An adequate management leads to the improvement of the Overall Performance and Customer

Satisfaction, which are the main objectives in the Company. The enclosed Figure 1.1 describes the Basic Framework:

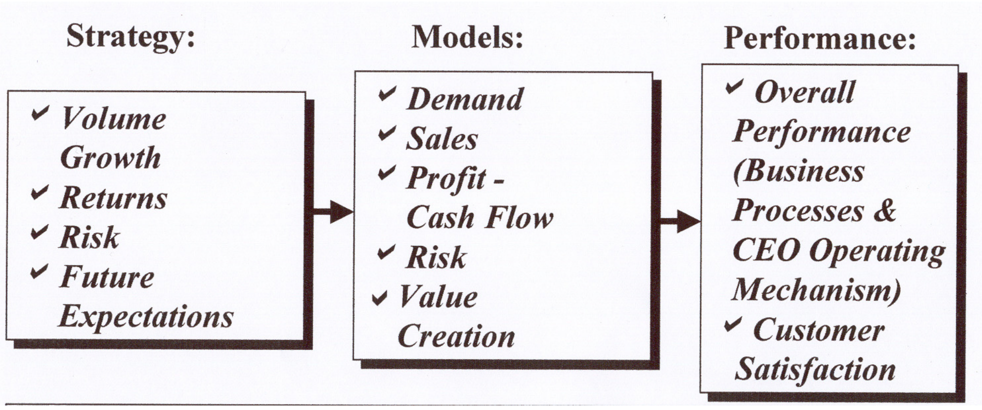


Figure 1.1: The Basic Framework

Any Strategic Decision implies a setting of the Volume Growth, Returns, Risk and the Expectations in the Business. Returns mean Company Profit and Cash Flow Return, we are not referring to the Total Shareholder Return concept. At the same time, Volume Growth is mainly affected by the Demand, decisions in Sales, and targeted Profits-Cash Flows. Returns are mainly affected by decisions in Sales, targeted Profits-Cash Flows, and the assumed level of Risk.

In this context, Sales is a dependent variable supported by underlying business processes or exogenous independent variables that we will analyse through out the research. However, it is not an objective of the research to make an analysis of the Demand models.

One of the reasons to adopt this approach is that American Companies are more oriented to Operations than to Sales, and the European ones more to Sales than Operations. This suggests that many companies are biased in its Management approach and emphasize the Business processes in which the CEO background is more skilled.

The Overall Performance, supported by the Business Process Management and the CEO leadership through his Operating Mechanism, as well as the Customer Satisfaction are the main objectives to achieve the best performance and sustainable and profitable growth.

The reader could find similar structures for the Strategy box on the left. Rappaport (1986, 1998)[1] defined as value drivers: sales growth rate, operating profit margin, income tax rate, working capital investment, fixed capital investment, cost of capital, and value growth duration. The operating framework was called "The Shareholder Value Network".

Black, Wright, Bachman, and Davies (1998)[2] defined the Strategic Value Drivers as Growth, Risk, and Return, and they aligned the business processes to the Shareholder Value considering three layers of drivers. These are: Strategic, Financial, and Operational, or, as the authors said, from macro to micro SHV-Shareholder Value drivers.

Warner and Hennell (1998, 2001)[3] defined the four key value drivers as: sales growth, profit margin, fixed assets utilization, and working capital control.

Copeland, Koller and Murrin (2000)[4] introduced the concept of Key Performance Indicators, due to the fact that the Value Drivers are too general, and lack specificity as they mention in their book.

Our approach goes beyond the objective of the previous authors. We include the Expectations, as a way to understand drivers and how to attract capitals. We emphasize the need of a different set of measures and processes to care for the interests of Shareholders, even including the investor's behavioural measures and processes.

1.4 Theoretical literature on Corporate Growth

We can historically identify five streams of research related to Corporate Growth together with the main authors in each section. These are:

- Theories explaining growth. Penrose (1959), Chandler (1962), Marris (1963), Alchian and Demsetz (1972), Greiner (1972), Mueller (1972), Jensen and Meckling (1976),

[1] Rappaport, A., 1998, *Creating Shareholder Value: a guide for managers and investors*, The Free Press, New York, 3, 56.

[2] Black, Dr A., Wright, P., Bachman, J., and Davies, J., 1998, *In Search of Shareholder Value: managing the drivers of performance*, Financial Times, Pitman Publishing, 7, 91.

[3] Warner, A., and Hennell, A., 2001, *Shareholder Value Explained*, 2nd Ed., Financial Times, Prentice Hall, 6, 71.

[4] Copeland, T., Koller, T., and Murrin, J., 2000, *Valuation: measuring and managing the value of companies*, 3rd Ed., John Wiley & Sons, Inc., 6, 99.

Nelson (1991), Geroski and Machin (1992), Gertz and Baptista (1995), Baghai, Coley and White (1996), Ghoshal (1997), Slywotzky (1998), Garnsey (1998), Canals (2000), Roberts (2004) and Coad (2007).

- Corporate growth being part of a Strategy Theory. Coase (1937), Penrose (1959), Ansoff (1965), Andrews (1971), Williamson (1975), Nelson and Winter (1982), Chandler (1990), Prahalad and Hamel (1990), Ghosal, Hahn and Moran (1997), and AT Kearney (2000).
- Definition models explaining growth. DuPont (1953), Higgins (1977), Johnson (1981), Kyd (1981), Varadarajan (1983), Govindarajan and Shank (1984), Eiseman (1984), Olson (1989), and Clark, Chiang and Olson (1989).
- Econometric models explaining corporate growth rates. Evans (1987), and Geroski (1998).
- Econometric models explaining growth. Pakes (1985), Jaffe (1986), Griliches and Mairesse (1983), and Hall and Mairesse (1995).

At this point, we can summarize the main contributions for the above mentioned different groups. They are as follows:

The microeconomic theory. Coase (1937)[5], and Williamson (1975)[6]. The firm is viewed as a production function that the entrepreneur must optimise. In this case, growth is the change in output caused by the changes in the inputs of the production function and leads to an adjustment to the optimum firm's size.

The resource-based theory. Penrose (1959, 1995)[7] stated that in the long run the profitability, survival, and growth of a firm does not depend so much on the efficiency with which it is able to organize the production of even a widely diversified range of products, as it does on the ability of the firm to establish one or more wide and relatively impregnable "bases" from which it can adapt and extend its operations in an uncertain, changing, and competitive world. Penrose emphasized the processes and limits of firm growth, and categorized three potential limits to growth. These limits include managerial ability, product or factor markets, and uncertainty and risk.

---

[5] Coase, R.H., 1937, "The Nature of the Firm", *Economica*, 4, 386-405.
[6] Williamson, O., 1975, *Markets and Hierarchies*, The Free Press, New York.
[7] Penrose, E., 1995, *The Theory of the Growth of the Firm*, 2nd Ed., Oxford University Press, New York

The evolutionary theory. Nelson and Winter (1982)[8] discuss the circumstances under which firm growth initially increases with firm size, but then it also decreases with firm size for firms of 20 years or older. They introduced the concept of routines as the main processes impacting the evolution. These routines include recruitment, evaluation of investment projects, R&D, and advertising policies, growth being the interaction between routines and knowledge. They state the limit to grow as the resistance to change routines by people when these have been in place for a long time.

The corporate-strategy view. Several authors were contributing to this corporate-strategy view. The main ones are:

Chandler (1962, 1990)[9] focused on organizational capabilities and structure innovations like the divisions approach. He described the divisions, headed by middle managers, administered their functional activities through departments, and integrated production and distribution by coordinating flows from suppliers to consumers in different, clearly defined markets. He very clearly stated that the divisional managers must be evaluated on the financial and market performance of the divisions. Growth must be a responsibility of the top managers who must concentrate on planning and allocate resources with the objective to pursue organizational efficiency.

Ansoff (1965, 1990)[10] provided the framework for the analytical approach to business policy for growth and expansion. He gave a highly complex "cascade of decisions" and mainly talks about the gap analysis. This is the key to unlock strategy in the companies and the gap describes where you are at present and where you want to be in the current portfolio of businesses. The key variables to analyse the gaps were the resources available and the attractiveness of the industry for each business unit. Additional contributions were the "paralysis by analysis" where strategic plans were laid out but remained unimplemented, and profits/growth remained stagnant. Finally, in his Strategic Success Paradigm, he emphasized the importance of the influence of market environment, alignment of management with the

[8] Nelson, R. and Winter, S., 1982, *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge.

[9] Chandler, A., 1962, *Strategy and Structure*, The MIT Press, Cambridge.

--------------, 1990, *Scale and Scope*, Harvard University Press, Cambridge.

[10] Ansoff, H. I., 1965, *Corporate Strategy: An Analytical Approach to Business Policy for Growth and Expansion*, McGraw-Hill, New York.

-------------- and Mc Donnell, E., 1990, *Implanting Strategic Management*, 2nd Ed., Prentice Hall, New York.

environment, and the internal capabilities like the cognitive, the psychological, the sociological, the political, and the anthropological capabilities.

Andrews (1965)[11] argues that strategy formulation is merely a series of subactivities which are primarily administrative. He introduced the concept of strategy as a pattern of decisions and consistent with the intended strategy. His work has been focused on the analytical steps needed to conceive a strategy, and he emphasizes the role of the CEO as the architect of the company's strategy. Andrews was not specially addressing the growth item, but it is clear that choosing clear goals and policies as the key elements of the strategy is, to a certain extent, implicit.

Greiner (1972)[12] argues that the companies go through stages of growth, stagnation and even decline in times of crisis. The key dimensions of the model are: age, size of the organization, stage of evolution, stages of revolution, and the industry growth rate. Based on these key dimensions, Greiner developed a model with five growth stages: creativity, direction, delegation, coordination, and collaboration, and separated by four crises: leadership, autonomy, control, and red tape. The model helps companies to understand why certain management styles, organizational structures, and coordination mechanism work better at different stages of growth.

Clark, Chiang and Olson (1989)[13] provide an excellent description of all the definition models and they state how excessive growth in sales can be as destructive for the survival of a firm as no growth at all. After the wide presentation of specific models, they proceed with a presentation of the growth theory in management decision making, then use the models to forecast real business situations and finally determine the most adequate capital structure of the firm, which is matched with the corporate growth rate.

Ghoshal, Hahn, and Moran (1997)[14] start studying the correlation between the prosperity of an economy and the relative role of large firms operating in that economy. They propose that this is due to the positive influence of management competence. They developed a theoretical framework based on two aspects of management competence: entrepreneurial

[11] Andrews, K.R., 1971, *The Concept of Corporate Strategy*, 3rd Ed., Irwin, Homewood, IL.
[12] Greiner, L.E., 1972, "Evolution and Revolution as Organizations Grow", *Harvard Business Review*, 37-46.
[13] Clark, J., Chiang, T. and Olson, G., 1989, *Sustainable Corporate Growth: a model and management planning tool*, Quorum Books, Westport, Connecticut.
[14] Ghosal, S., Hahn, M. and Moran, P., 1999, "Management Competence, Firm Growth and Economic Progress", Contributions to Political Economy, ConPec, *Cambridge Political Economy Society*, 18, 121-150.

judgement and organisational capability. They show that the interaction of these two factors affects the speed at which firms expand their operations, the kind of expansion, and the process through which firms create value.

Other contributions on corporate growth cannot be classified as being part of a Strategy Theory. But it is worth mentioning them as belonging to one of the five streams of research as described at the beginning of this section. These are:

Geroski (1997-99)[15] focuses on the growth of firms in theory and practice suggesting that firm size follows a random walk, the corporate growth rates are random, and corporate performance is erratic. He also discusses the inconsistency of his findings with the growth models analysed, and he states that the companies not always display sustained success and that previous stages of success do not guarantee future success.

Baghai, Coley, and White (1999)[16] McKinsey. Based on the experience of 30 of todays' greatest growth companies they found that the secret is to manage business opportunities across three time horizons at once: extending and defending core business in horizon 1, building new businesses in horizon 2, and seeding options for future businesses in horizon 3. They emphasize that Management must be engaged in these tasks which should not be deferred to some future long term plan.

Doorley III, and Donovan (1999) Deloitte & Touche developed the "Growth System" with three main tools: A due diligence checklist, a growth diagnostic, and ten essential practices. In the growth diagnostic they propose to test against: commitment to growth, ability to create a growth strategy, the company's capabilities to identify the critical processes, leverage a growth strategy, and design systems to grow.

---

[15] Geroski, P., Machin, S. and Walters, C., "Corporate Growth and Profitability", *Journal of Industrial Economics*, 45, 2, 171-189.
Geroski, P., 1998, "An Applied Econometrician's view of Large Company Performance", *CEPR Centre for Economic Policy Research*, Discussion Paper No 1862.
Geroski, P., 1999, "The Growth of Firms in Theory and Practice", *CEPR Centre for Economic Policy Research*, Discussion Paper No 2092.

[16] Baghai, M., Coley, S. And White, D., 1999, *The Alchemy of Growth*, Orion Business, London,

It is worth listing the ten essential Growth System practices from the Deloitte & Touch system as quoted in their corporate website. These are:

1. Believe deeply that growth drives value creation
2. Articulate a growth vision, embed it throughout the organization
3. Link growth performance to rewards and performance
4. Create a valuable formula as a platform for long term growth
5. Manage the valuable formula across the growth cycle
6. Globalise the valuable formula, maintain integrity and modify locally
7. Identify and nurture all growth-supporting processes
8. Leverage two key strategic weapons –innovation and alliances- to exploit valuable formulas
9. Benchmark growth foundations vs. the "best of the best" and aim to beat them
10. Design and implement initiatives to align foundations

McGrath, Kroeger, Traem, and Rockenhaeuser (2000) [17] AT Kearney suggest that companies need to achieve a strategic balance between top and bottom line growth. The strongest companies are those that recognize and understand the importance of both innovation and improvement. These companies never stop growing and are the true Value Growers. They recommend the use of the AT Kearney Growth matrix where the x-axis is the Market Value growth adjusted for the change in equity, and the y-axis the revenue growth. The figure shows the situation of the companies above or below the average of the industry.

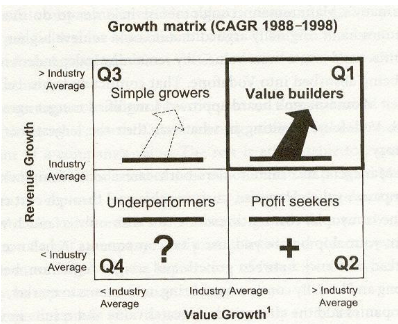


Figure 1.2: AT Kearney. The Value Growth matrix

[17] McGrath, J., Kroeger, F., Traem, M. and Rockenhaeuser, J., 2000, *The Value Growers: achieving competitive advantage through long-term growth and profits*, McGraw-Hill, New York.

They also show a Value-growth platform for the business, which is very useful when applied. This is as follows:

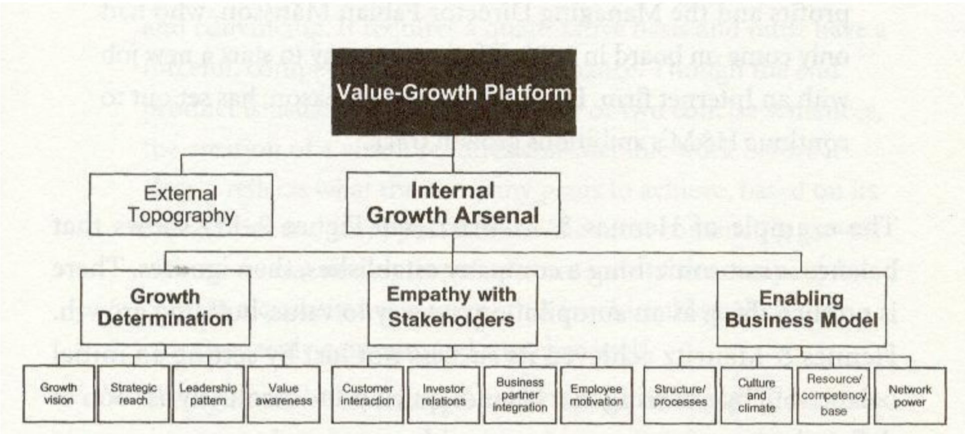


Figure 1.3: AT Kearney. The Value-Growth Platform.

Canals (2000)[18] develops an integrative model of corporate growth explaining the nature of the factors influencing corporate growth. These are: the firm's internal and external context, the development of a business concept, resources and capabilities, and the strategic investment decisions. Additionally he studies the decision-making process of decisions for growth, the methodology to understand this process and improve the evaluation of growth decisions, and finally mentions the limits and sustainability of corporate growth.

Roberts (2004)[19] describes ways of thinking about the problem of designing business organizations for performance and growth. He also seeks to explain some of the great changes in actual companies that are creating the new model of the modern firm. Buying growth through acquisitions, innovation and job design for multi-tasking are the key organization themes for growth and innovation which are described in chapter six of his Modern Firm book.

Slywotzky, and Wise (2004)[20] explain how companies can employ the demand innovation to fuel growth in markets that seemingly have run out of steam. Demand innovation goes beyond the usual approach of improving products to generate new profits by developing opportunities that surround a product. This is like reinventing the demand side and giving

[18] Canals, J., 2000, *Managing Corporate Growth*, Oxford University Press.
[19] Roberts, J., 2004, *The Modern Firm: organizational design for performance and growth*, Oxford University Press.
[20] Slywotzky, A., Wise, R. and Weber, K., 2004, *How to Grow when Markets Don't*, Warner Business Books, New York.

more importance to customer needs. They start describing the growth crisis and how we can go forward.

Harvard Business Review- OnPoint (2006)[21] offers a collection of articles compiled by Clifford Baden and provides tools to think strategically how to grow in the long term. The tittles show the background of the articles. These are:

1. Bhide, A., 1996, *"The Questions every Entrepreneur must answer"*.
2. Slywotzky, J, and Wise, R., 2002, *"The Growth Crisis and how to escape of it"*.
3. Gunther McGrath, R., and MacMillan, I., *"Market Busting: Strategies for exceptional Business Growth"*. It is important to emphasize that they have identified the eight actions to redefine the profit drivers and realize low risk growth. These are:
    - Change your unit of business
    - Retain your unit of business, but radically improve your key metrics, particularly productivity
    - Improve your cash-flow velocity
    - Dramatically improve your asset utilization
    - Improve your customer's performance
    - Improve your customer's personal productivity
    - Help improve your customers' cash flow
    - Reduce your customer's assets intensity
4. Waite, T., 2002, *"Stick to the Core or Go for More"*.
5. Zook, C., and Allen, J., 2003, *"Growth outside the Core"*.
6. Hemp, P., 2002, *"Growing for Broke"*.
7. Kim, W.C., and Mauborgne, R., 1997, *"Value Innovation: The Strategic Logic of high Growth"*.
8. Mankins, M., and Steele, R, 2005, *"Turning Great Strategy into Great Performance"*.
9. Nohria, N., Joyce, W., and Roberson, B., 2003, *"What really Works"*. Based on a multiyear research they examined 200 established management best practices, covering a ten-year period by 160 companies. They discovered and defined the 4+2 formula for business success, which requires to excel at the four primary practices, and to embrace two of the four secondary practices. The details from their article are:

[21] Dillon, K. and Baden, C., 2006, "Growing your Business", *Harvard Business Review – Onpoint*, Executive Ed., Boston.

- Primary Practices:
  1. Strategy. Devise and maintain a clearly stated, and focused strategy
  2. Execution. Develop and maintain flawless, and operational execution
  3. Culture. Develop and maintain a performance-oriented culture
  4. Structure. Build and maintain a fast, flexible, and flat organization
- Secondary Practices:
  5. Talent. Hold on to talented employees and find more
  6. Innovation. Make industry-transforming innovations
  7. Leadership. Find leaders who are committed to the business and its people
  8. Mergers and Partnerships. Seek growth through mergers and partnerships

1.5 Link of the current research with the theoretical literature on Corporate Growth

We can summarize the link of the current research with the theoretical literature in the following items:

- The traditional view holds that the firm's sole objective must be profit maximization. Penrose extended this view by claiming that firms desire profits in order to expand, and growth and profit are equal factors in expanding decisions. We extend Penrose's views stating that sales, profit/cash flow, risk and value creation are equal factors to look after and essential to grow the business.

- Penrose explained how the Managerial Resources are a key element to limit growth. We fully support her view stating that all the business processes (resources, acquisitions,..) reach a saturation or upper bound level in every firm/sector unless we redefine the business identifying opportunities to expand and to reach the next stage.

- We cannot simplify growth to just regress a rate of growth. It is very important to identify the key factors driving growth and determine the underlying business processes for each factor.

- We fully agree with the theories viewing the firm as a set of contracts among factors of production, with each factor motivated by its own interest. We extend this view stating that every key factor driving growth is driven by different business processes managed by teams/

teams/departments (sales, operations,..) pursuing their own interest, and many times in conflict. It is up to the CEO to, through his leadership, solve these issues, and a trade-off between departments may provide the best solution. In this sense we fully subscribe to Andrews (1965) contribution stressing the key role of the CEO as the architect of strategy and the influence on the Vision, leadership, and coaching for the organization.

- Geroski and Machin (1992) stated that corporate growth is idiosyncratic and firm specific, depending upon each firm's history and innovations. We state that corporate growth is affected by its history of robust key factors (sales capabilities, generation of profit/cash, risk control and capabilities to attract capitals when required), and the life cycle of their sector. A Company could have very robust business processes, but competing in a mature sector sometimes may succeed for a limited period of time.
- AT Kearney (2000), Canals (2000) , Roberts (2004), and Slywotzky and Wise (2004) describe the business drivers, even if the latter are more focused on the demand and customer processes leading to corporate growth and the improvement of performance. All of them are very enlightening and many of them are the result of the joint work and sharing of experiences with very important companies. We validate the key drivers or business processes through an empirical research based on historical financial data. There is a common objective in all to drill down into the processes for improvement. We can say that we complete their work with a different approach.
- There is a clear relation between the business processes leading to the company's growth and the key drivers of business performance. This latter approach could open us to a complete body of literature based on Business Performance, however this is not the objective of our research. We stand on the Determinants of Corporate Growth and emphasize the difficulties to grow pursuing a sustainable and profitable growth.

1.6 What is innovative in our current research?

The main innovative aspects against previous research are the following:

- We identify the "Y's key factors" driving growth in a balanced way. These are: Demand, Sales, Profit/Cash Flow, Risk, and Value Creation. As previously mentioned we will not cover the econometric demand models in the current research.

- Every factor is laid down to the "X's business processes", as an example: Sales is driven by the current Market situation, Core Resources, Research and Development (New Products Development and Introduction), and Investments (Mergers and Acquisitions, IT-Information Technology, etc..). It is important to stress that Sales is not a key factor only owned by the Salesforce, but it is also a shared responsibility with the Operations, Technology R&D, and the Investments (Finance and M&A) teams.
- The increasing returns (ramp-up) at the early stages and the saturation or upper bound of the Y-key factor at the late stages of the X-Business processes has been taken into account in the econometric models. This concept has been borrowed from the Adbudg Model popularised by Little (1970)[22], but never introduced in this context dealing with financial variables.
- Identify the significance of the parameters of the X-Business processes by Industrial Sector for the Sales and Profit-Cash Flow model.
- The introduction of the lags and first differences for each X-Business processes allow us to understand from the econometric outcome, specifically the Sales model, how a variable behaves in the long and short term.
- As a consequence, the accurate knowledge of every Y-key factor and its X-Business processes is key to understand the relevant Business Process Management approach to Corporate Growth. The main advantage is that we can deploy people to reach certain targets by each X-business process. Conversely, as the reader can see, we are neither focused on the effects of the Balance Sheet structure nor in the macroeconomic variables effect. The latter is captured in the "Market situation" variable.
- The annual or quarterly waterfall forecasting of the Y-Variables on the X-Business processes has not been previously modelled through Panel Data Econometrics in the economic literature on corporate growth, and this is leading us to apply dynamic econometric models. At the same time the waterfall forecasting approach is a very familiar methodology at the Companies Management level.

[22] Little, J., 1979, "Aggregate Advertising Response Models: The State of the Art", *Working Paper: 1048-79*, *Sloan School of Management*, MIT.

1.7 Y's saturation level or upper bound effect against X's resources

It is very important to capture the effect of the scarcity of resources, and the limitation to grow. As above mentioned Penrose (1959) described the managerial resources as a key element to limit growth, and we generalize that any Y-key factor shows a saturation level when increasing the X-Core resources mainly influenced by the competition intensity, lack of selling ideas or new products, or new opportunities in mature markets. In a practical way, there are less important available companies to acquire in every sector, and clearly complexity costs (communication and teams coordination) increase as size does. These hidden costs refrain companies from growing and show its saturation level in net sales, profit, etc..

The Adbudg model popularised by Little (1970) explains the saturation of net sales for the higher levels of deployed resources. The firm resources are limited and subject to saturate its outcome of net sales unless we invest in new products, markets, technologies or acquisitions.

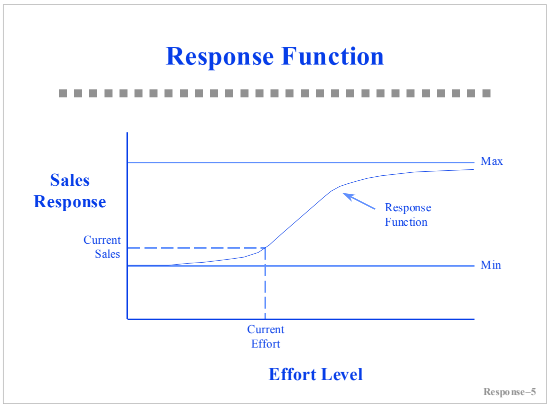


Figure 1.4 The Adbudg response function[23]

The Adbudg response function "Sales response" $y = r_i(X_i)$ is a function of the X (advertising or resources expenditures) in levels. It captures four stages of growth: the increasing returns, linear, decreasing returns and the final saturation. When we differentiate $r_i(X_i)$ with respect to X_i we get the results, which are shown below.

[23] Graph borrowed from Lilien, G. and Rangaswamy, A., 2006, *Marketing Engineering: computer-assisted marketing analysis and planning*, 2nd Ed., Prentice Hall, 37-40.

The Sales (adbudg response function) and its derivative are the following:

$$r_i(X_i) = b_i + (a_i - b_i)\frac{X_i^c}{d_i + X_i^c} \quad (1.7.1)$$

$$k = a_i - b_i \quad (1.7.2)$$

$$dr_i(X) = k\left(\frac{cX^{c-1}d}{(d + X^c)^2}\right)dX \quad (1.7.3)$$

$$dr_i(X) = f(X_{-1}; dX;) \quad (1.7.4)$$

We can transform the derivative of the Adbudg response function taking logs and the outcome is the following:

$$log(\Delta y_{i,t}) = k_1 \, log \, X_{i,t} + k_2 \, log(\Delta X_{i,t}) - k_3 \, log(d + X_{i,t}) \quad (1.7.5)$$

$$log(\Delta y_{i,t}) = k_4 \, log \, X_{i,t} + k_2 \, log(\Delta X_{i,t}) + \eta_i \quad (1.7.6)$$

We can take as a proxy[24] the following linear model:

$$\Delta y_{i,t} = \eta_i + \beta_1 X_{i,t} + \beta_2 \Delta X_{i,t} \quad (1.7.7)$$

This specification shows the independent variables $X_{i,t}$ and $\Delta X_{i,t}$ measured in the same year. This is consistent with the Palda (1964)[25] model, which includes the sales (1st-lag) as well as advertising as explanatory variables. Due to the high possibility of correlation between these contemporaneous variables, we adopt the Bass and Clarke (1972)[26] specification and because the independent variable $X_{i,t}$ will often be highly correlated with the 1st and 2nd lag, and so on, we choose the 1st-lag as the most significant in the different PDL-Polinomial distributed lag models tested in the lag models of the advertising effects. The linear interactive model takes the following form:

$$y_{i,t} = a\, y_{i,t-1} + \beta_1 X_{i,t-1} + \beta_2 \Delta X_{i,t} \quad (1.7.8)$$

24 The related series: $\ln x = x - 1 - \frac{(x-1)^2}{2} + \frac{(x-1)^3}{3} - .... \quad if \; |x-1| \le 1$

25 Little, J.D.C., 1979, "Aggregate Advertising Response Models: The State of the Art", Sloan School of Management, M.I.T., Working Paper 1048-79, 28.

26 Bass, F.M. and Clarke, D.G., 1972, "Testing Distributed Lag Models of Advertising Effect", *Journal of Marketing Research*, Vol. 9, No 3, 303, Table 2.

In order to capture all the effects we are missing the conjoint effect and the linear interactive model takes the following form:

$$dy_{i,t} = \eta_i + \beta_1 X_{i,t-1} + \beta_2 dX_{i,t} + \beta_3 X_{i,t-1} dX_{i,t} \quad (1.7.9)$$

The last multiplicative variable is called the conjoint effect, and it highly correlates with the first differences $dX_{i,t}$, due to this we eliminate the conjoint effect and we have:

$$dy_{i,t} = \eta_i + \beta_1 X_{i,t-1} + \beta_2 dX_{i,t} \quad (1.7.10)$$

then the specified model under the autoregressive dynamic panel data identification becomes:

$$\Delta y_{i,t} = \beta_1 X_{i,t-1} + \beta_2 dX_{i,t} + \eta_i + \varepsilon_{i,t} \quad (1.7.11)$$

$$y_{i,t} = a\, y_{i,t-1} + \beta_1 X_{i,t-1} + \beta_2 dX_{i,t} + \eta_i + \varepsilon_{i,t} \quad (1.7.12)$$

This model specification allows us to capture the long and short-term adjustments. The $X_{i,t-1}$ provides the long-term variable and $dX_{i,t}$ provides the short-term adjustment.

Due to the fact that there are only a few companies with the variables at the saturation stage, the specified model is controlling the increasing returns (ramp-up) at the early stage much better than the linear relationship model.

Additionally, we can state that the autoregressive dynamic panel data model, with the incremental term based on a linear relationship, it captures the long-term effect and miss the short-term adjustment one. We can expect to get worse results from the linear relationship than the above mentioned model.

$$y_{i,t} = a\, y_{i,t-1} + \beta_1 X_{i,t} + \eta_i + \varepsilon_{i,t} \quad (1.7.13)$$

We can mention three different cases where the same model specification is used. The first is in the Balestra and Nerlove (1996) specification for the Gas demand model. This is a function of the lagged dependent variable, the relative price of gas, the 1st-lag and 1st-diff. of the total population, and the 1st-lag and 1st-diff. of the per capita income. See Hsiao[27] for a detailed description.

The second one is the general specification of the error correction model[28]. This is as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + \gamma_1 x_{t-1} + \gamma_2 y_{t-1} + u_t \quad (1.7.14)$$

The previous expression can be written in the following way:

$$y_t = (1+\gamma_2) y_{t-1} + \gamma_1 x_{t-1} + \beta_1 \Delta x_t + \beta_0 + u_t \quad (1.7.15)$$

[27] Hsiao, C., 2003, *Analysis of Panel Data*, 2nd Ed., Cambridge University Press, 4, 4.4, 92.
[28] Ramanathan, R., 1989, *Introductory Econometrics with applications*, 4th Ed., The Dryden Press, 10.8, 528.

The error correction model captures the short-run adjustment and it is also guided by the long-run theory. The model is an autoregressive model where the dependent variable is a function of the 1st-lag of the dependent, the 1st-lag of the independent and the 1st-diff. of the same independent variable. This is exactly the same specification than the derived from the Adbudg model

The third one is the Gross Investment equation[29], that we can find in the economic growth literature. This is as follows:

$$I = \delta K_{-1} + \Delta K \qquad (1.7.16)$$

Where I is the Gross Investment, Δ is the first differences operator, K the stock of capital and δ is the depreciation operator

Based on all the above mentioned model specifications, we will specify the variables in all the models as a linear combination of the long-term effect represented by the first lag of the independent variable (X_{-1}) and of the short-term by the first differences (dX).

As an example, if we have two independent variables "X_1 and X_2", we will adopt the following specification of the autoregressive model:

$$y_{i,t} = a\, y_{i,t-1} + \beta_{11} X_{1,i,t-1} + \beta_{12}\, dX_{1,i,t} + \beta_{21} X_{2,i,t-1} + \beta_{22}\, dX_{2,i,t} + \eta_i + \varepsilon_{i,t} \qquad (1.7.17)$$

The increment of the Y-key factor influencing growth is a function of the lag, and the first differences of the X-Resource or underlying Business process. The two variables for each X help us to take better control of the variable from the econometric point of view.

[29] Andres, J., Escribano, A., Molinas, C., and Taguas, D., 1990, La Inversión en España: Econometría con restricciones de equilibrio, Antoni Bosch Editor, *Instituto de Estudios Fiscales*, 3.3, 91.

As an example, we can visualize the saturation in the Y-sales against the related X-Business processes for one of the Panel Data that we will be using later: 500 Companies, and 20 years of data by company (1983-2002) sourced by Standard & Poor's Compustat.

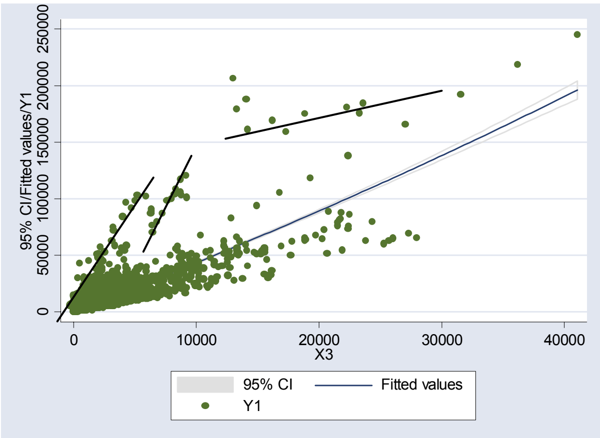


Figure 1.5: Y1-Net Sales against X3-SG&A – Selling General & Administration Expenditures.

There is a clear change in the slope reaching a saturation level at the range of Y1 ($150-200 billion) and X3 ($15-25 billion) as shown in Figure 1.5. Due to the competition effect businesses cannot grow sales with the same rates of investments in core resources.

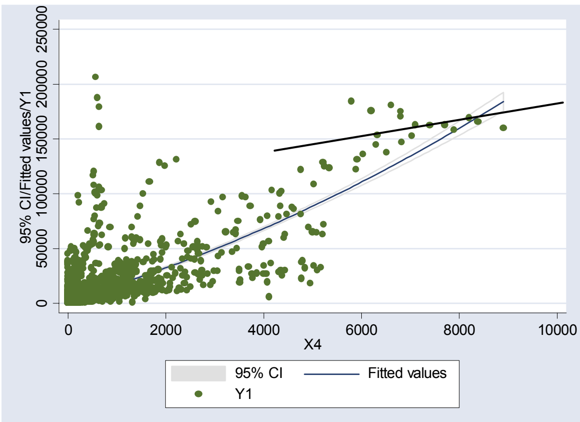


Figure 1.6: Y1-Net Sales against X4-Research & Development Expenditures.

There is also a clear change in the slope reaching a saturation level at the range of Y1 ($150-200 billion) and X4 ($6-9 billion) as shown in the Figure 1.6. Due to the R&D

productivity in investments, with the current trend of more accurate projects selection, businesses cannot grow sales with the same rates of investments in the R&D area. There is also a limit due to the decreasing returns to scale (diseconomies of scale).

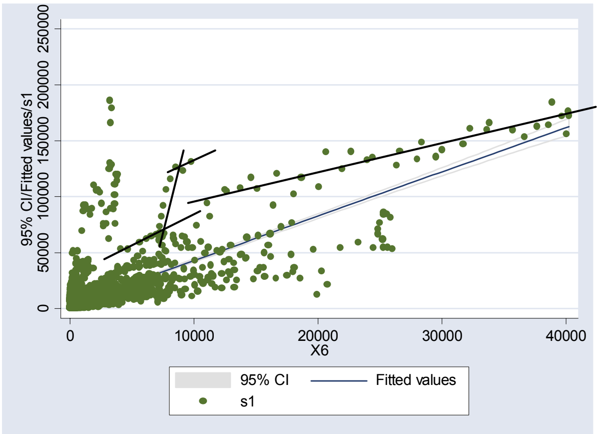


Figure 1.7: S1-Net Sales (const 2002 US$) against X6-R&D Stock (const 2002 US$).

As in the previous figure, it is clear the change in the slopes at different Sales and R&D Stock ranges, which finally shows a saturation level.

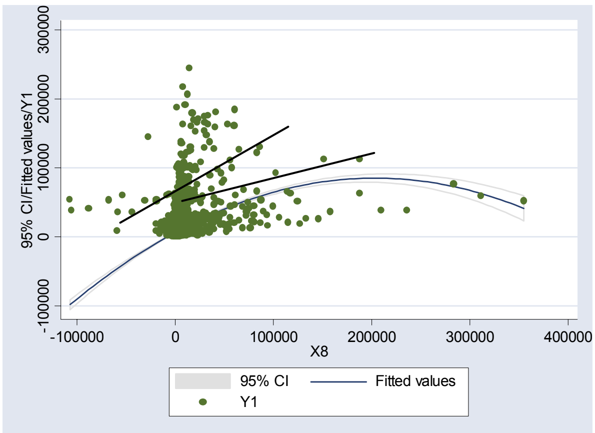


Figure 1.8. Y1-Net Sales and X8-Investments (acquisitions, etc..)

As in the previous figures, there is a clear change in the slope at different ranges of the Y1 and X8 showing different saturation levels. The key acquisitions in every sector have already been done. It is more and more difficult to identify Mergers and Acquisitions opportunities, unless you acquire small/medium niche market companies with complementary products to your core business or solve a geographical coverage gap, instead of trying to acquire your peer competition that, in the end, is in general very expensive and difficult to integrate.

1.8 The Hewlett-Packard Case

The HP Case allows us to show a true case of saturation and the characteristics of a situation of this kind. Let us see the enclosed net revenues graph. This is:

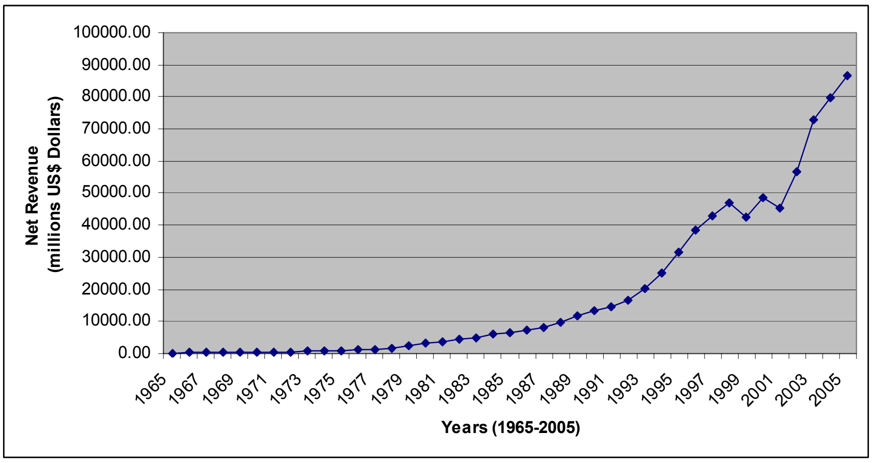


Figure 1.9. Hewlett-Packard Co. Net Revenues.

Closing Date	Year	Net Revenue $ US mln	Net Income $ US mln
Oct-90	1990	13233	739
Oct-91	1991	14494	755
Oct-92	1992	16410	549
Oct-93	1993	20317	1177
Oct-94	1994	24991	1599
Oct-95	1995	31519	2433
Oct-96	1996	38420	2586
Oct-97	1997	42895	3119
Oct-98	1998	47061	2945
Oct-99	1999	42370	3491
Oct-00	2000	48782	3697
Oct-01	2001	45226	680
Oct-02	2002	56588	-903
Oct-03	2003	73061	2539
Oct-04	2004	79905	3497
Oct-05	2005	86696	2398

Table 1.1. Hewlett-Packard Co. Net Revenues & Net Income.

We could see an excellent growth till 1998 and then ups and downs the following years in a very clear situation of stagnation, and saturation mode, and later on 2001 jumping again.

The Analyst - John Slatter's[30] comments were the following:

- Hewlett-Packard's competition has increased in recent years.
- The Company seems to analyse decisions endlessly and sends no clear messages to a fast-moving market.
- The Company growth depends heavily on low margin consumer business that no longer have much zip.
- Hewlett-Packard sells inkjet printers, but the real revenue comes from the cartridges full of ink that need to be replaced on a regular basis. Printer designs and patent protections allow the company to get good profit margins on these sales.

At the same time the Company hired a new CEO Ms Carleton S. Fiorina in 1999. She is a former AT&T, and Lucent Technologies with nineteen years experience in the field, and was able to close the Compaq acquisition on 2002 jumping Net revenues. But as she said on Oct, 2004 "We are not fully leveraging what we built" struggling a little bit on the Net Income side.

This is a true story where we can look in detail a saturation from1998 till 2001, and a clear recovery with the Compaq and further acquisitions. The main takeaway is that fierce competition, low margin products, no clear messages to the market by Management on growth opportunities are clear signs of stagnation and saturation. This HP Case seeks to illustrate a true case, and it does not intend to emphasize the specifics of Hewlett-Packard at this point in time.

1.9 The Methods and Directions matrix of Corporate Development

Combining the Ansoff's directions of development with the methods of development we have the combined Methods and Directions matrix described by Allen (1998)[31]. This matrix will allow us to define the main variables identifying the growth vectors or driving factors of corporate growth from the current situation. This is as follows:

30 Slatter, J., 2001, *The 100 Best Stocks you can buy 2002*, Adams Media Corporation, Avon, 189.

31 Allen, P.,1998, *Combining Directions and Methods of Development*, Business Policy, University of Durham, 31.3, 25

Methods ↓	Ansoff's Directions				
Mergers & Acquisitions			B	C	
Strategic Alliances					
Internal Development		A	D	E	E
	Withdrawal	Current Situation	Consolidation & Market Penetration	Product & Market Development	Diversification

Table 1.2 Methods and Directions of Corporate Development. P. Allen (1998).

The Driving Factors or Business Processes identifying the different courses of actions can be described in the following way:

Course of Action	Driving factor of corporate growth	Related Business Processes
A	Core Resources. Improvement in the current situation.	Headcount resources, Productivity actions, etc..
B and C	Investment in Merger & Acquisitions	Joint Ventures, Mergers, Acquisitions, etc..
D	Core Resources. Improvement increasing resources.	Increasing Resources, Agents, Salesforce,
E	Research & Development, Advertising expenditures.	Investment in Merger and Acquisitions

Table 1.3 Courses of Action, Driving Factors, and related Business Processes.

Based on Allen's methods and directions matrix we can relate the financial measures that better identify the driving factors/independent variables of the econometric models.

1.10 Secondary Research: The NYSE CEO REPORT 2007[32]

The New York Stock Exchange report has been focused on Planning for Growth, and Valuing People prepared by Opinion Research Corporation for the NYSE Group. This report shows in the "Business Opportunities and Challenges chapter" the opinions of the CEO's mainly related to the expectations of source of revenue growth for 2007.

The enclosed table shows the estimated source of revenue growth for 2007 by Industry:

	Retail/Consumer Products	Energy	Financial Services	Manufacturing	Business Services
Organic growth	58%	51%	71%	49%	57%
M&A activity	19%	23%	2%	17%	17%
Will contribute equally	23%	23%	26%	34%	26%
Don't know		3%			

Table 1.4 Expectations of Source of Revenue Growth by Industry for 2007 by Opinion Research Corporation.

The Organic growth accounts for 49 to 71% of the estimated source of revenue growth for 2007. The Financial Services sector estimates 71% and, very clearly, it is the higher rating. In all Industry Sectors, the equal contribution between Organic Growth and M&A activities is highly rated between 23% and 34%, which means that the M&A activity will continue very strongly.

[32] Opinion Research Corporation, 2006, "The NYSE CEO Report 2007: Planning for Growth, Valuing People", *NYSE Group*, *New York*.

The same study shows that there is little difference between companies if they are large or small in the opinion of the expectations of source of revenue growth. The global results of the survey can be summarized in the following graph:

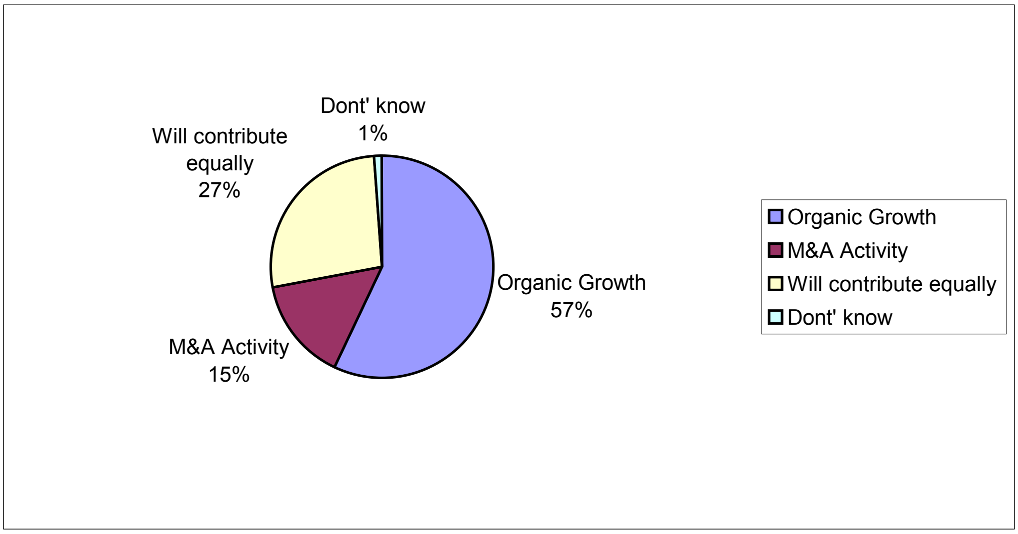


Figure 1.10 Expectations of source of Company's Revenue Growth for 2007 by Opinion Research Corporation.

If we split the "will contribute equally" responses, we achieve a 70.5% Organic Growth, and 28.5% M&A Activity, and 1% Don't know.

Chapter 2

The Sales Model

2.1 Introduction

In this chapter, we study the main business processes impacting the Company Sales. The current literature is very much concerned with the way to organise for growth with the objective to create value for the shareholders. There is also a wide literature on the analysis of productivity, research and development, but not specifically in Sales. Sales and added value production output are covered as dependent variables and the models are mainly based on the Cobb-Douglas production function where the independent variables are labour, capital, and others. Two typical examples can be seen on FitzRoy and Kraft (2004)[33] and Bloom and Van Reenen (2006)[34]. Our objective is to find out and demonstrate the impact on Sales of the most relevant internal business processes with the independent variables based on Allen's matrix of the methods and directions of the corporate development[35] through an empirical econometric research. At the same time, our analysis can be considered as an extension of the business process management approach.

We have analysed the industrial 240 Companies of the S&P 500 after excluding the Banks, Diversified Financials, Insurance and Real Estate. The business processes have been chosen based on Allen's matrix of methods and directions, as above mentioned, and identifying the market situation, resources, research and development and investments as the key driving factors of corporate sales growth. The Market Situation was measured by the log of the real gross domestic product. Resources was measured by the selling general and

[33] See FitzRoy, F. and Kraft, K., 2004, "Co-Determination, Efficiency and Productivity", *IZA-Institute for the Study of Labour*, Discussion Paper No 1442, 14

[34] See Bloom, N. and Van Reenen, J., 2006, "Measuring and explaining management practices across firms and countries", *Center for Economic Performance*, Paper No 716, Page 36, Table 2, Column 5.

[35] See Allen, P., 1998, "Business Policy", *University of Durham*, 31-3, 25.

Administration expenditures to sales ratio. Research and Development was measured by the log of the Stock of R&D capital, and Investments was measured by the investment to sales ratio.

In summary, the development of the current research is as follows: Section 2.2 examines the previous research and how our results differ from the existing literature. Section 2.3 describes the data, performed adjustments, and the correlation among the key variables. Section 2.4 shows the specification of the model. Section 2.5 summarises our main results. Section 2.6 shows a detailed discussion of the econometric estimates. Section 2.7 shows the most significant business processes by industrial sector. This calculation was performed discriminating the different economic sectors by a set of dummies. Section 2.8 clarifies the stock of R&D capital used in our research and previously built by Griliches (1981), and later in joint papers with Mairesse (1981) and Hall (1982). Section 2.9 describes the interrelation of variables and the shift from direct R&D expenditures to company acquisitions and finally in Section 2.10 the conclusion.

2.2 Previous research on the Sales Models.

We have identified three different groups of econometric research. All of them address different aspects of Sales and Growth and opening areas of research. These groups can be summarized as follows: stochastic production frontier models, corporate growth rate regressions, and sales models in levels. We will proceed to summarize the different areas of econometric research describing the most relevant first working papers in every area as follows:

Aigner, Lovell and Schmidt (1977)[36] and Meeusen and Van den Broek (1977)[37] developed the Stochastic Production Frontier Models where the production output is a function of the labour input and the capital employed like the Cobb-Douglas function. They have additionally introduced non-controllable random errors capturing the non-expected events in

[36] See Aigner, D., Lovell, C., and Schmidt, P., 1977, "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics,* 6, 21-27.

[37] See Meeusen, W, and Van den Broek, J., 1977, "Efficiency estimation from Cobb-Douglas production functions with composed error", *International Economic Review,* 18, 435-444.

the firm, and the distance error to the stochastic production frontier. This is the first time that the production output was limited due to the non-expected events and the technical efficiency of the firm. They started a very important area of research based on the technical efficiency, productivity, and competitiveness and it was well developed in many working papers along the years.

Geroski (1999)[38], together with Machin, and Walters (1997)[39] studied the growth and profitability rates. Geroski concluded that the firm size follows a random walk, corporate growth is history dependent and every firm seems to have its own history. He described the theories of corporate growth and the implications in the growth models for every theory. A very important conclusion, due to Geroski, is the finding of the irregular and erratic innovation by the majority of the firms, and the existence of a threshold to get signs of learning or increasing returns to the innovative activity. The results of the joint work show the unpredictability of corporate growth due to the unpredictability of future shocks, and the link between current growth and changes in the market value of firms.

Hall and Mairesse (1998)[40] studied a sales model based on a Cobb-Douglas production function and performing OLS and GMM estimations. The most important conclusion is the high productivity of research and development in increasing the sales. These results were achieved for the United States data, and they used the GMM methodology to control for the simultaneity and firm heterogeneity.

Additionally they found that the contribution of R&D to the Sales productivity declined during the 1980s, and the simultaneity bias was higher in the US than in France. This bias was probably due to the higher liquidity constraints for R&D Investments in the US firms than in the French firms.

Our research differs in three main aspects when compared with the above mentioned previous research. Firstly, it differs in the specification of the econometric models; secondly, in the variables used and thirdly in the conclusions. The autoregressive dynamic models were used in the Geroski, Machin and Walters' research when regressing the growth rate of the firm by previous growth rates and changes in current expectations of future profitability. The

[38] See Geroski, P., 1999, "The Growth of Firms in Theory and Practice", *CEPR nr 2092*.

[39] See Geroski, P., Machin, S., and Walters, C., 1997, "Corporate Growth and Profitability", *Journal of Industrial Economics*, Vol 45, No 2.

[40] See Mairesse, J., & Hall, B., 1996, "Estimating the Productivity of Research & Development: An exploration of GMM methods using data en French and United States manufacturing firms", *NBER*, Working Paper No 5501.

rest of studies are based on a static Cobb-Douglas production function where the production output is a function of labour, capital, and knowledge or R&D capital as specifically applied by Hall and Mairesse.

Our research is based on an autoregressive dynamic model where the net sales is regressed by the last year net sales and the market situation, resources, R&D capital and the Investments performed at the firm level. Additionally we take the lag and first differences of each variable, which implies a very important difference versus all the previous research. The main feature of our approach is the possibility to control for the long and short-term significance of every variable in its contribution to the net sales of the company.

At the level of conclusions, we could achieve our objective of getting the significant contribution of the different business processes to the net sales of the company in a short and long-term view of every process. Geroski, Machin, and Walters' research is based on the growth rate of the firm and they show the strong association between growth rate and changes in the market value of firms. They studied the trade off between growth and profits and reached the conclusion that long period growth rates are predictors of increases in long run profitability. We differ in the fact that we are regressing net sales to several operational variables in the company and we are not mixing profitability which will be the subject of the profit-cash flow model.

Hall and Mairesse clearly found that R&D investment has been very productive in increasing the output for the United States. Among other very important findings, they state that the R&D contribution to sales during the 1980s seems to be lower than it was in the 1970s. We find the same conclusion related to the contribution of the R&D investment. Based on the fact that not all the sectors in the economy are using the R&D investment as a key driver for growth, we find that the short-term investments in R&D are more significant than the long-term ones.

2.3 Data and Resources.

The data used in the research come from several sources. Company data are from Standard & Poor's 500 Compustat – North America (500 Companies). After excluding Banks, Diversified Financials, Insurance, and Real Estate the sample was 240 Companies, 20 years by cross-section (1983-2002), the Industry classifications updated to the new GICS-Global Industry Classification Standard (23 Industry groups in total, and after omitting the financial ones 19 groups). The total number of observations in the panel is 4800.

The Software used is Stata-SE, release 8.0.

The definition of the variables, where the notation in lower case letters indicates that a variable has been transformed into a natural logarithm or ratios, are the following:

Net Sales, s = ln(Sales). Year end net sales adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes specific for every sector and supplied by the US Bureau of Labour Statistics.

Market Situation, g = ln(real GDP). Real Gross Domestic Product supplied by the Bureau of Economic Analysis.

Resources, e = Selling general and administration expenditures to sales ratio. The SG&A expenditures where adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis and Sales adjusted to constant 2002 US Dollars by the PPI-Producer Price Indexes specific for every sector. This variable wants to capture the "core competences", which is a term first introduced and defined by Prahalad and Hamel[41] in the strategic management literature. Core competences relate to the current resources, processes and skills providing competitive advantage to the company.

Research & Development, r = ln(Stock of R&D capital). The method of construction of the Stock of R&D capital was initially built by Griliches (1981), Griliches and Mairesse (1981), and Griliches and Hall (1982). It is a standard perpetual inventory with a depreciation rate of 15%. Prior to calculate the Stock of R&D Capital the annual R&D expenditures have been adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

Investment, i = Investment to Sales ratio. The annual total investments have been adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis and Sales adjusted to constant 2002 US Dollars by the PPI-Producer Price Indexes specific for every sector.

[41] See Prahalad, C.K., and Hamel, G., 1990, "The Core Competence of the Corporation". *Harvard Business Review.*

This variable mainly seeks to capture the Mergers and Acquisitions processes. Tirole[42] states that: "a standard finding is that firms with more cash on hand and less debt invest more, controlling for investment opportunities". We could obviously infer that higher investment opportunities will lead to increase net sales and corporate growth.

The enclosed table summarizes the statistics on the key variables.

Dependent and Explanatory Variables		Mean	Std Dev	Min	Max
Sales	s	8.002	1.645	-0.833	12.407
Market Situation	g	8.973	0.181	8.639	9.258
Resources	e	0.224	0.159	-0.052	2.416
Res. & Development	r	5.853	1.798	-2.207	10.602
Investments	i	0.203	0.669	-21.618	20.868
Sales	1st-lag	8.002	1.645	-0.833	12.407
Market Situation	1st-lag	8.973	0.181	8.639	9.258
	1st-diff.	0.033	0.015	-0.002	0.069
Resources	1st-lag	0.224	0.159	-0.052	2.416
	1st-diff.	0.002	0.057	-1.073	1.828
Res. & Development	1st-lag	5.853	1.798	-2.207	10.602
	1st-diff.	0.135	0.172	-0.742	2.079
Investments	1st-lag	0.203	0.669	-21.618	20.868
	1st-diff.	-0.013	0.815	-32.811	18.858

Table 2.1 Mean, standard deviation, and range of each variable. Period: 1983-2002.

The average company sales of the sample is US$ 2986.93 million and a maximum of US$244507.19 million in constant 2002 US Dollars. Our objective of selecting the S&P 500 is clearly biased to analyse the larger companies which will lead us to understand how the bigger companies are behaving in terms of expenditures and investments to generate opportunities and growth.

The real gross domestic product ranges from US$ 5645.75 billions in 1983 to US$10487.00 billions in 2002 in constant 2002 US Dollars. This shows a 3.31% annual average growth rate for the 19 years period.

The average Stock of R&D Capital of the sample is US$348.28 million with a maximum of US$40215.19 million. This wide range is the result of the mix of several sectors with very low investments in R&D such as transportation, hotels, restaurants, etc... and the R&D

[42] See Tirole, J., 2006, "Sensitivity of investment to cash flow", *The Theory of Corporate Finance*, Princeton University Press, 2, 100.

intensive such as capital goods, automobile, technology hardware and equipment, and telecom.

The average investment to sales ratio of the sample is 0.203, which gives us an average investment for the sample of US$606.34 million in constant US Dollars. The investment to sales ratio has a range between –21.61 to 20.87 indicating the important presence of divestments in the sample.

The enclosed table summarizes the correlation or covariance matrixes for the group of variables to be considered in the econometric models. Due to the definition of the different explanatory variables we are not confronted with a collinearity problem. There is only a coefficient higher than 0.5 in absolute value. This is the case with the investments (1st-lag) and (1st-diff) at 0.59, for that reason we will drop the Investments (1st-diff) from the regressions due to the lower significance of this coefficient, when compared with the 1st-lag one.

Explanatory Variables		Market Situation g	Resources e	R & D r	Investments i
Market Situation	g	1.000			
Resources	e	0.130	1.000		
Res. & Development	r	0.266	-0.022	1.000	
Investments	i	0.035	-0.001	-0.103	1.000

Explanatory Variables		Market Situation		Resources		Res. & Development		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
Market Situation	1st-lag	1.000							
	1st-diff.	-0.160	1.000						
Resources	1st-lag	0.114	-0.004	1.000					
	1st-diff.	0.044	-0.074	-0.115	1.000				
Res. & Development	1st-lag	0.245	-0.052	-0.043	0.044	1.000			
	1st-diff.	0.040	0.095	0.336	0.042	-0.319	1.000		
Investments	1st-lag	0.092	-0.011	0.172	0.202	-0.118	0.353	1.000	
	1st-diff.	-0.036	0.074	-0.043	-0.405	-0.002	0.020	-0.597	1.000

Table 2.2 Correlation or covariance matrix of the explanatory variables.

2.4 The Sales Model specification.

Based on the Methods and Directions matrix of Corporate Development due to Allen (1998)[43] already described in our section 1.9, the main processes identified affecting Sales are the Market situation, Resources, Research and Development as well as Investments.

43 See Allen, P., 1998, "Business Policy", *University of Durham*, 31-3, 25.

We assume that the sales are a function of the previous year and the incremental sales are due to the main processes previously mentioned (See Section 2.6 for the detailed econometric estimates).

Model I. We assume that the incremental contribution of each one of the processes is a linear contemporaneous relationship. This means:

$$s_{it} = \alpha\, s_{i,t-1} + \beta_1\, g_{it} + \beta_2\, e_{it} + \beta_3\, r_{it} + \beta_4\, i_{it} + \eta_i + \varepsilon_{it} \qquad (2.4.1)$$

Model II. We assume that the incremental contribution of each one of the processes is a linear combination of the 1st-lag and 1st-diff. relationship. This means:

$$s_{it} = \alpha\, s_{i,t-1} + \beta_1\, g_{i,t-1} + \beta_2\, dg_{it} + \beta_3\, e_{i,t-1} + \beta_4\, de_{it} + \beta_5\, r_{i,t-1} + \beta_6\, dr_{it} + \beta_7\, i_{i,t-1} + \beta_8\, di_{it} + \eta_i + \varepsilon_{it} \qquad (2.4.2)$$

The specification of this second model is based on the Adbudg response function widely explained in the previous chapter (item 1.7). The Adbudg response function controls for the increasing returns (ramp-up) at the early stage and saturation produced by the scarcity of resources at a late stage. As demonstrated in item 1.7 this effect can be measured by the (1st-lag) and (1st-diff.) of the same variable, and, due to the fact that there are fewer companies at the saturation stage, in the end we are really controlling the increasing returns stage (ramp-up) better than the linear relationship model (Model I).

Balestra and Nerlove (1966) have used a similar model specification for the Gas demand as a function of the lagged dependent variable, the relative price of gas, the 1st-lag and 1st-diff of the total population, and the 1st-lag and 1st-diff. of the per capita income. See Hsiao[44] for a detailed description.

The variables were described in the data, but we repeat them for clarification. These are the following (See Appendix 1a for a fuller variables description):

Sales = s_{it} = ln(Net Sales) = Natural logarithm of net sales

Market Situation = g_{it} = ln(real GDP) = Natural logarithm of real GDP

Resources = e_{it} = Selling General & Administration expenditures to Sales ratio

[44] See Hsiao, C., 2003, "Dynamic models with variable intercepts", *Analysis of Panel Data*, Cambridge, 4, 94.

Research & Development = r_{it} = ln(Stock of R&D Capital). See Appendix 2.

Investments = i_{it} = Investment to Sales ratio

Intercept = η_i

Residuals = ε_{it}

Due to the fact that the dependent variable sales and the explanatory ones (like the market situation and the research and development) are in logs, the related coefficients will be elasticities. This means that a 1% change in the Stock of R&D Capital will impact β_3% in the change in sales.

2.5 Description and discussion of results.

After conducting all the econometric estimators for the specified Models I and II and selecting the most adequate ones according to the different relevant tests, we can therefore describe and discuss the following results.

<u>Market Situation.</u> The Model I shows no contribution of the market growth to the sales of the companies, but Model II shows a positive contribution that can be explained by the annual change of the gross domestic product. This change, in constant 2002 US Dollars, was 3.29% during the period of 1995 to 2002, and it was 3.31% when looking at the original data between 1983 to 2002.

The evolution of the GDP in constant 2002 US Dollars shows a steady and continuous growth without any external shocks for the analysed period 1995 to 2002.

<u>Resources.</u> Both Models I and II show that the relationship between sales and resources has a negative trend. This negative evolution can be explained by five reasons:

1. IT Productivity growth. The huge investments in New Hardware, Software and Services grew very fast getting productivity out of the Organizations, and in consequence, reducing the need of personnel in the Companies. Borrowing the evolution over time of the IT role in the companies from the Boston Consulting Group, they state that this process started in the 1970's being IT a support back office, passing in the 1980's to be a

support core business processes and finally in the 2000's a source of differentiation and competitive advantage.

IT Invesments have an important contribution in the growth and firm performance. Draca, Sadun, and Van Reenen[45] state that "there is some reasonable evidence of a strong firm level association between IT and firm performance" and they also describe how the productivity growth has been growing in the US since 1995 and an important contribution is due to the IT Investments.

The IDC Consulting (2004) is forecasting a strong growth in the US IT spending for the coming five years from a 3% growth in Health Care and Communications & Media to the 5.7-5.8% growth in Retail and Wholesale and Construction. The most important sectors for the IT spending are the Manufacturing and Financial Services both standing at 5% for the 5-year CAGR (%) growth.

2. The Selling General and Administration expenditures become less important in the mix of expenditures/investments contributing to the growth of the companies. The SG&A to Net Sales ratio was growing from 24.8% to 25.4% in the period 1995 to 2002, but the current Net Sales were growing from 6966.2 to 13044.7 million current US Dollars. This is an annual 9.38% growth rate for the period and near to double the Sales, on the other hand the SG&A to Net sales ratio was growing a small 0.6 percent points for the period.
3. Changing structures: The fact that the Organizations are becoming flatter is forcing the teams to do the same work with less people. See Roberts[46] and Whittington[47] for a description of how the organisational design is affecting the determinants of firm performance.
4. Changing boundaries: Outsourcing processes are becoming more important and impacting the Organizations with headcount reductions and
5. Changing processes like Variable Cost and Selling General and Administration Productivity. This item includes headcount reductions due to on-site cost cutting and relocations to low cost countries.

[45] See Draca, M., Sadun, R., and Van Reenen, J., 2006, "Productivity and ICT: A Review of the evidence", *Center for Economic Performance*, CEP Discussion Paper no 749, 30.

[46] See Roberts, J., 2004, "The whole system", *The Modern Firm*, Oxford University Press, 5, 241.

[47] See Whittington, R., Pettigrew, A., Peck, S., Fenton, E., and Conyon, M.,1999, "Change and Complementarities in the new Competitive Landscape: A European Panel Study, 1992-1996". *Organization Science*, Vol. 10, No 5, 583-600.

The last three items could be aggregated under the Corporate Restructuring concept, but we wanted to show them separately, because the first one is related to the Organisational design of the organization impacting performance, as described by Roberts, and Whittington, and the other two items are related to changing boundaries and processes.

Research and Development. Both Models I and II show a positive contribution of the stock of R&D capital to Net Sales, and Model II shows that the short-term expenditures in R&D are more important than the long-term ones, when looking at the whole panel.

This second item can be explained with the following arguments:

1. Operations Management. Companies in the high-tech sectors (intensive in R&D expenditures) are very conscious about productivity spending, becoming very selective in choosing the projects, and favouring the short-term R&D expenditures to get the highest return on investment (or the shortest pay-back) per project.
2. Financial. The pressure on Management to get short-term results is forcing a shift from the long to short-term R&D spending (innovation projects), and product based strategic acquisitions which allow quicker and less risky results as an alternative to the internal longer term New Product Development.
3. Managerial myopia. Short-termism is forcing a decrease in the annual R&D spending. This is based on the following approach: Why do we need to invest and get the results for a new management team in place in the near future? Why do we need to harvest if a new Management team will be taking office and getting the future results? We are better off not investing and getting the results now. "This is obtaining good short-term results and appear efficient to Investors" as mentioned by Tirole[48]. In other words managerial myopia or short-termism is forcing a decrease in the annual R&D spending while sales are growing.

Our research shows how important is to invest and build a stock of R&D capital and that this stock must be higher than a certain threshold. This behaviour is highly impacting in a positive way in the long and short-term to grow Sales, but it is certainly a limitation not

[48] See Tirole, J., 2006, "Takeovers and Managerial Incentives", *The Theory of Corporate Finance*, Princeton University Press, 11, 430.

controlling for the innovative and imitative role of the R&D at the same time. This relates to the two faces of R&D, as mentioned by Griffith, Redding and Van Reenen[49].

The fact that short-term innovations and new product launchings of the year are more important than the long-term ones means that, for the whole population of companies, the R&D process is becoming more a short-term process across the board.

It is very important to regress the panel data with specific coefficients by cross-section (or sector). We will be able to verify if the coefficients of the stock of R&D capital shows differences among the sectors clarifying the previous concept.

<u>Investments</u>. Both Models I and II show a positive contribution of Investments to the Sales. The annual Investments (M&A, P&E, etc…) very rarely show a success in the same year. This is the reason the long-term effect of the Investment is so important, and the short-term (1st-diff) was eliminated from the model II due to multicollinearity.

As described in the Methods and Directions matrix of the Corporate Development in the previous section 1.9: Strategic product based, geographical coverage of gaps, core business expansions and absorbing competitors are the main elements driving the high growth in Investments (M&A, etc..). This is the case when considering that it is more and more difficult to find good opportunities to merge or acquire companies. The period 1998-2001 shows the largest activity for M&A's in the United States.

In general a merger or an acquisition is an easy and faster way of getting a product line, and a market share than via internal development. This activity may refrain management from investing free cash flow in new products or excess capacity, but quoting Tirole[50]: "it seems that takeovers did not have a large negative impact on long-term investments such as R&D expenditures". This is true for a large population of companies, but when dealing with consolidated high knowledge intensity MNL-Multinationals the major motivations for M&A's activities are completing the product portfolio gaps or industry consolidation by absorbing competitors. In these cases, the cash flow invested in a merger or acquisition will not be duplicated in internal developments. Additionally a merger or acquisition is faster, and

[49] See Griffith, R., Redding, S., and Van Reenen, J., 2004, "Mapping the two faces of R&D: Productivity growth in a panel of OECD Industries", *The Review of Economics and Statistics*, 86(4), 883-895.

[50] See Tirole, J., 2006, "The rise of takeovers and the backlash: What happened?", *The Theory of Corporate Finance*, Princeton University Press, 1, 50.

in consequence we can state that in the high end of companies in every sector there is a negative impact and the increase in M&A's will restrict the internal investments in R&D.

The relationship between Investments and larger Sales and Profits is clear, but there is a high ratio of failure in terms of delivery shareholder value and the expected returns. 17% of the M&A deals created value for shareholders, 53% of them lost value, and 30% of them without any kind of improvement according to the KPMG Peat Marwick report (1999). There is a wide literature covering this issue, but the foundation for success is to take care of the following stages: the synergies valuation, the integration plan, the due diligencies, experienced Management in place, integration of cultures, and open and flexible communication. Communicating the vision, Management alignment to execute the vision, and fast and focused execution of the Integration are the key elements of the execution plan. An integration team must be deployed and focused execution is critical for the success of the project.

Finally the limited size of the home countries, the difficulties to compete in the global market due to the size of the companies and markets, internal operations and management struggling with the lack of organizational capabilities to go International, as well as the lack of family members to continue the business are the main causes argued by the companies to evaluate access to the M&A processes.

2.6 Detailed discussion of the Econometric estimates

The proposed Sales Models I and II were estimated using the Dynamic Panel Data estimators: Difference and System GMM-Generalized Method of Moments developed the first by Arellano-Bond (1991), and the second by Arellano and Bover (1995) and Blundell and Bond (1998), in order to get consistent estimates for the parameters. Several econometric estimators (one and two-steps and robust versions) have been performed to control for the impact of the different proposed variables affecting the Sales, based on the best estimates we can conclude the following:

2.6.1 The Sales Model I.

After regressing all the alternative estimators: Difference and System GMM (one and two steps, and robust versions), and using the variables in levels as instruments, as recommended by Arellano (1989)[51]. The System GMM-1 estimator provides the most consistent estimates of the coefficients. The test for AR(2) is not rejecting the null hypothesis of no second-order autocorrelation in the first-differenced residuals (-1.96<-1.23). This implies that the estimates are consistent.

The Sargan test for the one-step homoskedastic estimator rejects the null hypothesis that the over-identifying restrictions are valid (chi2(table)=168.61<chi2(140)=721.78). This could be due to heteroskedasticity.

Sales (1st-lag). The coefficient at 0.574 is a little bit disappointing, because we were expecting a coefficient between 0.8 to 0.95. We were expecting a higher coefficient to secure that the sales are highly relying on the previous year.

Market Situation. It does not show the process relevant contributing to sales.

Resources. The negative coefficient shows that there is a negative contribution of the Selling general and administration expenditures to sales ratio to the log of sales. We widely explained the reasons in the previous item.

Research and Development. The coefficient shows a positive contribution to sales. In this case the coefficient is an elasticity and an increase of 1% in the stock of R&D capital contributes with 0.025% to the increase of sales.

Hall & Mairesse[52] arrived at the same conclusion based on a Cobb-Douglas production function, 525 US Companies, and for the period 1981-1985. In this case the definitions of the variables were exactly the same as we have considered them in our research. Their coefficient was 0.027 for the First Diff. and 0.033 for the GMM fixed effects estimation, while in our case we reached 0.025. They concluded that the R&D investment was very productive in increasing the true output, but the lower prices favour the consumers and damage the manufacturers.

---

[51] See Greene, W., 2000, "Models for Panel Data", *Econometric Analysis*, 4th Ed., Prentice Hall, 14, 584.

[52] See Mairesse, J., and Hall, B., 1996, "Estimating the productivity of research and development: an exploration of GMM methods using data on French and United States manufacturing firms", *NBER*, Working paper No 5501, 17 and 23.

<u>Investment.</u> The coefficient shows a positive contribution to sales. In this case the coefficient indicates a linear relationship between the Investment to sales ratio and the log of sales.

	Fixed Effects OLS	System GMM-1
Sales (1st-Lag)	0.355 (29.38)	0.574 (47.91)
Market Situation		
Resources	-0.186 (-13.84)	-0.197 (-18.08)
R& D	0.064 (22.68)	0.025 (18.20)
Investments	0.002 (2.57)	0.004 (2.68)
constant	0.993 (64.23)	0.793 (37.83)
Nr Observations F-Statistic R-squared	 12.87 0.843	1608 4288.6
Sargan chi2(..)= (d.f.) Test for AR(1) Test for AR(2)		721.78 140 -1.07 -1.23
t-values in parentheses		

Table 2.3 The Sales Model I

2.6.1a The Sales Model I. Panel unit root tests.

Based on a pooled data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the market situation and the resources are non-stationary and they are integrated of order two, I(2). The investment is non-stationary and it is integrated of order one, I(1). All the other variables are stationary, which are all I(0).

THE SALES MODEL I - AUGMENTED DICKEY FULLER TEST.						
	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
s	-16.249	1.974				
s_1	-18.334	2.018				
g	-75.542	2.658	-57.317	2.385	-47.391	2.092
e	-9.929	1.788	-19.774	1.756	-33.367	1.922
r	-9.018	2.152				
i	-23.019	1.170	-37.713	2.063		
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					
We assume 4 lags, a constant and a trend						
Ho: there is a unit root in the time series (non-stationary)						
We reject the null hypothesis for all the time series, excepts (g, e and i)						

Table 2.4 The Augmented Dickey-Fuller test.

Based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the p-values at 1.0 and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 1b). We can state that the panel is a non-stationary one and the model must be reestimated based on a first differenced variables model.

2.6.1b The Sales Model I. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[53]. The outcome of the test shows that the null hypothesis of at most 3 cointegrating vectors is rejected since the trace statistic of 88.74 is greater than the 5% critical value of 3.76. The trace test indicates four cointegrating equations, and the normalized outcome gives us three equations.

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.575628	2322.865	47.21	54.46
At most 1 **	0.154161	625.7172	29.68	35.65
At most 2 **	0.098568	294.2133	15.41	20.04
At most 3 **	0.043833	88.74836	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels

Table 2.5 The Johansen Cointegration test (Trace)

Based on a pooled data of the panel we have used the Engle and Granger test[54]. This is the residual-based test where in the first stage the cointegrating OLS regression of the sales on the market situation, the resources, the investment and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1st lag of the residuals is performed.

[53] Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.
[54] Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 2, 251-276.

The outcome shows that the t-statistic of -19.81 is more negative than the critical value of -4.18 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[55] Table 2 for N=4.

2.6.1c The Sales Model I. Vector error correction estimates.

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. These long-run relationships are captured by the cointegrating equations. The cointegrating equations[56] are the following:

$$CointEq1 = s\_1 - \underset{(-26.207)}{0.0633}\, i\_1 - 2.0840 \quad (2.6.1.1)$$

$$CointEq2 = g\_1 + \underset{(10.179)}{0.0418}\, i\_1 - 9.1777 \quad (2.6.1.2)$$

$$CointEq3 = e\_1 + \underset{(23.149)}{1.2387}\, i\_1 - 0.5515 \quad (2.6.1.3)$$

To perform the Vector error correction estimates we have selected the specification with intercept, no trend, lags interval 1 to 2 in the first differences and including two exogenous variables, the sales (1st-lag) and the research and development. The outcome of the VECM shows that the convergence has been achieved after ten iterations and the restrictions[57] identify all cointegrating vectors. The LR test for binding restrictions shows that the statistic chi-square(1)=0.0152 does not exceed the critical value of 3.84 at the 5% level. This means that the null hypothesis, that the restrictions are accepted, is not rejected. The error correction equation corresponding to the sales (1st-diff) shows the highest coefficient of multiple determination (R-squared) of 0.893 and the highest value of the test of the overall significance of the regression (F-statistic) of 877.95. Additionally, the Akaike AIC and Schwarz SC show the lower values, which it indicates the best fitted error correction model, as compared to the other ones (see Table 2.6).

---

[55] Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157

[56] t-Statistics shown in parentheses

[57] See cointegration restrictins in Appendix 1b.

The final outcome of the error correction model of the sales (1^{st}-diff.) shows the coefficients of the cointegrating equations very significant and contributing in a negative way to the sales (1^{st}-diff.). All the other coefficients are significant, except the first differences of the sales (1^{st} and 2^{nd}-lag), of the market situation (2^{nd}-lag), and of the resources (1^{st}-lag). It is important to remark the positive contribution of the 1^{st}-lag of sales and the research and development to the sales (1^{st}-diff.).

We can also estimate the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegrating regression using a pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$s = 0.492\ g - 0.482\ e - 0.042\ i - 2.284 \quad (2.6.1.4)$$

(12.39) (-24.83) (-11.80) (-6.27)
R-sq = 0.2441
F(3, 2593) = 279.14

- Augmented Dickey-Fuller test for unit root. Stationarity of residuals. Lags (4) and trend.
t-statistic = -14.004 is more negative than the critical value of t = -3.410 at the 5% level and the null hypothesis of a unit root can be rejected. The residuals are stationary.
Durbin Watson d-statistic (7, 1980) = 1.87.

- The error correction model (t-values in parentheses):

$$\Delta s = 0.017\ \Delta s\_1 + 0.214\ \Delta g - 0.288\ \Delta e + 0.129\ \Delta r - 0.003\ \Delta i - 0.043\ ehat\_1 + 0.0824$$

(2.44) (3.41) (-22.25) (29.89) (-4.59) (-4.62) (4.04)
R-sq=0.5630
F(6, 1506) = 323.43 (2.6.1.5)

The coefficient of the residuals is negative and highly significant. This means that the dependent variable sales "s" was above its equilibrium value in the period (t-1) and it will decrease in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is -0.043, which is a low amount and the speed of adjustment is low. The sales are not adjusted in a quick way to the short-term changes in the market situation, the resources, the research and development and the investment in our model. This demonstrates that the lags of the different variables are very important to consider.

Error Correction:	D(S)	D(G)	D(E)	D(I)
CointEq1	-0.971 [-96.41]	-0.165 [-8.98]	0.360 [12.32]	-0.903 [-2.96]
CointEq2	-0.078 [-5.25]	-0.876 [-29.44]	0.000 [NA]	-0.600 [-1.30]
CointEq3	-0.042 [-23.67]	0.024 [7.41]	0.044 [9.23]	-0.997 [-18.56]
D(S(-1))	0.008 [0.68]	0.015 [0.75]	0.038 [1.14]	0.330 [0.98]
D(S(-2))	0.018 [1.69]	-0.026 [-1.37]	0.003 [0.09]	1.262 [3.98]
D(G(-1))	0.046 [3.16]	0.382 [14.63]	-0.030 [-0.68]	0.942 [2.15]
D(G(-2))	0.020 [1.46]	0.349 [13.92]	-0.004 [-0.08]	0.203 [0.48]
D(E(-1))	-0.016 [-1.33]	0.005 [0.25]	0.009 [0.25]	-0.707 [-1.96]
D(E(-2))	0.028 [2.24]	-0.056 [-2.51]	-0.091 [-2.48]	0.753 [2.01]
D(I(-1))	0.003 [2.13]	-0.002 [-0.75]	-0.009 [-2.19]	0.362 [8.31]
D(I(-2))	-0.004 [-3.24]	0.006 [2.78]	-0.004 [-1.11]	-0.086 [-2.26]
C	-1.785 [-96.89]	-0.387 [-11.59]	0.708 [12.89]	2.055 [3.68]
S_1	0.845 [90.48]	0.180 [10.66]	-0.346 [-12.45]	-1.397 [-4.94]
R	0.004 [4.95]	0.002 [1.22]	0.004 [1.64]	0.127 [5.65]
R-squared	0.894	0.472	0.164	0.449
Adj. R-squared	0.893	0.467	0.156	0.443
F-statistic	877.950	93.573	20.532	85.085
Log likelihood	2822.850	2006.181	1324.164	-1861.904
Akaike AIC	-4.089	-2.900	-1.907	2.731
Schwarz SC	-4.035	-2.847	-1.854	2.784

Table 2.6 The Sales Model I. Vector error correction models

2.6.1d The Sales Model I. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that resources "e" and research and development "r" does not Granger cause "s" cannot be rejected, the F-statistics are lower than the critical F(4, 3095)=2.21 at the 5% level of confidence. This means that sales cannot be predicted by the history of the resources and the research and development. Additionally, the null hypothesis that sales (1^{st}-lag), market situation and investment does not Granger cause sales is rejected. In consequence, the current sales can be predicted by the previous year sales, the market situation and the current investment (see Appendix 1b). These results indicate that the previous variable help in the prediction of sales, but it does not indicate causality in the common use of the term[58].

2.6.1e The Sales Model I. Model re-estimation

Due to the fact that we were using non-stationary data the outcome of the dynamic model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the dynamic models (see Table 2.3). We will proceed to estimate the model in first differences due to the existence of I(1) series.

Based on a panel data we have implemented a MLE-maximum likelihood estimation of the model, due to the fact that we have an autoregressive model, then the MLE[59] estimator is consistent.

The outcome of the panel-dynamic MLE estimator shows that the coefficient of the sales (1^{st}-lag) is not significant. We have performed the fixed effects and random effects OLS estimators and the hausman test indicates that the statistic chi2(4)=49.32 exceeds the critical value of 9.49. In consequence, the null hypothesis that the individual effects are uncorrelated with the other regressors is rejected and the fixed effects OLS is consistent and the right estimator.

The market situation and the research and development show a positive and significant contribution to the sales, and the resources and the investment show a negative and significant contribution to the sales. All the variables estimated in first differences. The results are very similar to the previous dynamic model estimation, except the non-significance of the first differences of sales (1st-lag) and the negative contribution of the investment (1^{st}-diff) to the sales (1^{st}-diff.).

---

58 EViews 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software,* 12, 376.

59 Hsiao, C., 2003, *Analysis of Panel Data,* 2nd Ed., Cambridge, 4.2, 70

Panel Data	First Differences	MLE Estimator	Fixed Effects OLS
Sales	ds_1	0.008 [1.35]	
Market Situation	dg	0.276 [4.65]	0.322 [4.91]
Resources	de	-0.298 [-23.36]	-0.287 [-19.37]
Research & Development	dr	0.134 [30.46]	0.117 [17.6]
Investment	di	-0.004 [-6.02]	-0.003 [-3.86]
Constant	cons	-0.009 [-4.70]	-0.008 [-3.81]
Nº Observations R-squared F-Statistic Log likelihood		1561 3282.67	1563 0.535 216.93

Table 2.7 The Sales Model I. Model re-estimated in First Differences.

2.6.2 The Sales Model II.

As performed in the previous model, we have regressed all the alternative estimators: Difference and System GMM (one and two steps, and robust versions), and using the variables in levels as instruments, as recommended by Arellano (1989). The System GMM-2 estimator provides the most consistent estimates of the coefficients. The test for AR(2) is not rejecting the null hypothesis of no second-order autocorrelation in the first-differenced residuals (-1.96<-0.66). This implies that the estimates are consistent.

The Hansen test for the two-step estimator does not reject the null hypothesis that the over-identifying restrictions are valid (chi2(216)=212.23<chi2(table)=251.29).

Sales (1st-Lag). The coefficient at 0.890 shows us that current sales rely very much in the previous year and are highly significant. We also gain efficiency against the coefficient at 0.574 in the Sales Model I.

Market Situation. The process shows a negative contribution of the economic activity to the log of sales in the long-term (1st-lag), and a positive contribution in the short-term (1st-diff.). The linear combination of the two processes shows a positive contribution of the economic activity to the log of sales. This can be demonstrated by the fact of the negative sign of the 1st-lag of the Market situation in levels and positive in 1st-differences being the first coefficient lower in absolute value than the second one. The positive contribution has been widely discussed in the previous section 2.5.

Looking at the Difference GMM-2, the second best estimator we can also see the positive contribution to the log of sales due to the positive coefficients of the 1st-lag and 1st-diff. variables.

Resources. The process shows a negative contribution to the log of sales. The 1st-lag and 1st-diff. coefficients are both negative, this explains that, in the long and short-term, the contribution of the variable to the log of sales is not positive.

Research and Development. The process shows a positive contribution to the log of sales. This can be demonstrated by the fact that the coefficients of the 1st-lag and 1st-diff. are positive. This implies that the research and development effect in the long and short-term is highly significant to increase sales. The significance of the coefficient of the 1st-diff. is much higher than the 1st-lag one. This means that the short-term investments in the business are very relevant contributing to increase sales, and for the analysed (S&P 500) sample of companies pushing short-term is a fact. This item has been widely explained in the previous item 2.5.

Investments. The final outcome shows the 1st-lag of Investments (long-term) as significant and contributing in a positive way to increase sales. The 1st-diff. of Investments were dropped from the model due to multicollinearity against the 1st-lag of Investments.

If we were keeping the 1st-diff. of Investments in the Model II we could see a higher statistic of the test for AR(2) passing to –1.05 instead of –0.66 in the current estimates, the test for AR(1) passing to –5.29 instead of –3.63, the Sargan test not rejecting the null hypothesis, and the coefficient of the 1st-lag of sales improving to 0.976. In summary we could see the consistency of the estimates worsening and it was a good practice to drop the 1st-diff. of Investments from the model.

	Fixed Effects OLS	System GMM-2	Difference GMM-2
Sales (1st-Lag)	0.586 (39.66)	0.890 (2131.32)	0.601 (17.33)
Market Situation (1st-Lag)		-0.037 (-123.15)	0.198 (4.60)
Market Situation (1st-Diff.)	0.146 (3.14)	0.093 (88.05)	0.210 (4.58)
Resources (1st-Lag)	-0.139 (-9.82)	-0.046 (-192.70)	-0.100 (-4.42)
Resources (1st-Diff.)	-0.224 (-24.49)	-0.274 (-2823.87)	-0.227 (-16.67)
R&D (1st-Lag)	0.030 (11.75)	0.003 (62.41)	0.017 (2.57)
R&D (1st-Diff.)	0.089 (18.33)	0.101 (1228.07)	0.060 (6.42)
Investments (1st-Lag)	0.013 (15.32)	0.011 (710.05)	0.009 (11.00)
constant	0.701 (34.79)	0.558 (214.65)	-0.006 (-3.65)
Nr Observations	1566	1566	1171
F-Statistic	1751.49	9.19E+07	1006.49
R-squared	0.9467		
Hansen chi2(..)=		212.23	29.95
(d.f.)		216	20
Test for AR(1)		-3.63	-4.08
Test for AR(2)		-0.66	-0.86

t-values in parentheses

Table 2.8 The Sales Model II.

2.6.2a The Sales Model II. Panel unit root tests.

Based on a pool data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the market situation (1st-lag and 1st-diff.) are non-stationary and they are integrated of order two, I(2). The resources (1st-diff.) and the investment (1st-lag) are non-stationary and they are integrated of order one, I(1). All the other variables are stationary, which are all I(0).

Based on panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the p-values at 1.0 and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 1c). We can state that the panel is a non-stationary one and the model must be re-estimated based on a first differenced variables model.

THE SALES MODEL II - AUGMENTED DICKEY FULLER TEST						
	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
s	-16.249	1.974				
s_1	-18.335	2.018				
g_1	-78.170	2.766	-56.582	2.454	-44.827	2.112
dg	-71.863	2.582	-58.881	2.381	-47.957	2.145
e_1	-12.694	2.033				
de	-13.770	0.872	-34.678	1.889		
r_1	-9.033	2.169				
dr	-16.683	1.941				
i_1	-23.324	1.443	-42.620	1.822		
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					
We assume 4 lags, a constant and a trend						
Ho: there is a unit root in the time series (non-stationary)						
We reject the null hypothesis for all the time series, excepts (g_1, dg, de and i_1)						

Table 2.9 The Augmented Dickey-Fuller test

2.6.2b The Sales Model II. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[60], but e-Views shows near a singular matrix, and it does not provide any outcome.

Based on a pooled data of the panel we have used the Engle and Granger test[61]. This is the residual-based test where in the first stage the cointegrating OLS regression of the sales on the market situation (1st-lag and 1st-diff.), the resources (1st-diff.), the investment (1st-lag) and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1st lag of the residuals is performed. The outcome shows that the t-statistic of -28.69 is more negative than the critical value of -5.02 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[62] Table 2 for N=5.

60 Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

61 Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 2, 251-276.

62 Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157

2.6.2c The Sales Model II. Vector error correction estimates

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. These long-run relationships are captured by the cointegrating equations. E-Views shows near a singular matrix and it does not provide any outcome. We have estimated the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegrating regression using a pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$s = \underset{(8.71)}{0.392}\ g\_1 + \underset{(0.40)}{0.119}\ dg - \underset{(-0.43)}{0.025}\ de - \underset{(-10.31)}{0.045}\ i\_1 - 1.463 \qquad (2.6.2.1)$$

R-sq = 0.0720
F(4, 2543) = 49.30

- Augmented Dickey-Fuller test for unit root. Stationarity of residuals. Lags(4) and trend.
t-statistic = -22.590 is more negative than the critical value of t = -3.410 at the 5% level and the null hypothesis of a unit root can be rejected. The residuals are stationary.
Durbin Watson d-statistic (7, 1924) = 1.91

- The error correction model (t-values in parentheses):

$$\Delta s = \underset{(39.81)}{0.629}\ \Delta s\_1 - \underset{(-2.58)}{0.035}\ \Delta g\_1 + \underset{(1.83)}{0.117}\ \Delta dg - \underset{(-12.36)}{0.166}\ \Delta e\_1 - \underset{(-25.26)}{0.256}\ \Delta de + \underset{(13.75)}{0.028}\ \Delta r\_1$$

$$+ \underset{(10.92)}{0.053}\ \Delta dr + \underset{(8.41)}{0.008}\ \Delta i\_1 + \underset{(0.32)}{0.007}\ ehat\_1 - 0.015$$

R-sq = 0.8604
F(9, 1424) = 982.48 (2.6.2.2)

The coefficient of the residuals is positive and non significant. This means that the dependent variable "s" was below its equilibrium value in the period (t-1) and it will increase in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is 0.007, which is a very low amount and the speed of adjustment is very low. The residuals (1^{st}-lag) are not significant, and this means that the short-run disequilibrium adjustment is not significant.

2.6.2d The Sales Model II. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that resources (1^{st}-lag) and research and development (1^{st}-lag) does not Granger cause sales "s" cannot be rejected, the F-statistics are lower than the critical value F(8, 3091) = 1.94 at the 5% level of confidence. This means that sales cannot be predicted by the history of the resources (1^{st}-lag) and the research and development (1^{st}-lag). Additionally, the null hypothesis, that all the other variables, does not Granger cause sales is rejected. In consequence, the current sales can be predicted by the previous year sales, the market situation (1^{st}-lag and 1^{st}-diff.), the resources (1^{st}-diff.), the research and development (1^{st}-diff.), and the investment (1^{st}-lag) (see Appendix 1c). These results indicate that the previous variable help in the prediction of sales, but it does not indicate causality in the common use of the term[63].

2.6.2e The Sales Model II. Model re-estimation

Due to the fact that we were using non-stationary data the outcome of the dynamic model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the dynamic models (see Table 2.8). We will proceed to estimate the model in first differences due to the existence of I(1) series.

Based on a panel data we have implemented a MLE-maximum likelihood estimation of the model, due to the fact that we have an autoregressive model, then the MLE[64] estimator is consistent.

The outcome of the panel-dynamic MLE estimator shows that the coefficient of the sales (1^{st}-lag) is not significant. We have performed the fixed effects and random effects OLS estimators and the hausman test indicates that the statistic chi2(7)=551.69 exceeds the critical value of 14.07. In consequence, the null hypothesis that the individual effects are uncorrelated with the other regressors is rejected and the fixed effects OLS is consistent and the right estimator.

[63] EViews 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software,* 12, 376.
[64] Hsiao, C., 2003, *Analysis of Panel Data,* 2nd Ed., Cambridge, 4.2, 70

Resources show a negative and significant contribution to the sales. All the variables estimated in first differences. All the results are very similar to the previous dynamic model estimation.

Panel Data	First Differences	MLE Estimator	Fixed Effects OLS
Sales (1st-lag)	ds_1	-0.003 [-0.34]	
Market Situation (1st-lag)	dg_1	0.259 [4.06]	0.329 [5.06]
Market Situation (1st-diff.)	d2g	0.298 [4.96]	0.319 [5.35]
Resources (1st-lag)	de_1	-0.355 [-19.65]	-0.345 [-17.89]
Resources (1st-diff.)	d2e	-0.241 [-23.78]	-0.249 [-22.64]
R&D (1st-lag)	dr_1	0.125 [26.82]	0.084 [10.97]
R&D (1st-diff.)	d2r	0.103 [20.33]	0.081 [13.62]
Investment (1st-lag)	di_1	0.007 [9.91]	0.008 [10.36]
Constant	cons	-0.009 [-4.37]	-0.006 [-2.78]
Nº Observations		1418	1418
R-squared			0.548
F-statistic			166.18
Log likelihood		3160.43	

Table 2.10 The Sales Model II. Model re-estimated in First Differences.

2.7 The Sales Model. Industrial Sector Analysis

Quoting and borrowing from Geroski[65]: "it is very important to track down the sources of the heterogeneity between firms in order to understand the determinants of Corporate Performance". Differences among the companies are very clear, and confirm the idiosyncratic character of firms (meaning that aggregate or industry level determinants are weak relative to idiosyncratic determinants). Under the understanding that the determinants at the aggregate corporate performance level are weak, we are going to control the sources of the heterogeneity at the sector level.

[65] See Geroski, P., 1999, "The Growth of Firms in Theory and in Practice", *CEPR*, Discussion Paper No 2092, 14.

Trying to understand the underlying business processes at the industry group level which impact the Sales, we will introduce a set of binary or dummy variables to identify the industry groups, denoted by D, in order to perform the econometric work. The binary or dummy variables are assuming values such as 1 if the company belongs to the related industry group, and 0 in the negative case.

The sectors have been defined adopting the latest GICS-Global Industry Classification Standard[66]. This classification was launched in 1999 by Standard and Poor's and Morgan Stanley Capital International with the objective to facilitate the investment research and management process for financial professionals worldwide.

The period of our database covers from 1983 until 2002. As of December 2002, the number of sets at each level of aggregation is the following: 10 sectors aggregated from 23 industry groups, 59 industries, and 122 sub-industries. We have defined the dummies based on the 23 industry groups and coded with a four-digit number according to the GICS-Standard (16). See Table 2.5 for the breakdown of the Industry Groups.

The data have been prepared as follows: Sales are deflated by the sector PPI-producer price indexes and the rest by the GDP deflator for fixed non residential investments. The model, including the set of dummies to identify each industry sector, will be as follows:

$$s_{it} = \alpha\, s_{i,t-1} + \beta_{1,i}\, D_i\, g_{i,t-1} + \beta_{2,i}\, D_i\, dg_{it} + \beta_{3,i}\, D_i\, e_{i,t-1} + \beta_{4,i}\, D_i\, de_{it} + ..$$

$$+ \beta_{5,i}\, D_i\, r_{i,t-1} + \beta_{6,i}\, D_i\, dr_{it} + \beta_{7,i}\, D_i\, i_{i,t-1} + \beta_{8,i}\, D_i\, di_{it} + \beta_{9,i}\, D_i + \varepsilon_{it} \qquad (2.7.1)$$

where:

Sales = s_{it} = ln(Sales)

Market situation = g_{it} = ln(real GDP)

Resources = e_{it} = Selling General & Administration expenditures to Sales ratio

Research & Development = r_{it} = ln(Stock of R&D Capital)

Investments (Acquisitions,..) = i_{it} = Investment to Sales ratio

---

66 See Standard & Poor's, 2002, "GICS-Global Industry Classification Standard". *S&P Analysts' Handbook*. Annual Edition.

Dummies = D_i

Intercept = $\beta_{9,i}\, D_i$

Residuals = ε_{it}

After estimating the fixed and random effects OLS-Ordinary Least Squares and the Hausman test, we can see that the test shows that the random effects estimator has degenerated to a pooled OLS. However, the OLS estimation is inconsistent for a dynamic model, both for fixed or random effects. Thinking that we need to estimate a dynamic model, due to the lagged dependent variables, we can use the First-differenced stacked IV-Instrumental Variables Anderson-Hsiao (Table 2.5), the Difference and System Arellano-Bond GMM-Generalized Method of Moments (Table 2.6). All the previous estimators can be implemented either for fixed or random effects, and the MLE-Maximum Likelihood estimator in the case of random effects[67] (Table 2.7), while the latest is inconsistent in the case of fixed effects.

All the above mentioned alternative models have been estimated and, based on these, we can explain the specifics of the sectors with the significant parameters, and the relevant processes contributing to the Sales. These are:

Materials. The econometric outcome shows the positive effect of the market situation in the long-term, the negative effect of the resources in the short-term, the positive effect of the research and development in long and short-term, and also the positive effect of investments in the long-term contributions to the Sales. This behaviour is very typical of the industrial sectors, but it is not very strongly affected by the negative effect of the resources in long-term. This means that the US operations have been growing and the specifics of the products and related markets allow for valued local manufacturing.

Capital Goods. The estimates show a very strong negative effect of the resources in long and short-term, the positive effect of the research and development in long and short-term, and also the positive effect of investments in long and short-term contributions to the Sales. This outcome can be interpreted in the sense of very hard headcount reductions, and relocations to low cost manufacturing countries. These actions were a consequence of major corporate

[67] See Hsiao, C., 2003, "Dynamic models with Variable Intercepts", *Analysis of Panel Data,* Cambridge University Press, 4, 70.

reorganizations with the objectives to get a better cost, productivity, net income, and in the end remaining competitive in their mature markets.

Automobile & Components. The econometric outcome shows the positive effect of the research and development and investments long-term contribution to the Sales. Several multibillion mergers and acquisitions took place during the analysed period from 1995 till 2002. The industry reached 18 million light cars shipped in the year 2000, being a record for the industry, and the major restructuring plans were already done in 1994.

Media. The outcome shows a positive effect of the investments in long and short-term contribution to the Sales. It indicates that major mergers and acquisitions were conducted during the analysed period. It is important to remark that the significance of the short-term is higher than the long-term which is an indicator of higher significant activity in short-term.

Food, Beverage and Tobacco. The sector shows a negative effect of the market situation in the short-term contribution to the Sales. We do not capture the advertising effects in the sales for the consumer markets, and this is a disadvantage trying to control for the contributions in the Consumers markets.

Health Care Equipment & Services. The estimates show the positive effect of the market situation, and the investments in the long-term contribution to the Sales.

Pharmaceuticals & Biotechnology. The econometric outcome shows the positive effect of the market situation and research and development in the long-term contribution to the Sales. The large scale mergers and acquisitions were implemented earlier than the analysed period and the companies took the new strategies to collaborate and partner in new developments from 1998 in approximated figures. This is the reason the investments were not significant.

The sector shows that the drivers are both long-term and the research and development is clearly a key process.

Software and Services. The estimates show the global positive effect of the market situation. This can be demonstrated by the fact of the negative sign of the 1^{st}-lag of the Market situation in levels and of the positive sign in 1^{st}-differences being the first coefficient lower in absolute value than the second one. The negative effect of the resources is also shown, as well as the positive effect of the research and development in the short and long-term contribution to the Sales.

Technology Hardware & Equipment. The econometric outcome shows the global positive effect of the market situation, the negative effect of the resources, the positive effect of the research and development in the short and long-term, and the global positive effect of the investments contribution to the Sales.

It is important to remark that in this sector, the significance of the coefficients of the research and development is higher in the short-term (1^{st}-diff.) than in the long-term (1^{st}-lag). This means that the companies relied more on short-term investments in R&D (annual product innovations) than on the longer term ones for the analysed period.

The global positive effect of the investments can be demonstrated by the fact that the coefficient of the long-term (1^{st}-lag) is higher in absolute value than the short-term (1^{st}-diff.).

Utilities. The estimates show a negative effect of research and development and investment in the short-term contribution to the Sales. The Electric, Gas, and Multi-utilities & Unregulated Power are the three subsectors with very different and substantial differences in pricing, and production to the market. It requires further discrimination and a lower aggregation level of data to reach more powerful and reliable results.

GICS	Group	Market Situation		Resources		Res. & Development		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials. 1510	1.783 (2.180)				0.957 (2.670)	1.015 (2.330)	0.103 (2.250)	
3	Capital Goods. 2010			-3.288 (-2.100)	-4.070 (-4.750)	0.724 (3.800)	1.062 (2.770)	0.239 (2.050)	0.108 (2.160)
6	Automobile & Components. 2510					0.631 (2.500)		0.671 (3.230)	
9	Media. 2540							0.953 (7.770)	0.362 (10.390)
12	Food, Beverage and Tobacco. 3020		-5.001 (-2.710)						
14	Health Care Equipment & Services. 3510	2.581 (2.980)							
15	Pharmaceuticals & Biotechnology. 3520	2.181 (2.110)				0.231 (2.090)			
20	Software & Services. 4510.			-2.518 (-4.710)	-1.921 (-6.190)	0.655 (3.950)	0.428 (1.740)		
21	Technology Hardware & Equipment. 4520			-2.178 (-6.430)	-1.892 (-18.280)	0.759 (5.220)	0.908 (10.480)		-0.053 (-11.820)
23	Utilities. 5510						-2.306 (-3.790)		-0.882 (-8.030)
	* t-values in parentheses								

Table 2.11 First-differenced stacked instrumental variables Anderson-Hsiao estimation. (190 Companies, 540 Observations, and Period: 1995-2002)

GICS	Group	Market Situation		Resources		Res. & Development		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials. 1510					-0.004 (-1.880)		0.522 (9.490)	0.316 (6.970)
3	Capital Goods. 2010				-4.025 (-5.060)		0.537 (6.050)	0.177 (3.310)	0.150 (3.340)
6	Automobile & Components. 2510							0.614 (7.060)	
7	Consumer Durable & Apparel. 2520						1.032 (2.580)		
9	Media. 2540							0.468 (7.890)	0.317 (7.950)
14	Health Care Equipment & Services. 3510							0.292 (6.980)	
20	Software & Services. 4510.		3.275 (3.180)		-1.888 (-7.410)	-0.020 (-3.750)	0.726 (10.740)		
21	Technology Hardware & Equipment. 4520	-0.021 (-3.710)	7.760 (5.920)	-0.237 (-2.030)	-1.408 (-6.070)		0.584 (6.510)	0.078 (4.430)	
23	Utilities. 5510						1.175 (9.040)		
	* t-values in parentheses								

Table 2.12 Arellano-Bond. System GMM-2 robust estimation.

(187 Companies, 710 Observations, and Period: 1998-2002)

GICS	Group	Market Situation		Resources		Res. & Development		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials. 1510				-1.634 (-2.080)			0.563 (8.870)	0.335 (8.430)
3	Capital Goods. 2010			-1.437 (-2.320)	-3.314 (-5.940)	0.169 (2.930)	0.803 (6.510)	0.302 (4.760)	0.174 (4.500)
7	Consumer Durable & Apparel. 2520					0.152 (1.990)	1.072 (2.920)		
9	Media. 2540							0.526 (8.170)	0.297 (10.300)
13	Household & Personal Products. 3030							0.709 (2.510)	0.752 (3.480)
14	Health Care Equipment & Services. 3510							0.251 (4.330)	
15	Pharmaceuticals & Biotechnology. 3520				-1.532 (-4.140)				
20	Software & Services. 4510.	-0.124 (-3.670)	2.932 (3.110)	-0.794 (-3.990)	-1.422 (-7.470)	0.151 (2.310)	0.51 (4.420)	0.12 (4.320)	0.054 (2.690)
21	Technology Hardware & Equipment. 4520	-0.135 (-5.630)	3.016 (4.970)		-1.588 (-19.600)	0.135 (4.800)	0.691 (12.170)	0.084 (10.560)	-0.012 (-2.450)
22	Telecommunication Services. 5010							0.136 (2.790)	
23	Utilities. 5510							0.508 (6.020)	

* z-values in parentheses

Table 2.13 MLE-Maximum likelihood random effects estimation

(204 Companies, 1454 Observations, and Period: 1995-2002)

2.8 The Stock of R&D Capital. (See Appendix 2).

The Sales function (Salesforce, CRM systems and tools, etc..) has an inertia from previous years and is also dependent on the sector (Consumers, Technology, etc..). To solve the problem we have considered panel data dynamic models and certain variables must be transformed in order to reach sound results. There are two important papers where these items have been discussed with very important conclusions. These are:

Geroski [68] in his paper "An applied Econometrician's view of Large Company Performance" described the main variables affecting growth, and reached very important conclusions to be analysed in this section: first, corporate growth rates are very unpredictable, and second, most of the firms show no sign of learning or increasing returns to innovative activity over time, except when very high thresholds of activity have been reached.

Based on the above concepts, Geroski is enlightening us about the threshold that the innovative activity requires. This is analysed under the perspective of regular patents supporting innovative research and, in consequence, it is built a cumulative stock of innovative activity, as well as the Griliches' Stock of R&D Capital. This means that a company to pursue sales growth needs to build a Stock of R&D Capital of its activity, and the larger companies will be better positioned to get a competitive advantage in the market due to the larger volumes. If we look specifically at the annual innovative spending, we can see that it is very difficult to find any kind of correlation with any variable.

Looking at the Geroski's paper there is no problem with the transformation of variables. The only criticism may be that the conclusions on the corporate growth rate are quite limited.

The Booz Allen Hamilton Consulting Company[69] conducted a survey on October, 2005 reaching the main conclusion that "No discernable statistical Relationship between historical R&D Spending levels and Sales Growth, Gross Profit, Operating Profit, Enterprise Profit, Market Capitalization, or Total Shareholder Return".

There are other very important conclusions in this survey, but the above mentioned is quite surprising.

---

[68] Geroski, P., 1998, "An Applied Econometrician's View of Large Company Performance", *CEPR Centre for Economic Policy Research*, Discussion Paper No 1862, 16.

[69] Jaruzelski, B, Dehoff, K, and Bordia, R., 2005, "Smart Spenders. The Global Innovation 1000 - Annual Analysis of the World's 1000 Largest R&D spenders", *Booz Allen Hamilton Consulting Company*, 50.

Based on the Geroski findings, we understand that innovative annual spending is erratic and the Sales Growth ratio unpredictable, and it is logical that the Booz Allen Hamilton could not reach a better conclusion due to their statistical approach.

Trying to address this issue, we need to look at the R&D Spending as an Stock of Capital with a certain inertia and history from previous years. This variable transformation makes a complete change in the analysis and, additionally, the investment threshold must be considered. It is after certain values of the threshold that the largest companies could get benefits, because the business process provides a competitive advantage and the critical mass of R&D expenditures and patents must be achieved to succeed. It is logical that the Booz Allen Hamilton analysis do not show any statistical relationship, because they miss the variables transformation and the investment threshold in their analysis.

The threshold R&D level is the minimum amount under which the companies do not find an investment profitable. This has already been mentioned in Geroski's work on this subject, and in another important econometric work by González and Jaumandreu (1998)[70].

González and Jaumandreu have been working with a sample of 2000 manufacturing Spanish Companies for the period 1990-95 and discriminate by Industry sector and company size to identify the thresholds. The main conclusions are the sizes of the thresholds are dependent on the company size, the smaller the firms the bigger the thresholds, and viceversa.

González and Jaumandreu provide good insights on the ranges that they found. They state: "thresholds range roughly across industries between 0.2 to 0.5 of the R&D intensity of the median performing firm", and also "On average, the biggest firms show a threshold that amounts to half of the threshold of the smallest firms".

Based on our current research, we can show a graph of the econometric outcome related to the relation between the incremental log of sales and the global process, (the latter being the linear combination of the long-term (1st-lag) and the short-term (1st-diff.) of the logs of the Stock of R&D Capital). We show the scatter diagram of the results and see the positive contribution of the R&D expenditures to the incremental sales in Figure 2.1. At the same time we assess a threshold based on our Sales Model.

[70] See González, X., and Jaumandreu, J., 1998, "Thresholds effects in product R&D decisions: theoretical framework and empirical análisis", *FEDEA*, 23

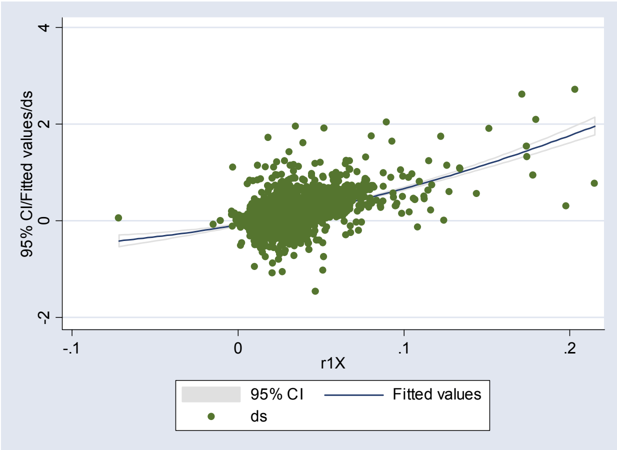


Figure 2.1 The incremental Sales (1st-diff.) against the Stock of R&D Capital global process . ($r_{1X,it}$ = 0.003 $r_{i,\,t-1}$ + 0.101 dr_{it})[71]

We run a separate regression a fixed effects OLS estimator where the dependent variable is the log of sales (1st-diff.) and the independent variable is the global process r1=(0.003 r_1)+(0.101 dr). This is the expression defined with the coefficients obtained from the Sales Model II specification and the Arellano-Bond System GMM-2 estimates. The outcome of the regression shows: ds=1.228079 r1 – 0.021828 and, solving the equation for the ds=0, we get the threshold at r1=0.018.

We split our Panel database in two sub-samples. One is based on the global process r1 less than 0.018 and the second on the r1 higher than 0.018 both for the year 2002. We use the specifications of the Sales Model II described in section 2.4 and estimate by the Arellano-Bond linear System GMM-2 dynamic panel data estimator. The results have been detailed in the enclosed table 2.8.

The coefficients of the Restricted panel data for r1>0.018 show the coefficients of the log of the Stock of R&D Capital (1st-Lag and 1st-Diff.) and the related t-values are much higher than the outcome of the Restricted panel data for r1<0.018. This means that the companies of the sub-sample with r1>0.018 show a positive and significant contribution of the Stock of R&D Capital to the sales higher than the companies of the sub-sample with r1<0.018,

[71] See Table 2.4. The Sales Model II, System GMM-2 estimates.

and a higher probability to surpass the R&D critical mass, learning processes and increasing returns to scale of research and development[72] than the sub-sample with r1<0.018.

The companies of the sub-sample with r1<0.018 show also a significant and positive contribution of the log of the Stock of R&D Capital to the sales. This can be demonstrated by the fact of the negative sign of the 1st-Lag of the Stock of R&D Capital in levels and of the positive sign in the 1st-Differences being the first coefficient lower in absolute value than the second one. The companies in this sub-sample have a very low probability to surpass the R&D critical mass and, additionally, some of the companies belong to sectors where the annual R&D expenditures are very low, in some cases erratic, and without continuity in successive years.

	Restricted Panel Data r1 < 0.018	Unrestricted Panel Data	Restricted Panel Data r1 > 0.018
Sales (1st-Lag)	0.948 (187.22)	0.890 (2131.32)	0.872 (2430.59)
Market Situation (1st-Lag)		-0.037 (-123.15)	-0.009 (-14.73)
Market Situation (1st-Diff.)	0.452 (8.60)	0.093 (88.05)	0.168 (118.73)
Resources (1st-Lag)		-0.046 (-192.70)	-0.057 (-216.76)
Resources (1st-Diff.)	-0.286 (-37.16)	-0.274 (-2823.87)	-0.333 (-1303.32)
R&D (1st-Lag)	-0.003 (-6.03)	0.003 (62.41)	0.005 (124.31)
R&D (1st-Diff.)	0.033 (9.75)	0.101 (1228.07)	0.109 (618.60)
Investments (1st-Lag)	0.028 (20.96)	0.011 (710.05)	0.009 (1193.86)
constant	0.111 (11.07)	0.558 (214.65)	0.325 (58.53)
Nr Observations Nr of Groups F-Statistic	210 34 99701.86	1566 219 9.19E+07	1177 182 1.72E+07
Hansen chi2(..)= (d.f.) Test for AR(1) Test for AR(2)	22.40 138 -3.02 -1.02	212.23 216 -3.63 -0.66	172.88 180 -3.04 -0.57

t-values in parentheses

Table 2.14 The Sales Model II. System GMM-2 results with the threshold at r1=0.018

[72] See Geroski, P., 1998, "An Applied Econometrician's view of large Company Performance", *CEPR-Centre for Economic Policy Research*, Discussion Paper No 1862, 16.

The tests for AR(2) do not reject the null hypothesis of no second-order autocorrelation in the first-differenced residuals (-1.96<-1.02) for the r1<0.018 regression and also (-1.96< -0.57) for the r1>0.018 regression. This implies that the estimates are consistent in both regressions.

The Hansen tests for the two-step estimators do not reject the null hypothesis that the over-identifying restrictions are valid (chi2(138)=22.40<chi2(table)=166.42) for the r1<0.018 regression and also (chi2(180)=172.88<chi2(table)=212.30) for the r1>0.018 regression.

To test for a unit root on the residuals, we have used the augmented Dickey-Fuller test. The outcome of the tests show that we reject the null hypothesis that there is a unit root "no stationary residuals" (-20.82<-2.86) at the 5% interpolated DF critical value for the sub-sample r1>0.018 regression and (-6.53<-2.88) at the 5% interpolated DF critical value for the sub-sample r1<0.018 regression. In consequence, we can state that the residuals are stationary in both sub-samples.

2.15 The Shift among Investments (Interrelation of Variables). The General Electric Case

We already mentioned that the takeovers were not negatively influencing the long-term investments such as R&D investments, see Tirole[73]. As the outcome of our econometric work demonstrates, the Investments for the whole S&P 500 companies have been growing (x2.2) times faster than the R&D expenditures for the period 1983-2002, but both processes have been growing at the same time and the previous Tirole and Hall assessments hold.

We can mention an exception to the previous statement. The large knowledge based MNL-Multinational Companies are struggling to identify medium-scale new opportunities in every field. They do not need to cover geographical coverage, and the main opportunities are based on filling product gaps. The SBU-Strategic Business Units are not duplicating investments and it is much easier to invest in an acquisition providing a new product range

[73] See Tirole, J., 2006, "The rise of takeovers and the backlash: What happened?", *The Theory of Corporate Finance*, 1, 50.

faster than developing their own products. A new acquisition provides a certain reduction in the current technology resources, a quick access to the new product range, and an integration of a new company with all the benefits that this opportunity provides. The possibility to report integrated sales is a good incentive for the short-termism already mentioned in previous chapters.

It is clear that the acquisition of companies is faster than own development, but it requires a Management team fully committed, knowledgeable of the analysed sector, a correctly structured financial deal, and it also requires the other party be ready to sell the company.

As an example, we can look at the evolution of the R&D expenditures to Net sales in percent for the General Electric Company from the years 1972-2001. Looking at the graph we may infer that the company walks away from R&D[74]. This is as follows:

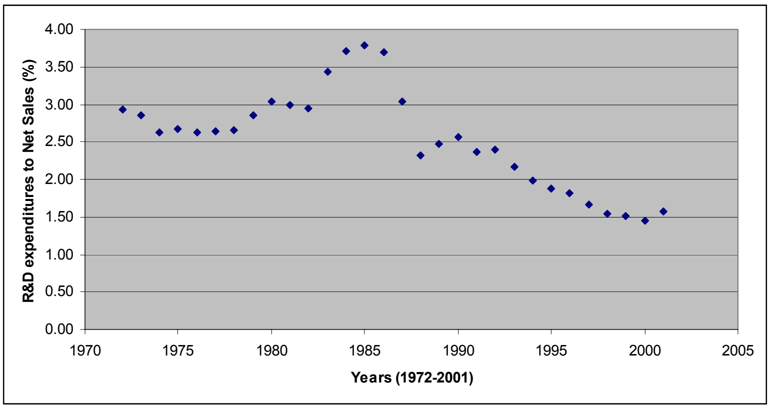


Figure 2.2 General Electric Co. R&D Expenditures to Net Sales in percent.

It is clear that the share of the R&D expenditures as a percent of Sales decreases every year, as well as the R&D expenditures spent in their current and core businesses. The General Electric Company is filling the deck of new products through acquisition of companies. As above mentioned, the reason of this is timing.

Generally speaking, if you make an acquisition to fill a product gap the time of realizing it is shorter than internal development. A general solution cannot be stated with regards to cost.

[74] Kennedy, A., 2000, "Milking the Traditional Businesses", *The End of Shareholder Value*, Orion Business Books, London, Part 2, 4, 54-55.

In the previous econometric work, we found out that there is a very low correlation between the R&D and the Investment variable with the adequate transformations. However, it would be wrong to think that one company is walking away from one type of investment, because it could be compensated by another variable, as it is the case with General Electric. As a general statement, we can say that the Companies are growing both processes (R&D expenditures and Investments) and the empirical econometric work demonstrates that the companies are growing its Investments faster, than the R&D expenditures; but, in general they do not duplicate figures for the same objective (like product development,..). We can list cases where the company performs its own product development internally, and acquires the manufacturing facilities in a low cost country to manufacture the new product range.

Generally speaking, the above mentioned example opens a new dilemma. The Large Conglomerate Companies expanding in unrelated businesses such as Construction, Media, and Financial Services, which are not particularly R&D intensive, many times struggle with the long term competitiveness of the core industrial businesses fighting against niche players. These niche players are still very focused on the R&D processes which makes the time to market shorter. This forces the position of the Strategic Business Units of the Conglomerate Company, who are anchored in the past, with products becoming obsolete, and who are not able to respond to the current market challenges.

It is more and more difficult to find niche quality players to acquire and, due to this phenomenon, there are Large Conglomerate Companies that lose the capability to perform quality R&D in some of the core businesses. Huge increases in operating margins in the 90's came from the headcount reductions in the core and in the technology as a priority. The rationale was that if you need a new R&D team in place, you could buy the talent in high technology skilled emerging countries with a lower cost. It is true that you find very talented people in lower cost countries, but it takes time to get the product specifically for niche markets. People change and communication between companies are still a problem.

The main features of the Large Conglomerate Companies are:

- Diversification of the portfolio of Businesses
- Potential additional use of P&E, IT, R&D, and Services across businesses
- Easier Financial consolidations
- Wide range of products, and

- Decreasing risk due to the portfolio of products

As above mentioned, one of the main risks for the Large Conglomerate Companies is becoming uncompetitive at the core, and this is usually happening to the short cycle (cash generation) businesses, which are far from the Headquarters' strategies.

2.10 Conclusion

We have presented the analysis of the main variables and processes impacting the Sales of the Companies. Two models have been specified to identify how critical the short and long-term of the different considered variables are. This objective has been widely achieved and, at the same time, an explanation of the significance and impact of every variable on the Sales has been provided.

In accordance with the outcome estimates of the Sales Model II, it is important to emphasize the significance of the Research and Development processes in a short and a long term, as well as the significance of the Investments in the long term. These significances have been widely explained to clarify to the Management Community that the R&D processes are very important and require very careful attention. The slowdown in new product introductions in the short and long term and in investments in the long-term is a clear signal of sales decrease for the future.

The Augmented Dickey-Fuller test for a unit root of each variable and the Fisher-type test have been performed, and they show that the panels are non-stationary and the models needed to be re-estimated.

Additionally, the Johansen Cointegration test provided the number and the final cointegrating equations to be considered for the Sales Model I and it did not provide any outcome for the Sales Model II, the Engle-Granger 2-step method confirmed the details of the final estimation in first differences for the Sales Models I and II, and the VECM-Vector error correction models estimation provided the LR test of binding restrictions and all the error correction models estimates for the Sales Model I and it did not provide any outcome for the Sales Model II.

Finally, the models have been re-estimated with all the variables in first differences. For the Sales Model I, the fixed effects OLS is consistent and the outcome shows the market situation and the research and development with a positive and significant contribution to the sales, and the resources and investment with a negative and significant contribution to the sales. See Section 7.1.2a for a fuller discussion of the conclusions and Appendix 1b for the details of the estimates.

For the Sales Model II, the fixed effects OLS is consistent and the outcome shows the market situation (1st-lag and 1st-diff.), the research and development (1st-lag and 1st-diff.), and the investment (1st-lag) with a positive and significant contribution to the sales, and resources (1st-lag and 1st-diff.) with a negative and significant contribution to the sales. See Section 7.1.2b for a fuller discussion of the conclusions and Appendix 1c for the details of the estimates.

The sector analysis has been included to demonstrate the importance of understanding the particular characteristics of every one. The same kind of analysis can be done at the firm level and can identify the different policies of the companies.

A complete analysis of the Stock of R&D Capital and the identification of the threshold of R&D has been provided for the analysed panel. The threshold of R&D has allowed us to discriminate two sub-samples of companies and identify their behaviour. The first sub-sample of companies shows a very low annual R&D expenditures, in some cases erratic, and without continuity in successive years. The second sub-sample of companies shows a very positive and significant contribution of the R&D to increase sales, and, in consequence, the companies have surpassed their critical mass of R&D, the learning processes and increased returns to scale of research and development.

As a consequence of the learning provided by the outcome of the econometric models, a very practical list of long and short-term actions has been included to keep on a track leading to a successful management of the companies. See Appendix 10.

In the last section, the General Electric case shows us the shift among investments, how an acquisition may cover a product gap much faster than our own product development and reduce the time to market. This fact may shift the significance of the parameters from the R&D to the Investment in Mergers & Acquisitions in some companies. However, the companies are currently investing in R&D and Acquisitions simultaneously.

Chapter 3

The Profit-Cash Flow Model

3.1 Introduction

In this chapter we study the main business processes impacting on the Company Profits. There is a wide literature focused on the analysis of productivity, research and development, and investments, but not specifically on profits. Profits are covered as the dependent variables and we can find two different types of models. The first type is based on the structure-conduct-performance framework of industrial analysis[75] where the independent variables are the market share, the concentration ratio, and the advertising-sales ratio. A typical example can be seen in Shepherd (1972)[76]. The second type is based on the Cobb-Douglas production function where the independent variables are labour, capital, materials, and others like the stock of R&D capital, management practices, etc… A typical example can be seen in Bloom and Van Reenen (2006)[77]. Our objective is to find out and demonstrate the impact on Profits of the most relevant internal business processes with the independent variables based on Allen's matrix of the methods and directions of the corporate development[78] through an empirical econometric research. At the same time, our analysis can be considered as an extension of the business process management approach.

We have analysed the industrial 240 Companies of the S&P 500 after excluding the Banks, Diversified Financials, Insurance and Real Estate. The profitability has been measured at the operational level, not at the net income bottom line, avoiding the accounting corporate issues related to the depreciation, amortization, extraordinary items, etc...We have chosen the Earnings before interest, tax, depreciation and amortization to Total Assets ratio.

---

[75] See Martin, S., 1994, *Industrial Economics: Economic Analysis and Public Policy*, 2nd Ed., Prentice Hall, New Jersey, 1, 3.
[76] See Shepherd, W., 1972, "The elements of market structure", *Review of Economics and Statistics*, Vol. 54, No 1,
[77] See Bloom, N., and Van Reenen, J., 2006, "Measuring and explaining management practices across firms and countries", *CEP Center for Economic Performance*, Discussion Paper No 716, Page 36, Table 2, Column 5.
[78] See Allen, P., 1998, "Business Policy", *University of Durham*, 31-3, 25.

The numerator is a measure of profit and cash flow[79], and dividing it by the total assets we get a return measure. The business processes have been chosen based on Allen's matrix of methods and directions as above mentioned, and we identify the market situation, sales, research and development, productivity and investments as the key driving factors of corporate profit. The Market Situation was measured by the log of the real gross domestic product. Sales were measured by the log of net sales, Research and Development was measured by the stock of R&D capital to sales ratio, Productivity by the log of the apparent variable cost productivity, and Investments were measured by the investment to sales ratio.

In summary, the development of the current research is as follows. Section 3.2 examines the previous research and how our results differ from the existing literature. Section 3.3 describes the data, performed adjustments, and the correlation among the key variables. Section 3.4 shows the specification of the model. Section 3.5 summarises our main results. Section 3.6 shows a detailed discussion of the econometric estimates. Section 3.7 shows the most significant business processes by industrial sector. This calculation was performed discriminating the different economic sectors by a set of dummies. Section 3.8 describes the dilemma between investing in R&D or selective investments and finally in Section 3.9 the conclusion.

3.2 Previous research on Profit-Cash Flow Models.

We have identified the seven most important empirical studies on profitability and related areas of research in a historical order. These studies are analysed and summarized in this section.

Jaffe (1986)[80] studied the productivity and spillovers of R&D and developed the Profit model depending on the accumulated Stock of R&D, Capital, Market Share and the Four-Firm concentration variables. The estimation of the model was based on two cross-sections of 432 companies, and two periods 1972-74 and 1978-80. The main conclusion is that the

---

[79] See Bodenhorn, D., 1964, "A Cash-Flow concept of Profit, *The Journal of Finance*, Vol. 19, No 1, 16-31.

[80] See Jaffe, A., 1986, "Technological Opportunity and Spillovers of R&D: Evidence from Firm's Patents, Profits, and Market Value", *The American Economic Review*, Volume 76, Issue 5, 984-1001.

firms whose research is in areas with other firms with similar and very intensive in R&D expenditures have a higher return to R&D in term of profits and market value. Meanwhile firms with low R&D show lower profits and market value when compared with their intensive R&D peers. The stock of accumulated R&D capital was calculated in the same way as it was developed by Griliches and Mairesse (1984).

Cubbin and Geroski (1987)[81] modelled the specific firm profits from the average industry profits for a UK sample of 217 companies over the period 1951-77. They found considerable heterogeneities within most industries. Two thirds of the sample were converging to a common profitability level, and some firms were able to maintain higher profitability levels almost indefinitely, and independent of the market forces. The differences among firms show that the large, productive, and fast growing ones earn higher profits in the long run, and the acquisition based on high capital intensive industries earn lower returns in the long run.

Geroski and Jacquemin (1988)[82] studied the persistence and predictability of profits for three European Economies. They have identified the firm specific characteristics associated with the persistence to maintain high profits, and these are: relatively young firms, operating in less concentrated sectors, in the United Kingdom, domestic market orientation, and high degree of specialisation. The predictability of profits is associated with industry growth, ownership control, in the United Kingdom, domestic market orientation, and operating in less concentrated sectors.

Mairesse and Hall (1996)[83] studied a sales model based on a Cobb-Douglas production function and performing OLS and GMM estimations. They estimated sales in the case of the United States, and sales and value added in the case of the French data. The most important conclusion is the high productivity of research and development in increasing the sales in the case of the United States, and the positive significant association in the case of France.

[81] See Cubbin, J., and Geroski, P., 1987, "The convergence of Profits in the Long Run: Inter-Firm and Inter-Industry comparisons", *Journal of Industrial Economics*, 427-442.

[82] See Geroski, P., and Jacquemin, A., 1988, "The Persistence of Profits: A European Comparison", *Economic Journal*, Vol. 98, No 391, 375-389.

[83] See Mairesse, J., and Hall, B., 1996, "Estimating the Productivity of Research and Development: An exploration of GMM methods using data on French and United States Manufacturing Firms", *NBER-National Bureau of Economic Research*, 5501, Table 2, 7.

Nissim and Penman (2001)[84] studied the negative and significant association between changes in the interest rates and residual earnings, and this finding corroborates the negative correlation between changes in interest rates and stock returns. They also analysed the interest rate effects on accounting profitability, and assets growth, which are tied to the residual earnings valuation model.

Bloom and Van Reenen (2006)[85] studied the effect of the management practices on the performance measures such as sales, return on capital employed, Tobin's Q, and sales growth. They developed a survey through personal interviews to the Management from 732 medium sized manufacturing firms in Europe and the US. The econometric modelling was based on a production function with labour, capital, material, management practices, and workforce characteristics as the independent variables. They found that the management practices were strongly associated with superior firm performance. They also found that the American companies were, on average, much better managed than the European ones, and a combination of low product market competition and the succession planning in family firms based on *primo geniture* were the main causes of inferior management practices and, in consequence, less successful firms.

Draca, Sadun and Van Reenen (2006)[86] modelled a Cobb-Douglas production function where capital was split between IT capital and non-IT capital, aside of labour, and materials. They identified a strong firm correlation between IT and firm performance. The spillovers for ICT are very weak, being clearer for the innovation or R&D processes. This research includes an important summary of all the most important firm-level studies of IT and productivity.

Rajan, Reichelstein, and Soliman (2006)[87] studied theoretically and empirically the behaviour of the ROI-Return on Investment as a function of accounting conservatism, growth in new investments, the useful life of assets, and the internal rate of return of projects available to the firm. They concluded that higher investments growth is shown to result in

---

[84] See Nissim, D., and Penman, S., 2001, "An Empirical Analysis of the Effect of Changes in Interest Rates on Accounting Rates of Return, Growth, and Equity Values", *Columbia University, Graduate School of Business.*

[85] See Bloom, N., and Van Reenen, J., 2006, "Measuring and Explaining Management Practices across Firms and Countries", *CEP-Centre for Economic Performance*, No 716, 14.

[86] See Draca, M., Sadun, R., and Van Reenen, J., 2006, "Productivity and ICT: A Review of the Evidence", *CEP-Centre for Economic Performance,* No 749, 5.

[87] See Rajan, M., Reichelstein, S., and Soliman, M., 2006, "Conservatism, Growth, and Return on Investment", *Stanford University, Graduate School of Business.*

lower levels of ROI provided the accounting is conservative, while the opposite is true for liberal accounting policies. A more conservative accounting will increase ROI provided that growth in new investments has been moderate.

Our research differs in three main aspects when compared with the above mentioned previous research. Firstly, it differs in the specification of the econometric models, secondly, in the variables used and thirdly, in the conclusions. We only find autoregressive dynamic models specified in the Nissim and Penman's research when regressing the return on net operating assets. The rest of the studies are based on a static Cobb-Douglas production function where the profitability is a function of labour, materials, capital, and other variables. Capital is specified according to the variable to be controlled. The stocks of capital have been specified for R&D in Jaffe, Mairesse and Hall, and for IT and non-IT in Draca, Sadun and Van Reenen.

Our research is based on an autoregressive dynamic model where the profit is regressed by the last year profit, and the market situation, sales, research and development, productivity, and investments performed at the firm level. Additionally, we take the lag and first differences of each variable. This is a very important difference versus all the previous research. The main feature of our approach is the possibility to control for the long and short-term significance of every variable in its contribution to the profitability of the company. Our approach allows to monitor the R&D and the Investments effects separately, but not tracking specifically the IT investment.

At the level of conclusions, we achieved our objective of getting the significant contribution of the different business processes to the profitability of the company in a short and long-term approach. Jaffe, Mairesse and Hall found the R&D investments very productive in getting profitability, and we got exactly the same findings. Geroski and Jacquemin found the relevant variables to predict the profits based on an external view of the firm characteristics, whereas, in our research we have built a model with predictive power to forecast in short-term the company profitability based on the accounting variables. We cannot trace the interest rate effects as in Nissim and Penman, due to the fact that our focus is on the internal business processes. We also cannot trace the IT productivity, as in Draca, Sadun and Van Reenen, due to the fact that we did not control for this variable.

3.3 Data and Resources.

The data used in the research come from several sources. Company data are from Standard & Poor's 500 Compustat – North America (500 Companies). After excluding Banks, Diversified Financials, Insurance, and Real Estate, the sample covered 240 Companies, 20 years by cross-section (1983-2002). The Industry classifications are updated to the new GICS-Global Industry Classification Standard (23 Industry groups in total, and after omitting the financial ones 19 groups). The total number of observations in the panel is 4800.

The Software used is Stata-SE, release 8.0.

The definition of the variables, where lower case letters indicate that a variable has been transformed into a natural logarithm or ratios, are the following:

<u>Profit-Cash Flow,</u> π = EBITDA to Total Assets ratio in percentage. Earnings before interest, tax, depreciation and amortization to Total assets ratio.

<u>Market Situation</u>, g = ln(real GDP). Real Gross Domestic Product supplied by the Bureau of Economic Analysis. The real GDP variable is the same across all companies.

<u>Net Sales</u>, s = ln(Sales). Year end net sales adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes specific for every sector and supplied by the US Bureau of Labour Statistics.

<u>Research & Development</u>, r = Stock of R&D capital to net Sales ratio. The method of construction of the Stock of R&D capital was initially built by Z. Griliches (1981), Z. Griliches and J. Mairesse (1981), and Z. Griliches and B. Hall (1982). It is a standard perpetual inventory with a depreciation rate of 15%. Prior to building the Stock of R&D Capital, the annual R&D expenditures have been adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

The net Sales were adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes specific for every sector and supplied by the US Bureau of Labour Statistics.

<u>Productivity</u>, v = ln(Apparent Variable Cost Productivity). The Apparent Variable Cost Productivity is constructed forcing the productivity result as the balancing variable cost number between two periods after the volume and inflation impacts have already been calculated.

The annual VCP[88] figures were adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis after the calculations below mentioned. The productivity is driven conceptually by either cost efficiencies or product mix. In our analysis we calculate the total number without any insight about the source of this productivity. Due to the fact that we base our analysis at the operational factory level, the VCP figure is consistent with our research. The Selling General and Administrative expenditures are not included and, in consequence, the productivity that we calculate is not the total productivity of the company.

The Apparent Variable Cost productivity table and calculations are the following:

	Year 2	Year 1	V	Constant	Inflation Index	Price Realization	Volume
Sales	sls2	sls1	sls2 - sls1	sls2/ics	ics	sls2 - sls2/ics	sls1 - sls2/ics
Cost of Goods Sold	cogs2	cogs1	cogs2 - cogs1	cogs2/ic	ic	cogs2 - cogs2/ic	(sls1 - sls2/ics) (cogs1/sls1)
Contribution Margin	sls2 - cogs2	sls1 - cogs 1	V1			V2	V3

V1 = sls2 - sls1 - (cogs2 - cogs1) = sls2 - sls1 - cogs2 + cogs1

V2 = sls2 - sls2/ics - (cogs2 - cogs2/ic)

V3 = (sls1 - sls2/ics) - ((sls1 - sls2/ics) (cogs1/sls1)) = (sls1 - sls2/ics) (1 - (cogs1/sls1))

Apparent Variable Cost Productivity = V1 - V2 - V3

Table 3.1 The Apparent Variable Cost Productivity calculations

The Change of contribution margin "V1" is due to the current changes in sales less cost of goods sold.

The Change of contribution margin "V2" is due to the real changes in sales less cost of goods sold. The sales have been adjusted by the PPI-Producer price indexes for every sector supplied by the US Bureau of Labour Statistics. The cost of goods sold is adjusted by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

88 See General Electric Co: Corporate Financial Planning and Analysis, 1996, "Measurements Analysis and Planning: Analysing changes in profitability", *MAP Financial Bulletins*, MAP-402, 3.

The Change of contribution margin "V3" is due to the real sales volume change and discounted at the composite contribution margin rate in period one. This is consistent with the assumption that we identify price and cost inflation impacts separately.

The Apparent VCP is the result to deduce the price realization (V2) and volume (V3) impacts from the current change of contribution margin (V1) as previously defined. It can be argued that the product mix change in the product portfolios is not considered, but this is a minor issue when comparing the power of other productivity variables against the above mentioned calculation.

The cost of goods sold[89] represents all direct costs allocated to production, such as direct material, labour and overhead (supervisors, small toolings, etc…) related to the production lines.

Investment, i = Investment to Sales ratio. The annual total investment has been adjusted to constant 2002 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis and Sales adjusted to constant 2002 US Dollars by the PPI-Producer Price Indexes specific for every sector. This variable mainly seeks to capture the Mergers and Acquisitions processes. Jean Tirole[90] states that a standard finding is that firms with more cash on hand and less debt invest more, having a strong control on investment opportunities.

The enclosed table summarizes the statistics on the key variables.

Dependent and Explanatory Variables		Mean	Std Dev	Min	Max
Profit	π	16.723	9.129	-67.161	96.510
Market Situation	g	8.973	0.181	8.639	9.258
Sales	s	8.002	1.645	-0.833	12.407
Res. & Development	r	0.257	0.477	0.000	14.890
Productivity	v	-1.200	4.146	-10.349	9.924
Investments	i	0.203	0.669	-21.618	20.868
Profit	1st-lag	16.723	9.129	-67.161	96.510
Market Situation	1st-lag	8.973	0.181	8.639	9.258
	1st-diff.	0.000	0.143	-0.619	0.069
Sales	1st-lag	8.002	1.645	-0.833	12.407
	1st-diff.	0.058	0.570	-9.973	4.249
Res. & Development	1st-lag	0.257	0.477	0.000	14.890
	1st-diff.	-0.002	0.275	-6.633	9.119
Productivity	1st-lag	-1.200	4.146	-10.349	9.924
	1st-diff.	-0.039	5.236	-18.473	18.580
Investments	1st-lag	0.203	0.669	-21.618	20.868
	1st-diff.	-0.013	0.815	-32.811	18.858

Table 3.2 Mean, standard deviation, and range of each variable. Period: 1983-2002.

89 Standard and Poor's, 1998, "Income Statement", *Compustat (North America): Data Guide*, Mc Graw-Hill, Englewood, 6-1

90 See Tirole, J., 2006, "The Theory of Corporate Finance", *Princeton University Press*, Princeton, 2, 100.

The average company profit of the sample is 16.7%, the EBITDA to total assets was evolving from an average of 18.54% in 1995 to a 14.50% in 2002. This is a drop of 4.04 percent points in operating profits for the analysed period. Our objective of selecting the S&P 500 is clearly biased to analyse the larger companies and this will lead us to understand how the bigger companies are behaving in terms of the expenditures and investments to generate opportunities and profitability.

The real gross domestic product ranges from US$ 8360.38 billion in 1995 to US$ 10487.00 billion in 2002 in constant 2002 US Dollars. This means a 3.29% annual average growth rate for the 7 years period.

The average company sales of the sample is US$ 2986.93 million for the period 1983-2002, and the net sales ranges from US$ 2946.48 million in 1995 to US$ 6574.10 million in 2002. This means a 12.15% annual average growth rate for the 7 years period.

The average stock of R&D capital to sales ratio is 0.257 for the considered sample, and it ranges from 0.221 in 1995 to 0.332 in 2002. This means a gain of 1.58 percent points per year.

The average variable cost productivity is a negative US$ 3.32 million for the period 1983-2002, and it ranges from a negative US$ 4.24 million in 1995 to a negative US$ 7.52 million in 2002. This means an annual drop of 8.53% for the 7 years period. Variable Cost accounts for the cost of goods sold, direct labour, and the indirect supervision managers cost.

The average investment to sales ratio of the sample is 0.203 for the period 1983-2002, and it ranges from 0.283 in 1995 to 0.197 in 2005, this means an annual drop of 1.23 percent points for the 7 years period.

The enclosed table summarizes the evolution of the key variables.

Dependent and Explanatory Variables	Years	1995	1998	2002
Profit	π	18.545	16.813	14.504
Market Situation	g	9.042	9.144	9.280
Sales	s	7.988	8.332	8.791
Res. & Development	r	0.221	0.269	0.332
Productivity	v	-1.444	-1.690	-2.017
Investments	i	0.283	0.246	0.197

Table 3.3 Evolution of the key variables for the period 1995-2002.

The enclosed table summarizes the correlation matrixes or covariance matrixes for the group of variables to be considered in the econometric models.

Explanatory Variables		Market Situation g	Sales s	R & D r	Productivity v	Investments i
Market Situation	g	1.000				
Sales	s	0.170	1.000			
Res. & Development	r	0.060	-0.309	1.000		
Productivity	v	-0.085	-0.146	0.056	1.000	
Investments	i	0.026	-0.162	0.020	0.047	1.000

Explanatory Variables		Market Situation		Sales		Res. & Development		Productivity		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
Market Situation	1st-lag	1.000									
	1st-diff.	-0.157	1.000								
Sales	1st-lag	0.156	-0.050	1.000							
	1st-diff.	-0.036	0.161	-0.435	1.000						
Res. & Development	1st-lag	0.034	0.003	-0.313	0.126	1.000					
	1st-diff.	0.053	-0.055	0.050	-0.314	-0.248	1.000				
Productivity	1st-lag	-0.074	0.060	-0.149	0.101	0.063	-0.011	1.000			
	1st-diff.	-0.026	-0.005	0.003	-0.005	0.006	-0.023	-0.629	1.000		
Investments	1st-lag	0.079	-0.009	-0.219	0.309	0.131	0.004	0.047	-0.033	1.000	
	1st-diff.	-0.035	0.061	0.004	0.130	-0.023	-0.105	0.006	0.020	-0.597	1.000

Table 3.4 Correlation or covariance matrix of the explanatory variables.

Due to the definition of the different explanatory variables, we are not confronted with a severe collinearity problem. There are two coefficients higher than 0.5 in absolute value. This is the case with the productivity (1^{st}-lag) and (1^{st}-diff) at 0.629, and investments (1^{st}-lag) and (1^{st}-diff) at 0.597. We will drop the productivity (1^{st}-lag) and investments (1^{st}-lag) from the regressions due to the lower significance of their coefficients when compared with the 1^{st}-diff's ones.

3.4 The Profit-Cash Flow Model specification.

Based on the Methods and Directions matrix of Corporate Development due to Allen (1998), already described in our section 1.9, the main processes identified affecting the Profitability are the Market situation, Sales, Research and Development, Productivity and Investments. We assume that the Profit is a function of the previous year and the incremental profit is due to the main processes previously mentioned (See Section 3.6 for the detailed econometric estimates).

We assume that the incremental contribution of every one of the processes is a linear combination of the 1st-lag and 1st-diff. relationship. The autoregressive dynamic model is:

$$\pi_{it} = \alpha\, \pi_{i,t-1} + \beta_1\, g_{i,t-1} + \beta_2\, dg_{it} + \beta_3\, s_{i,t-1} + \beta_4\, ds_{it} + \beta_5\, r_{i,t-1} + \beta_6\, dr_{it} + \\ + \beta_7\, v_{i,t-1} + \beta_8\, dv_{it} + \beta_9\, i_{i,t-1} + \beta_{10}\, di_{it} + \eta_i + \varepsilon_{it} \qquad (3.4.1)$$

The specification of this model is based on the Adbudg response function as widely explained in the first chapter (item 1.7). The Adbudg response function controls for the increasing returns (ramp-up) at the early stage and saturation produced by the scarcity of resources at a late stage. As demonstrated in the item 1.7, this effect can be measured by the (1st-lag) and (1st-diff.) of the same variable and, due to the fact that there are fewer companies at the saturation stage, in the end we are really controlling the increasing returns stage (ramp-up) better than a linear relationship model.

Balestra and Nerlove (1966)[91] have used a similar model specification for the Gas demand as a function of the lagged dependent variable, the relative price of gas, the 1st-lag and 1st-diff of the total population, and the 1st-lag and 1st-diff. of the per capita income.

The variables were described in the data, but we repeat them for clarification. These are the following (See Appendix 3a for a fuller variables description):

Profit-Cash Flow = π_{it} = EBITDA[92] to Total Assets ratio

Market Situation = g_{it} = ln(real GDP) = Natural logarithm of real GDP

Sales = s_{it} = ln(Net Sales) = Natural logarithm of net sales

Research & Development = r_{it} = Stock of R&D Capital to Sales ratio. See Appendix 2.

Apparent Variable Cost Productivity = v_{it} = ln(Variable Cost Productivity)

Investments = i_{it} = Investment to Sales ratio

Intercept = η_i

Residuals = ε_{it}

91 See Hsiao, C., 2003, "Balestra and Nerlove (1966) Demand for Gas Model", *Analysis of Panel Data*, 4.4, 92

92 EBITDA is also named Operating Income Before Depreciation. It represents Net Sales less Cost of Goods Sold and Selling, General, and Administrative expenditures before deducting Depreciation, Depletion, and Amortization. Compustat (North America). Standard and Poor's, 1998, *Compustat (North America): Data Guide*, 6, 31.

Due to the fact that the dependent variable is a ratio, the coefficients of the log variables are not elasticities, and the interpretation will not be so straightforward.

3.5 Description and discussion of results.

After conducting all the econometric estimators for the specified model and selecting the most adequate one according to the different relevant tests, we can describe and discuss the following results:

Market Situation. The econometric results show a negative and significant contribution in the long-term, and positive and significant contribution in the short-term. This can be explained because the growth of the economic activity favours the growth of profitability for the year. The economic activity grew at 3.29% annual average growth rate for the period 1995-2002, and the profits of the companies dropped from 18.5% to 14.5% during the same period.

The United States enjoyed a long period of continuous expansion for the studied period of 1983-2002. It came to a halt in 2001 due to the terrorist attacks, but the slowdown of the economy started in the second half of 2000 when the demand of IT equipment began to fall. The drop of 80% of the company shares in the high tech sector started a general deterioration in business and consumer confidence.

The fact that the profitability of the companies at the operational level started to drop in 1995 through 1998 means that the economic activity was near to a change of the business cycle. The economic theory tells us that at the end of long periods of growth economic activity we can face drains of cash flow, working capital, fixed assets, management energies, and capital funds in the companies without having the right controls[93] on them. The drop in 2001 and 2002 are very clearly justified by the economic situation after 11th, Sep., 2001.

In summary, looking at the result for the combined short and long-term process we can state that the market situation had a positive contribution to increase the company profitability for the analysed period.

Sales. The results show a positive contribution of the sales to the profitability in the long and short-term.

93 See Tirole, J., 2006, "Control of Growth", *The Theory of Corporate Finance*, Princeton University Press, 2, 102.

Some of the estimators are not showing the sales in the long-term significantly contributing to the profitability of the company. This result could be explained by the fact that American companies are very much oriented to get results through Manufacturing Operations, and not through Sales. On the contrary, European companies have been dealing with different countries, cultures, languages, tougher competition from the relatively small home countries and are more oriented to the sales and marketing activities, than to the manufacturing operations.

The significant positive correlation between short-term incremental sales and profitability means that the companies are looking for annual opportunities to grow sales but with higher profits. In a certain way, we can state that the companies are pursuing a sustainable and profitable growth mainly based in the short-run.

In summary, looking at the result for the combined short and long-term process we can state that the net sales had a positive contribution to the company profitability.

Research and Development. The results show a positive significant contribution to the profitability in the long-term and a negative significant contribution in the short-term. This means that the investment in Research and Development provides a competitive advantage and a way to be differentiated from our Competitors and it allows to get a premium in profitability for the long-term. All the small innovations pursued in the short-term are associated with negative contributions to profitability. In other words, small innovations allow us to enter quickly in opportunities, but the outcome of the econometrics tells us that the contribution to profitability is not successful in the same year.

In short, looking at the result for the combined short and long-term process we can state that research and development has a positive contribution to increase the company profitability.

Variable Cost Productivity. The results show a positive significant contribution to the profitability of the annual actions in variable cost productivity.

We can identify three main processes leading to the improvement of VCP, these are:

1. In-company actions: headcount reduction, cost of materials decrease in their own operations, keeping moderate annual salary increases, and getting the highest deflation from outsourced products.

2. Re-location of manufacturing. Specifically in Corporate America the first moves were to Costa Rica (cost and tax benefits), later to Mexico (maquiladoras), and currently to China. They provided a very high Productivity shown in the short and long-term VCP improvement.
3. Restructuring processes implemented after every acquisition, avoiding replication of indirect, and more carefully of direct resources. In many cases the objective is to get geographical market coverage and this is forcing to dismantle and close factories reducing the operations in a country to just the sales and logistic operations. In these cases, there is the risk that cutting to the bone could be very negative and the customers' perception is that it is like walking away from the market.

The VCP Actions are significant in the short-term, but as a business process the short-termism is in fact trying to improve the variables in quarterly basis through productivity actions.

Bloom, Sadun & Van Reenen (2007)[94] studied how important was to incorporate the use of the IT Technology by US Multinationals as the main factor to get productivity in the 1990's, and the flexibility to react to these technology challenges leads to a clear productivity advantage.

<u>Investments.</u> The results show a negative significant contribution of the annual changes of the Investments to the profitability. It is important to emphasize that the important Investments do not show the results in the same year, but in the mergers and acquisitions when we make the investment we can consolidate and get the results in the same year. This is why we have found the first diff. variable more significant than the first lag ones.

Having in mind that the big Investments and the use of cash flow are available to the stronger balance sheets, and larger companies, and as mentioned by Tirole[95] "the recent merger wave in the 1998-2001 period, was the largest in American history and associated with high stock valuations". The drop in profitability can be explained by the degree of failure of the expectations of larger sales and profits according to the investments performed.

[94] Bloom, N., Sadun, R., and Van Reenen, J., 2007, "Americans Do IT Better: US Multinationals and the Productivity Miracle", *CEP-Centre for Economic Performance*, Discussion Paper No 788, 11.

[95] Tirole, J., 2006, "Takeovers and Leverage Buyouts", *The Theory of Corporate Finance*, Princeton University Press, 1, 44.

The KPMG Peat Marwick report (1999) states that 53% of the M&A's deals were losing value and were not reaching expectations.

3.6 Detailed discussion of the Econometric estimates

The proposed Profit model was estimated using the Dynamic Panel Data estimators: Difference and System GMM-Generalized Method of Moments developed the first by Arellano- Bond (1991), and the second by Arellano and Bover (1995) and Blundell and Bond (1998), in order to get consistent estimates for the parameters. Several econometric estimators (one and two-steps and robust versions) have been performed to control for the impact of the different proposed variables affecting the Profits. Based on the best estimates we can conclude the following:

3.6.1 The Profit-Cash Flow Model

After regressing all the alternative estimators: Difference and System GMM (one and two steps, and robust versions), and using the variables in levels as instruments, as recommended by Arellano (1989)[96]. The System GMM-2 estimator provides the most consistent estimates of the coefficients. The test for AR(2) does not reject the null hypothesis of no second-order autocorrelation in the first-differenced residuals (-1.96<-0.93). This implies that the estimates are consistent.

The Hansen test for the two-step estimator does not reject the null hypothesis that the over-identifying restrictions are valid (chi2(242)=222.78<chi2(table)=279.29).

Profit (1st-Lag). The coefficient at 0.82 shows us that the current profits very much rely in the previous year and they are highly significant.

Market Situation. The process shows a negative contribution of the economic activity to the profitability of the company in the long-term (1st-lag), and a positive contribution in the short-term. (1st-diff.). The linear combination of the two processes shows a positive contribution of the economic activity to the profitability of the company. This can be

96 See Greene, W., 2000, "Models for Panel Data", *Econometric Analysis*, 4th Ed., Prentice Hall, New Jersey, 14, 584.

demonstrated by the fact of the negative sign of the 1st-lag of the Market situation in levels and the positive sign in 1st-differences being the first coefficient lower in absolute value than the second one.

Sales. The process shows a positive contribution of the sales to the profitability of the company. The coefficients of the 1st-lag and 1st-diff. of the sales are positive, and the 1st-diff. coefficient is more significant than the 1st-lag one.

This means that the short-term actions have been critical to increase profitability for the current year, and are more robust than the long-term ones. It is clear that the linear combination of the two processes shows a positive contribution to the profitability of the company.

Research and Development. The process shows a positive contribution of the R&D to the profitability of the company in the long-term (1st-lag), and a negative contribution in the short-term (1st-diff.). The linear combination of the two processes shows a positive contribution of the R&D to the change of profitability of the company. This can be demonstrated by the fact of the positive coefficient of the 1st-lag of the stock of R&D capital to sales ratio in levels and negative of the 1st-differences being the second coefficient higher in absolute value than the first one. This means a decrease of the R&D global process (slope=-0.331), and the change of profitability also shows a negative slope of -0.394 for the analysed period. This is the reason for the positive association between both variables.

The coefficient of the short term (1st-diff.) shows a negative contribution to profitability. This means that the R&D processes in the year are not contributing in a positive way to the profitability of the company. The R&D processes require a long term development to contribute in a positive and significant way to the profitability of the company.

Variable Cost Productivity. The process shows a positive contribution of the VCP to the profitability of the company in the short-term. The 1st-lag of the VCP was eliminated due to multicollinearity with the 1st-diff. VCP one, and less significance of its coefficient.

Investments. The process shows a negative contribution of the Investments to sales ratio to the profitability of the company in the short-term. The 1st-lag of the Investments was eliminated due to multicollinearity with the 1st-diff. Investments, and less significance of its coefficient.

	Fixed Effects OLS	Sys GMM-2	Sys GMM-2 robust
Profit (1st-Lag)	0.518 (21.890)	0.821 (787.74)	0.824 (40.860)
Market Situation (1st-Lag)	-6.538 (-4.290)	-7.078 (-53.700)	-6.341 (-2.880)
Market Situation (1st-Diff.)	38.003 (3.810)	30.561 (51.920)	28.094 (2.890)
Sales (1st-Lag)		0.162 (24.240)	
Sales (1st-Diff.)	4.702 (7.270)	2.773 (153.130)	3.538 (2.470)
R&D (1st-Lag)	-7.330 (-6.400)	0.125 (4.420)	
R&D (1st-Diff.)	-14.370 (-12.490)	-16.345 (-394.190)	-16.225 (-5.660)
Productivity (1st-Diff.)	0.157 (7.860)	0.197 (106.76)	0.190 (6.760)
Investments (1st-Diff.)	-0.809 (-7.970)	-0.902 (-298.17)	-0.920 (-3.350)
constant	68.084 (4.840)	64.835 (54.470)	59.459 (2.940)
Nr Observations F-Statistic R-squared	1658 204.00 0.638	1658 3.79E+06	1658 349.75
Sargan (d.f.) Test for AR(1) Test for AR(2)		222.78 242 -6.83 -0.93	192.08 183 -6.53 -0.88
t-values in parentheses			

Table 3.5 The Profit-Cash Flow Model.

3.6.1a The Profit-Cash Flow Model. Panel unit root tests

Based on a pool data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the market situation (1st-lag and 1st-diff.) are non-stationary and they are integrated of order two, I(2). The research and development (1st-diff.) is non-stationary and it is integrated of order one, I(1). All the other variables are stationary, which are all I(0).

Based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the p-values at 1.0 and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 3b). We can state that the panel is a non-stationary one and the model must be re-estimated based on a first differenced variables model.

THE PROFIT-CASH FLOW MODEL - AUGMENTED DICKEY FULLER TEST.						
	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
π	-18.453	1.988				
π_1	-18.216	2.005				
g_1	-77.887	2.766	-56.377	2.454	-44.665	2.112
dg	-71.604	2.582	-58.669	2.381	-47.785	2.145
s_1	-17.725	2.018				
ds	-24.511	1.949				
r_1	-7.094	2.086				
dr	-10.047	1.375	-19.299	1.987		
dv	-31.291	2.004				
di	-31.643	2.053				
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					
We assume 4 lags, a constant and a trend						
Ho: there is a unit root in the time series (non-stationary)						
We reject the null hypothesis for all the time series, excepts (g_1, dg and dr)						

Table 3.6 The Augmented Dickey-Fuller test

3.6.1b The Profit-Cash Flow Model. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[97], but e-Views shows near a singular matrix, and it does not provide any outcome.

Based on a pooled data of the panel we have used the Engle and Granger test[98]. This is the residual-based test where in the first stage the cointegrating OLS regression of profit-cash flow on market situation (1st-lag and 1st-diff.), research and development (1st-diff.), and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1st lag of the residuals is performed. The outcome shows that

97 Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

98 Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 2, 251-276.

the t-statistic of -17.05 is more negative than the critical value of -4.70 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[99] Table 2 for N=4.

3.6.1c The Profit-Cash Flow Model. Vector error correction estimates

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. These long-term relationships are captured by the cointegrating equations. E-Views shows near a singular matrix and it does not provide any outcome. We have estimated the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegrating regression using a pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The ADF test for a unit root of the residuals of the cointegrating regression in levels shows a Durbin-Watson d-statistic of 0.003, and the residuals are non-stationary. In consequence, the cointegrating regression must be estimated in first differences and the error correction model in second differences. This is as follows:

- The cointegrating regression (t-values in parentheses):

$$\Delta\pi = \underset{(-7.33)}{-18.330}\,\Delta g\_1 + \underset{(3.61)}{45.073}\,\Delta dg - \underset{(-13.49)}{13.778}\,\Delta dr + \underset{(0.05)}{0.007} \qquad (3.6.2.1)$$

R-sq = 0.1695
F(3, 1552) = 105.57

- Augmented Dickey-Fuller test for unit root. Stationarity of residuals. Lags(4) and trend.
t-statistic = -20.010 is more negative tha the critical value of t = -3.410 at the 5% level and the null hypothesis of a unit root can be rejected.
Durbin-Watson d-statistic (7, 793) = 2.026.
The residuals are stationary

- The error correction model (t-values in parentheses):

$$\Delta\Delta\pi = \underset{(0.11)}{0.002}\,\Delta\Delta\pi\_1 - \underset{(-5.68)}{17\ 880}\,\Delta\Delta g\_1 + \underset{(2.20)}{27.606}\,\Delta\Delta dg - \underset{(-0.20)}{0.061}\,\Delta\Delta s\_1 + \underset{(8.54)}{5.932}\,\Delta\Delta ds$$

$$- \underset{(-9.73)}{14.611}\,\Delta\Delta r\_1 - \underset{(-9.75)}{14.683}\,\Delta\Delta dr + \underset{(7.29)}{0.102}\,\Delta\Delta dv - \underset{(-7.98)}{0.784}\,\Delta\Delta di + \underset{(1.11)}{0.141}\,ehat\_1 + \underset{(0.00)}{0.0006}$$

R-sq = 0.346
F(10, 1385) = 73.47 (3.6.2.2)

[99] Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157

The coefficient of the residuals is positive and non significant. This means that the dependent variable "Δπ" was below its equilibrium value in the period (t-1) and it will increase in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is 0.141, which is a very low amount and the speed of adjustment is very low.

The outcome of the error correction model in second differences show all the variables with a positive and significant contribution to the profit-cash flow, excepts the profit-cash flow (1^{st}-lag), the sales (1^{st}-lag), and the residuals (1^{st}-lag).

3.6.1d The Profit-Cash Flow Model. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that the apparent variable cost productivity (1^{st}-diff.) does not Granger cause the profit-cash flow "π" cannot be rejected, the F-statistic is lower than the critical value F(9, 3014) = 1.88 at the 5% level of confidence. This means that profit-cash flow cannot be predicted by the history of the apparent variable cost productivity (1^{st}-diff.). Additionally, the null hypothesis, that all the other variables, does not Granger cause the profit-cash flow is rejected. In consequence, the current profit-cash flow can be predicted by the market situation (1^{st}-lag and 1^{st}-diff.), the sales (1^{st}-lag and 1^{st}-diff.), the research and development (1^{st}-lag and 1^{st}-diff.), and the investment (1^{st}-diff.) (see Appendix 3b). These results indicate that the previous variables help in the prediction of the profit-cash flow, but it does not indicate causality in the common use of the term[100]

3.6.1e The Profit-cash flow Model re-estimation.

Due to the fact that we were using non-stationary data the outcome of the dynamic model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the dynamic models (see table 3.5). We will proceed to estimate the model in

100 EViews5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.

second differences due to the existence of the I(2) series. We will also show the outcome in first differences for comparison purposes.

Based on a panel data we have implemented the fixed and random effects OLS estimators and the Hausman test. It indicates that the random effects estimator has degenerated to a pooled OLS. The Newey-West[101] variance estimator produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity, and it computes the pooled OLS estimates for panel data sets. The outcome of the "newey2" HAC-Heteroskedasticity autocorrelation consistent covariance estimator shows that the coefficient of the profit-cash flow (1st-lag) is not significant. Due to this fact and the existence of 1st-lag variables, all the other estimates have been estimated by the MLE-maximum likelihood estimator.

Panel data	First Differences	HAC newey2 Pooled OLS robust	MLE Estimator	Second Differences	MLE Estimator
Profit-Cash Flow (1st-lag)	dπ_1	-0.037 [-1.59]		d2.π_1	
Market Situation (1s-lag)	dg_1	41.611 [3.76]	41.330 [3.40]	d2.g_1	4.812 [2.06]
Market Situation (1st-diff.)	ddg	67.931 [5.58]	65.703 [5.73]	d2.dg	31.682 [2.41]
Sales (1s-lag)	ds_1	-0.953 [-1.15]	-1.059 [-1.86]	d2.s_1	0.508 [1.96]
Sales (1st-diff.)	dds	0.223 [1.21]	0.275 [2.11]	d2.ds	4.478 [6.39]
R&D (1s-lag)	dr_1	-15.643 [-5.14]	-15.135 [-10.15]	d2.r_1	8.958 [7.95]
R&D (1st-diff.)	ddr	-18.154 [-7.69]	-18.156 [-18.01]	d2.dr	-4.441 [-3.06]
AVCP (1st-diff)	ddv	0.083 [5.53]	0.090 [6.44]	d2.dv	0.098 [6.56]
Investment (1st-diff)	ddi	-0.569 [-2.83]	-0.593 [-7.05]	d2.di	-0.632 [-6.20]
constant	cons	-1.719 [-4.52]	-1.717 [-4.15]	cons	-0.864 [-3.52]
Nr Observations		1504	1508		1307
F-Statistic		18.07			
R-squared					
LR chi2 (8)			433.76		312.31
Log likelihood			-4557.30		-4684.98
t-values in square brackets R&D = Research and development AVCP = Apparent variable cost productivity					

Table 3.7 The Profit-Cash Flow Model in first and second differences estimates.

[101] Newey, W.K. and West, K.D., 1987, "A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica*, 55, 703-708.

The outcome of the second differences MLE estimator, show a positive and significant contribution of all variables, with the exception of the research and development (1^{st}-diff.) and the investment (1^{st}-diff.) in second differences which show a negative and significant contribution to the profit-cash flow. This is consistent with the previous outcome of the model, and it offers a higher reliability than the first differences estimates.

In the second differences MLE estimation the market situation shows a positive and significant contribution of the long (1^{st}-lag) and short-run (1^{st}-diff.) coefficients. In the System GMM-2 estimation the market situation (1^{st}-lag) shows a negative coefficient. In the end, the linear combination shows a positive contribution, and this is better explained by the second differences estimation.

The research and development coefficients behave in the same way in the second differences MLE and the System GMM-2 estimation. The research and development (1^{st}-lag) shows a higher coefficient in absolute value than the (1^{st}-diff.) and the linear combination of both shows a positive contribution to the profit-cash flow.

The investment (1^{st}-diff.) shows a negative significant contribution to the profit-cash flow in the second differences MLE and the System GMM-2 estimators.

3.7 The Profit-Cash Flow Model. Industrial Sector Analysis.

As mentioned in the previous chapter, the determinants at the aggregate level are weak, therefore, we are going to control the sources of the heterogeneity at the sector level. To understand the underlying business processes at the industry group level which impact the profitability, we will introduce a set of binary dummy variables to identify the industry groups, denoted by D, in order to perform the econometric work. The binary or dummy variables are assuming values such as 1 if the company belongs to the related industry group, and 0 in the negative case.

The sectors have been defined adopting the latest GICS-Global Industry Classification Standard. This classification standard was launched in 1999 by Standard and Poor's and Morgan Stanley Capital International with the objective to facilitate the investment research and management process for financial professionals worldwide.

The period of our database covers from 1983 until 2002. As of December 2002, the number of sets at each level of aggregation is the following: 10 sectors aggregated from 23 industry groups, 59 industries, and 122 sub-industries. We have defined the dummies based on the 23 industry groups and have coded them with a four-digit number according to the GICS-Standard[102]. See Table 3.6 for the breakdown of the Industry Groups.

The model, including the set of dummies to identify each industry sector, will be as follows:

$$\pi_{it} = \alpha\, \pi_{i,t-1} + \beta_{1,i} D_i\, g_{i,t-1} + \beta_{2,i} D_i\, dg_{it} + \beta_{3,i} D_i\, s_{i,t-1} + \beta_{4,i} D_i\, ds_{it} + ..$$

$$+ \beta_{5,i} D_i\, r_{i,t-1} + \beta_{6,i} D_i\, dr_{it} + \beta_{7,i} D_i\, v_{i,t-1} + \beta_{8,i} D_i\, dv_{it}$$

$$+ \beta_{9,i} D_i\, i_{i,t-1} + \beta_{10,i} D_i\, di_{it} + \beta_{11,i} D_i + \varepsilon_{it} \qquad (3.7.1)$$

where:

Profit = π_{it} = EBITDA to Total Assets ratio

102 Standard & Poor's, 2002, "GICS-Global Industry Classification Standard". *S&P Analysts' Handbook*. McGraw Hill, New York

Market situation = g_{it} = ln(real GDP) = Natural logarithm of real GDP

Sales = s_{it} = ln(Sales) = Natural logarithm of net sales

Research & Development = r_{it} = Stock of R&D capital to Sales ratio

Apparent Variable Cost Productivity = v_{it} = ln(VCP) = Natural logarithm of VCP

Investments (Acquisitions,..) = i_{it} = Investment to Sales ratio

Dummies = D_i

Intercept = $\beta_{9,i} D_i$

Residuals = ε_{it}

After estimating the fixed and random effects OLS-Ordinary Least Squares and the Hausman test, we can see that the latter shows that the random effects estimator has degenerated to a pooled OLS, but the OLS estimation is inconsistent for a dynamic model, either for fixed or random effects. To estimate a dynamic model, needed due to the lagged dependent variables, we can use the First-differenced stacked IV-Instrumental Variables Anderson-Hsiao (Table 3.6), and the Difference and System Arellano-Bond GMM-Generalized Method of Moments (Table 3.7). The previous estimators can be implemented either for fixed or random effects, and the MLE-Maximum Likelihood estimator in the case of random effects[103] (Table 3.8), whereas it is inconsistent in the case of fixed effects.

All the above mentioned alternative models have been estimated and based on these grounds we can explain the specifics of the industry groups with significant parameters, and the relevant processes contributing to the profitability. These are:

Materials. The estimates show a positive contribution of the short-term of the market situation, of the productivity in a short and long-term, and a negative contribution of the short-term of the research and development, and of the Investments in short and long-term to the profitability of the company.

This is a very typical situation of the mature short-cycle businesses, where the lack of contribution of the short-term R&D and short and long-term investments is compensated by

[103] See Hsiao, C., 2003, "Dynamic Models with Variable Intercepts", *Analysis of Panel Data*, Cambridge University Press, 4, 70.

the productivity actions to improve the profitability.

The Net Sales and EBITDA were growing in a cyclical way reaching a maximum on the year 2000 and the Sales were dropping 8.9%, and EBITDA 28.8% from the year 2000 to the 2002.

Capital Goods. The outcome shows a positive contribution of the short-term of the market situation, of sales, of the short and long-term of the productivity, and a negative contribution of the long-term of the market situation and of the short and long-term of the investments to the profitability of the company.

This industry group is a mature long-cycle business, where we find sales and productivity compensating the lack of contribution of the short and long-term investments to the profitability. It is very disappointing that we cannot find any significance of the R&D processes in this industry group.

The Net Sales were steadily growing reaching a maximum in the year 2000 and they remain at the same level till 2002, and the EBITDA was growing to the maximum in the year 2000 and was dropping 6.9% from the year 2000 to the 2002.

Automobile & Components. The estimates show a negative contribution of the short-term research and development, and of the short and long-term of investments to the profitability of the company as well.

General Motors improved productivity a lot, whereas Ford Motor was struggling to control costs during this difficult time of weak demand. The reality was that the big three American automakers were losing market share against the foreign imports.

The Net Sales were continuously growing from 1995 till 2002, and the EBITDA reached a maximum in the year 2000 and was dropping a 55.5% from the year 2000 to the 2002.

Consumer Durables & Apparel. The outcome shows a positive contribution of the short-term sales, of the long and short-term productivity, and a negative contribution of the short and long-term investments to the profitability of the company.

This is very typical of the short-cycle businesses where the short-term sales and productivity compensate for the negative contribution of the short and long-term investments to the profitability.

The Net Sales were continuously growing from 1995 till 2002, and the EBITDA was reaching a maximum in the year 2000, and it remained constant till the year 2002.

Media. The outcome shows a positive contribution of the short-term sales, of short and long-term of productivity, and a negative contribution of the short-term investments to the profitability of the company.

It is clear that short-term sales and productivity were compensating the negative contribution of the short-term investments to the profitability.

Net Sales were continuously growing from 1995, until a maximum in the year 2000 and dropped 19.6% from the year 2000 to the 2002. The EBITDA was growing reaching a maximum in the year 1999, and was dropping 33.4% from the year 1999 to the 2002.

Food, Beverage and Tobacco. The estimates show a negative contribution of the short-term investments to the profitability of the company.

Net sales were steadily growing from 1995 till 2001, with a drop of 4.3% from 2001 to 2002, and EBITDA was always growing conveniently, even in 2002. The outcome does not show any significance of the productivity actions to compensate the negative contribution of the investments.

Health Care Equipment & Services. The outcome shows a positive contribution of the short-term of sales and productivity, of the long-term of productivity and a negative contribution of the short-term research and development and of the short and long-term of investments.

Net Sales and EBITDA were continuously growing for the period 1995 till 2002, but the Companies were very clearly acting in short-term sales and in productivity to compensate the negative contribution of the short-term research and development and of the investments.

Pharmaceuticals and Biotechnology. The estimates show a positive contribution of the market situation, of sales and of productivity, and a negative contribution of the investments to the profitability of the company.

It is important to remark the positive contribution of the long-term of sales, which is clearly positively associated with the research and development, as shown in the previous chapter. Net sales and EBITDA were consistently growing for the period, but the EBITDA was dropping at 9% in 2002 vs 2001.

The high significance of the Sales variable indicates that there is a real need to get market coverage, and it is a fact the specialization by therapeutic areas of the larger companies. The main priorities for the companies are to get market share, feeding patents, and protection against generics to maintain the high market share in their own area of leading research.

Software and Services. The outcome shows a positive contribution of the short-term of sales and productivity, and a negative contribution of the short-term market situation, of the short-term of research and development, and of the short and long-term of investments.

The Sales and EBITDA were continuously growing for the period 1995 till 2002, and the short-term push in sales and productivity compensates for the negative contribution of the short-term R&D, and of the investments to the profitability.

Technology Hardware, & Equipment. The estimates show a positive contribution of the short-term market situation, of the short-term sales, and of the short and long-term productivity, and a negative contribution of the long-term market situation, of the short-term of research and development, and of the short and long-term of investments.

The Sales and EBITDA were growing from 1995 to a maximum in the year 2000, and after the internet stocks crash the sales dropped 32.8%, and EBITDA 55.1% from 2000 to the 2002 respectively.

The behaviour of the companies for the segment is quite similar to the Capital Goods one, trying to compensate for the negative contribution of the research and development and of the investments by the increase of the short-term sales and of the short and long-term productivity.

Telecommunication Services. The outcome shows a negative contribution of the long-term of the market situation, of the productivity, and a positive contribution of the long-term of the sales to the profitability of the company. These results are quite weak for two reasons: First, these results come from an estimation and are not validated by the three estimators, and second, the evolution of the industry group figures is quite disappointing.

The net Sales reached a maximum in the year 2000, and were dropping 20.2% from 2000 to the 2002. The EBITDA was growing reaching a maximum in 1999 and dropping 16.6% from 1999 to the 2002.

As a summary of the different Industry Groups, we can show a graph of the evolution of the compound annual average growth rate of the Net Sales and the EBITDA for the period from 1995 to 2000.

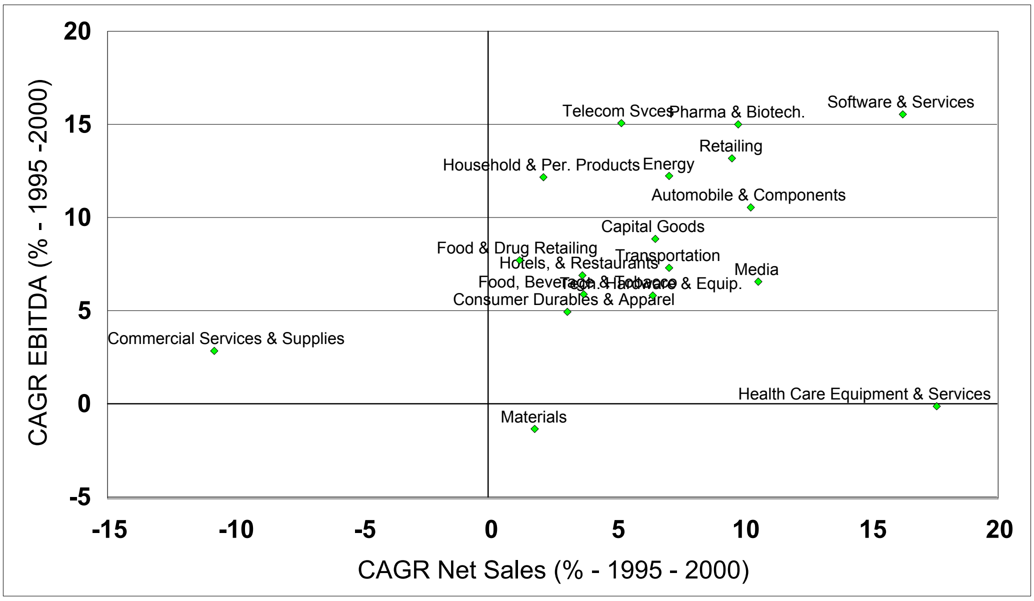


Figure 3.1 CAGR Net Sales against CAGR EBITDA by Industry Groups for the period 1995-2000.

The Software and Services, Pharmaceuticals & Biotechnology, and Telecommunication Services show the highest Net Sales and EBITDA growth. After a long prosperous period of economic activity, the Software and Services, as well as the Telecom Services, were identified by the firms of the other industry groups at the end of the period as the sources of productivity to improve processes[104], internal communication, and better systems to interface with customers. This was done with the objective to create a competitive advantage against competitors and increase profitability[105] for the analysed period 1995-2000.

[104] See Clarke, T., and Clegg S., 1998, *Changing Paradigms: The transformation of Management knowledge for the 21st century*, Chapter 1. Paradigms: The Implications of Information Technology, 29-34, and Chapter 3. Digitalization, 145-190, HarperCollinsPublishers, London.

[105] See Cohan, P., 2000, "How e-Commerce creates competitive advantage", *e-Profit*, Amacom, New York, 4, 69-94.

GICS	Group	Market Situation		Sales		Res.& Development		Productivity		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials.1510		92.274				-58.989				-4.841
			(1.910)				(-1.830)				(-3.350)
3	Capital Goods. 2010				14.606				0.209	-7.537	-6.286
					(4.120)				(3.040)	(-1.880)	(-2.810)
9	Media.2540				26.290			4.477	2.807		-8.444
					(2.310)			(3.070)	(2.310)		(-2.710)
12	Food, Beverage and										-13.419
	Tobacco. 3020										(-4.020)
14	Health Care Equipment						-40.043			-17.518	-17.966
	& Services. 3510						(-2.750)			(-2.130)	(-2.300)
15	Pharmaceuticals &				21.289					-10.655	-10.811
	Biotechnology. 3520				(2.560)					(-3.370)	(-5.500)
20	Software &		-187.275		20.641		-30.089		0.324	-8.012	-6.196
	Services. 4510		(-2.760)		(3.170)		(-2.710)		(2.670)	(-3.910)	(-3.950)
21	Technology Hardware				17.843			0.446	0.661	-1.534	-1.106
	& Equipment. 4520				(9.570)			(2.100)	(5.180)	(-4.320)	(-5.020)
	t-values in parentheses										

Table 3.8 First-differenced stacked instrumental variables Anderson-Hsiao estimation.

(204 Companies, 582 Observations, and Period: 1995-2002)

GICS	Group	Market Situation		Sales		Res.& Development		Productivity		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials.1510		33.489				-69.629			-8.421	-8.257
			(2.570)				(-6.830)			(-6.030)	(-6.570)
3	Capital Goods. 2010				11.223			0.297	0.332	-4.719	-3.979
					(5.230)			(3.260)	(3.480)	(-2.170)	(-2.590)
6	Automobile &						-143.573				
	Components. 2510						(-4.610)				
12	Food, Beverage and										-9.641
	Tobacco. 3020										(-9.190)
14	Health Care Equipment							0.131	0.164		
	& Services. 3510							(0.790)	(1.570)		
15	Pharmaceuticals &				21.063					-7.826	-7.716
	Biotechnology. 3520				(4.890)					(-4.540)	(-9.090)
20	Software &				11.033		-23.635	0.497	0.559	-4.904	-3.904
	Services. 4510				(3.390)		(-3.970)	(2.180)	(3.000)	(-3.530)	(-3.480)
21	Technology Hardware				6.118		-15.689	0.543	0.627	-1.629	-1.421
	& Equipment. 4520				(3.360)		(-7.540)	(4.870)	(5.940)	(-5.980)	(-5.520)
	t-values in parentheses										

Table 3.9 Arellano-Bond. System GMM-2 robust estimation.

(210 Companies, 799 Observations, and Period: 1999-2002)

GICS	Group	Market Situation		Sales		Res.& Development		Productivity		Investments	
		1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.	1st-lag	1st-diff.
2	Materials.1510	-0.573 (-3.630)					-59.867 (-4.100)	0.281 (2.370)	0.229 (2.890)	-8.069 (-4.530)	-8.050 (-7.290)
3	Capital Goods. 2010	-0.896 (-6.200)	51.175 (2.770)		9.165 (5.730)			0.301 (3.710)	0.265 (4.720)	-4.911 (-4.270)	-4.581 (-4.280)
6	Automobile & Components. 2510						-143.927 (-3.490)			-15.129 (-2.210)	-13.362 (-2.730)
7	Consumer Durables & Apparel. 2520				18.096 (3.630)			0.372 (2.300)	0.277 (2.450)	-14.682 (-2.300)	-11.760 (-2.400)
9	Media.2540	-15.819 (-5.340)	533.614 (5.170)	10.478 (4.690)	19.491 (3.960)	327.304 (4.590)	306.489 (4.560)		-1.105 (-4.520)		
12	Food, Beverage and Tobacco. 3020									-18.390 (-4.030)	-14.205 (-6.040)
14	Health Care Equipment & Services. 3510				6.414 (2.590)		-22.794 (-2.600)	0.584 (3.920)	0.422 (3.880)	-11.150 (-3.900)	-9.281 (-4.600)
15	Pharmaceuticals & Biotechnology. 3520	-2.201 (-5.000)	90.015 (3.440)	1.537 (3.140)	13.154 (6.810)			0.374 (2.690)	0.417 (4.490)	-5.301 (-3.890)	-4.179 (-5.030)
20	Software & Services. 4510	-1.240 (-3.700)		1.075 (2.710)	11.717 (5.680)		-18.308 (-5.160)	0.821 (6.610)	0.739 (8.770)	-5.272 (-7.180)	-3.893 (-7.710)
21	Technology Hardware & Equipment. 4520	-0.880 (-7.810)	63.022 (3.740)		9.549 (10.120)		-10.807 (-8.170)	0.696 (10.170)	0.615 (12.660)	-1.754 (-8.250)	-1.408 (-11.340)
22	Telecommunication Services. 5010	-17.275 (-2.210)		15.122 (2.320)				-0.837 (-3.330)			

t-values in parentheses

Table 3.10 MLE-Maximum likelihood random effects estimation.
(218 Companies, 1577 Observations, and Period: 1995-2002)

3.8 The Dilemma between investing in R&D or selective Investments.

The enclosed matrix shows the averages EBITDA to Total Assets in percent as a function of the Stock of R&D to Sales and the Investment to Sales ratios for the analysed sample in the research and the year 2002. The main objective is to show the differences in Profitability between investing in building a stock of R&D or in selective Investments (P&E, Acquisitions, etc…).

The highest EBITDA to Total Assets is 18.53%. It corresponds to the companies with a Stock of R&D Capital to Sales between Q3-third quartile and the Median and the Investment to Sales ratio between the Q3-third quartile and the Median. The profitability decreases for higher values of the Stock of R&D Capital to Sales and of the Investment to Sales ratios.

The highest amounts of the Stock of R&D to Sales and Investments to Sales ratios provide an 18.05% EBITDA to Total Assets and it is filled with companies from the Health Care Equipment & Services, Pharmaceuticals & Biotechnology, Software and Services, and Technology Hardware and Equipment. This is slightly lower than the 18.53% shown at the Third Quartiles and much higher than the 9.12% at the lowest levels.

For the whole sample, it is clear that the Companies building a high stock of R&D capital and selectively high levels of Investments can enjoy 8.9 percent points (18.05-9.12) higher EBITDA to Total Assets. This is due to the competitive advantage that these investments are bringing to the Company against the competition with the lowest amounts in R&D and Investments.

Stock of R&D Capital to Sales ratio (r.)

Investments to Sales ratio (i)		0	Min.=0.0038 <r< 0.0752=Q1	r<0.2113 Median	r<0.5295= Q3	r<2.9201= Max.
	Min.=-6.9164 <i<0.0055= Q1	9.38	9.12	13.15	11.78	-2.12
	i<0.1004= Median	15.81	16.84	16.39	13.9	10.08
	i<0.2118= Q3	16.97	15.88	13.5	18.53	12.18
	i<6.1596= Max.	12.65	10.02	13.7	12.73	18.05

Table 3.11 EBITDA to Total Assets ratio for the year 2002.

The row corresponding to the lowest level of Investments shows how the EBITDA to Total Assets ratio grows from 9.12 to 13.15 and drops to –2.12%. This shows that very high levels of Stock of R&D Capital to Sales do not provide any additional competitive advantage increasing the Profitability of the Company. This result is in line with Garnier's (2008)[106] experience in the Pharmaceutical Industry. His recommendation is to break-up the large R&D organizations into small cross disciplinary groups focused by disease in order to gain productivity, passion for their research, knowledge and results. In other words, high R&D organizations may fail on productivity.

The column corresponding to a nil investment in the Stock of R&D to Sales shows how the EBITDA to Total Assets grows from 9.38 to 16.97 and then drops to 12.65%. The arguments for this final drop can be found below.

We have two explanations of the drops of the EBITDA to Total Assets at the highest

[106] Garnier, J-P., 2008, "Rebuilding the R&D Engine in Big Pharma", *Harvard Business Review*, 68.

levels of Stocks of R&D to Sales and Investment to Sales. These are:

1. The level of Investments has a saturation level for the Company and further Investments do not provide any competitive advantage, due to diseconomies of scale and in consequence the EBITDA to Total Assets reaches a maximum and finally it drops.
2. The increase of the Profitability is associated to a moderate growth of the Investments and conservative accounting. If the growth of the Investments is high and the accounting is conservative the Profitability drops[107]

3.9 Conclusion

We have presented the analysis of the main variables and processes impacting the Profit-Cash Flow of the Companies. The model has been specified to identify how critical the short and long-term of the different considered variables are. This objective has been widely achieved and, at the same time, an explanation of the significance and impact of every variable on the Profit-Cash Flow has been provided.

It is important to emphasize the significance of the Market situation, Sales and Research and Development processes in the short and long-term, as well as the significance of the Productivity and Investments in the short-term. These significances have been widely explained to clarify to the Management Community that the Sales and R&D processes are very important in the short and long-term. It is also important the fact that the Investments and Productivity in the long-term have not been found significant to the profitability of the company.

The Augmented Dickey-Fuller test for a unit root of each variable and the Fisher-type test have been performed, and they show that the panel is non-stationary and the model needs to be re-estimated.

Additionally, the Johansen Cointegration test did not provide any outcome related to the number and the final cointegrating equations to be considered, the Engle-Granger 2-step

[107] See Rajan, M., Reichelstein, S., and Soliman, M., 2006, "Conservatism, Growth, and Return on Investment", *Stanford University, Graduate School of Business.*

method confirmed the details of the final estimation in second differences, and the VECM-Vector error correction models estimation did not provide any outcome.

Finally, the model has been re-estimated with all the variables in second differences. The MLE-maximum likelihood estimator in second differences is consistent and the outcome shows the profit-cash flow (1^{st}-lag) not significant, all the other variables with a positive and significant contribution to the profit-cash flow, excepts the research and development (1^{st}-diff.) and the investment (1^{st}-diff.) with a negative and significant contribution to the profit-cash flow. See Section 7.1.3 for a fuller discussion of the conclusions and Appendix 3b for the details of the estimates.

The sector analysis has been included to demonstrate the importance of understanding the particular characteristics of every one. The same kind of analysis can be done at the firm level and identify the different policies of the companies.

The analysis of the dilemma between R&D or selective Investments has been provided for the analysed panel for the year 2002. The highest profitability is shown at the 3^{rd} quartile of the R&D and Investments. The causes of the decrease of profitability for the largest amounts of R&D and Investments have been widely explained.

As a consequence of the learning provided by the outcome of the econometric models a very practical list of long and short-term actions has been provided to keep on a track leading to a successful management of the companies. See Appendix 10.

Chapter 4

Corporate Risk

4.1 Introduction

The Risk Models have been mainly developed in the Banking Operations, and the risk theories[108] are covering the Market, Credit Risk, and Integrated Models. It is important to describe the three areas before we start describing the main focus of our research:

4.1.1 The Market Models[109] deal with the estimation and inference of the VaR-Value at Risk for the main financial instruments (shares, bonds, options, futures, etc..), and the main areas of research relate to the alternative ways of calculation like the Marking to Future, CAViar-Conditional Autoregressive Value at Risk, and CVaR-Conditional VaR.

4.1.2 Credit Risk Models[110] deal with the Default Probability[111] of Bonds Payment, Credit Scoring[112], etc.. The main methods are CreditMetrics (JP Morgan), CreditRisk+ (Credit Suisse), CreditPortfolioView (Wilson and McKinsey), and CreditMonitor (KMV). The most important rating agencies are Moody's, Standard & Poor's, and Fitch Ratings, and the main areas of research deal with migration risks, interest rates from deterministic to stochastic, non linear products like options, etc..

4.1.3 Integrated Market and Credit Risk Models. The key metric is TvaR-Total Risk, the research is very recent and the main models are the Structural Model by Barnhill and Maxwell (2002)[113], and the Reduced Model by Jarrow and Turnbull (2000)[114] and Jarrow (2001).

---

108 McNeil, A.J., Frey, R. and Embrechts, P., 2005, *Quantitative Risk Management*, Princeton Series in Finance, 1, 2-3.

109 Peña, J.I., 2002, *La Gestión de Riesgos Financieros de Mercado y Crédito*, Financial Times-Prentice Hall, 1, 3-115

110 Crouhy, M., Galai, D., and Mark, R., 2000, "A comparative analysis of current credit risk models", *Journal of Banking and Finance*, 24, 59-117.

111 Löffler, G. and Posch, P.N., 2007, *Credit Risk Modelling using Excel and VBA*, Wiley Finance.

112 Mays, E., 2004, *Credit Scoring for Risk Managers – The Handbook for Lenders*, Thomson – South Western.

113 Barnhill, T.M. and Maxwell, W.F., 2002, "Modelling correlated market and credit risk in fixed income portfolios", *Journal of Banking and Finance*, 26, 347-374.

114 Jarrow, R. and Turnbull, S., 2000. "The intersection of market and credit risk", *Journal of Banking and Finance*, 24, 271-299.

This area of research integrates the market and credit risk models. It evolves as a natural way to get a better management of the risk. The main benefit is that the variables are taking in account both risks and also the interaction between them.

4.2 Key items of Corporate Risk Management

All the previous models are built based on the perspective of the Rating Companies and the needs of the Financial Institutions, but at this point it is worth emphasizing the significance of the same risk models under the perspective of the companies. We can summarize the key items of Risk management for a Company as follows:

4.2.1 Market Risk: Exposed to fluctuations in the following variables:

- Global activity
- Foreign exchange currency rates
- Commodity prices
- Interest rates
- Equity prices of available-for-sale equity securities in which the Company invested.
- Hedge positions
- Regulatory issues/legal risk. Environmental potential impact

4.2.2 Credit Risk:

- Own Probability of payment default to Suppliers-Creditors
- Probability of payments default by Clients-Debtors. Credit monitoring and control.
- Own credit rating
- Clients-Debtors credit ratings

4.3 Market and Credit Risk Models. Research Objectives

There is a large literature on market and credit risk models and the areas for the risk management control and improvement. The current main issues are related to the methodology of the Rating Agencies to get the company ratings, and the capability to predict the financial distress. We will be dealing with three models trying to address certain current issues. The main objectives of our research are:

4.3.1 Market Risk – Net Income Variability Model

We assume that the Company Risk[115] is the uncertainty of Income caused by the related Industry Group activity combined with its own characteristics and performance. Company Risk is generally measured by the variability of the company's Net Income over time. The Net Income variability can be measured by the standard deviation of the historical Net Income series. It assumes that the Net Income's evolution can be described by a trend coming from a systematic operational growth, and an additional noise due to the unsystematic fluctuations. We will take an integrated approach covering all the variables of a complete Profit and Loss Income Statement.

The objective is to identify the main variables/causes of variability to avoid unsystematic changes in the forecasted Net Income and their impact on the results of the companies positively or adversely.

4.3.2 Credit Risk – Default Probability Model

The main objective is to analyse the significance of the industry variables, based on a Panel composed by the S&P 500 Companies with 20 years of ratings and data, to make an assessment and to identify alternative variables for the default probability.

4.3.3 Credit Risk – Bankruptcy Model

The main objective is to regress and test the industry variables against a proposed dependent variable, to analyse the capability of the credit ratings variables to predict bankruptcy, and to show how the parameters of those variables are impacted.

4.4 Market Risk. Net Income Variability Model

4.4.1 Previous research on Earnings Variability Models

Firstly, we cannot mix the Implied Black-Scholes Volatilities in the Econometrics Derivatives, and the Models of Changing Volatility with the Earnings Variability Models. The

[115] See Brigham, E., and Gapenski, L., 1997, "Business Risk", *Financial Management: Theory and Practice*, Ch. 6 and 10.

former are essentially based on the random changes of the share prices, and the latter are based on the Net Income Variability for the year.

Secondly, the main studies on Earnings Variability[116] based on Beta Prediction Models are due to Ball and Brown (1968), Beaver (1970), Lev (1974), Hochman (1983), and Mandelker and Rhee (1984).

The best research covering a similar approach to ours is Officer (1973)[117]. He studied the variability of the market factor and for three different periods (Feb.,1897 until July, 1914 with the 12-stock Dow-Jones Industrial; Jan., 1915 until Jan, 1926 with the 20-stock Dow-Jones Industrial; and Feb., 1926 until June, 1968 with the Fisher Index, and an Arithmetic Index for the period June, 1968 until June, 1969). The time series were constructed by estimating the trailing 12 months of data, then the first month was dropped and the thirteenth month was added to obtain a new estimate. Each estimate was centered at the midpoint. A very important finding is the evidence that the variability of the market factor can be related to the business fluctuations as shown by the variability of the industrial production.

Our research differs in two aspects when compared with the Officer's research above mentioned. First, we are not analysing random variables and we need to de-trend the series, because we know in advance that there is a trend embedded in the evolution of the variables. Secondly, we are applying these variables to an econometric empirical estimation to identify the components of business risk to the Companies, not to the Stock Exchange. To the best of our knowledge, we do not know of any article dealing with these variables to evaluate the components of company risk in this manner.

4.4.2 **Data and Resources**

The data used in the research come from several sources. Company data are from Standard & Poor's 500 Compustat – North America (500 Companies). After excluding Banks, Diversified Financials, Insurance, and Real Estate the sample covers 330 Companies, 20 years by cross-section (1983-2002). Industry classification is updated to the new GICS-Global

116 See White, G., Sondhi, A., and Fried, D., 1998, "Earnings Variability", *The Analysis and Use of Financial Statements*, 18, 987-1018

117 See Officer, R., 1973, "The Variability of the Market Factor of the New York Stock Exchange", *Journal of Business*, Vol. 46, No 3, 434-453.

Industry Classification Standard (23 Industry groups in total, and after omitting the financial groups 19 groups). The total number of observations in the panel is 3003.

Net sales have been adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes for every sector supplied by the US Bureau of Labour Statistics, and all the other variables by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

Software used is Stata-SE, release 8.0.

4.4.3 The Net Income Variability Model

We build all the variables estimating the trailing standard deviation of the last five years[118] related to the linear adjustment of each one of the variables belonging to the Profit and Loss Income Statement. The reason to take the last five years period is to indicate clearly that these are not random variables and that what we want to describe and regress are the causes of the unsystematic variability. If we were calculating the volatility (std. deviation) of a variable for a given period without de-trending it would be wrong, because we know that there is a trend embedded in the evolution of the variables. The systematic variability (trend) is mainly due to the global market effects. Trying to isolate the unsystematic variability we need to de-trend with the five years linear adjustment and assign the estimate to the last year.

The NIV-Net Income Variability Model (See Appendix 4a) is:

$$\sigma_{ADJNI,it} = \alpha_i + \sum \beta_{X,i}\, \sigma_{X,it} + \varepsilon_{it} \qquad (4.4.3.1)$$

where:

$\sigma_{ADJNI,it}$ = Trailing Standard Deviation of the five years linear Adjusted Net Income

$\sigma_{X,it}$ = Trailing Standard Deviation of the five years linear adjusted exogenous variables

α_i = Individual effect or Intercept

ε_{it} = Errors or residuals term

118 Reilly, F., and Brown, K., 1997, "Risk Analysis", *Investment Analysis and Portfolio Management*, 5th Ed., The Dryden Press, 12, 398.

The enclosed table shows the Profit & Loss Income Statement variables considered as independent and dependent in the model.

Profit & Loss Income Statement variables	S&P Mnemonic	Std. Deviation Variable
Sales	SALE	σ_1
Cost of Goods Sold	COGS	σ_2
Selling General & Administrative Expenditures	XSGA	σ_3
'EBITDA	OIBDP	
Depreciation & Amortization	DP	σ_5
EBIT	EBIT	
Operating Profit	OIADP	
Interest Expenditures	XINT	σ_8
Non Operating Income/Expenditures	NOPI	σ_9
Special Items	SPI	σ_{10}
Foreign Currency Adjustment	FCA	
Pretax Income	PI	
Total Income Taxes	TXT	σ_{13}
Minority Interest	MII	σ_{14}
Income before Extraordinary Items & Discontinued Operations	IB	
Extraordinary Items	XI	σ_{18}
Discontinued Operations	DO	σ_{19}
Net Income	NI	
Preferred Dividends	DVP	σ_{16}
Savings due to Common Stock Equiv.	CSTKE	σ_{17}
Adjusted Net Income (Dependent Variable)	NIADJ	σ_{ADJNI}

Table 4.1. The Net Income Variability Model variables

4.4.4 Summary of Results

We started running the fixed and random effects estimators, and the Hausman test outcome with chi2(table)=22.36 < Statistic=163. This means that the null hypothesis of "Ho: Individual effects are uncorrelated with other regressors" is rejected, and the consistent estimator is a fixed effects OLS-Ordinary Least Squares.

The Total Income Taxes (σ_{13}), Minority Interest (σ_{14}) and Preferred Dividends (σ_{16}) variables were dropped from the regression outcome due to low significance.

With the model we want to advice Corporate Management of the business processes which have been historically the reasons to out- or under-perform the targets. It is clear that the model is a forecasting one and we did not eliminate the variables due to high multicollinearity. It may not affect the forecasting performance of a model and may even be possible to improve it[119].

After conducting the fixed effects OLS estimator and dropping the non significance variables, we can describe and discuss the following results:

The standard deviation of the extraordinary items, special items, discontinued operations, non operating income/expense, sales and depreciation show a positive and significant contribution to the standard deviation of the adjusted net income.

The standard deviation of the selling general and administrative expenditures, cost of goods sold, interest expenditures and savings due to common stock equivalents show a negative and significant contribution to the standard deviation of the adjusted net income.

Conducting a Dickey-Fuller test for a Unit Root, we got: the Critical Value (5%)=2.86 < Statistic=7.53. This means that the null hypothesis "Ho: there is a unit root. Non-stationary residuals" is rejected; the residuals are stationary and the spurious regression will not be a problem.

Extraordinary Items, Special Items, Discontinued Operations, and Non Operating Income/Expense show a positive contribution to the variability of the Adjusted Net Income and the highest level of significance of the parameters. This means that the Variability of Net Income is better explained by unusual items in nature and that it occurs infrequently.

In a second group, we can find Selling General and Administrative Expenditures, Sales, and Cost of Goods Sold which are related to the Operations of the Business, and which show a low level of significance of the parameters to the variability of the Adjusted Net Income. The fact that all the operational variables are in the second group means that in the analysed period it has been easier for the companies to act in the unusual items than in the operations (Sales, Variable Cost Productivity, etc..) to contribute to a positive variability of

[119] Ramanatahan, R., 1997, "Multicollinearity and Forecasting Performance", *Introductory Econometrics with Applications*, 4th Ed., The Dryden Press, 5, 236.

the Adjusted Net Income.

Profit & Loss Income Statement variables (S&P Mnemonic)	Std. Deviation Variable	Fixed Effects OLS
Sales (SALE)	σ_1	0.256 (15.91)
Cost of Goods Sold (COGS)	σ_2	-0.240 (-13.38)
Selling General & Administrative Expenditures (XSGA)	σ_3	-0.427 (-16.26)
Depreciation & Amortization (DP)	σ_5	0.124 (3.29)
Interest Expenditures (XINT)	σ_8	-0.600 (-5.13)
Non Operating Income/Expenditures (NOPI)	σ_9	0.820 (18.49)
Special Items (SPI)	σ_{10}	0.890 (80.27)
Extraordinary Items (XI)	σ_{18}	0.875 (87.72)
Discontinued Operations (DO)	σ_{19}	0.357 (21.02)
Savings due to Common Stock Equivalents (CSTKE)	σ_{17}	-0.662 (-6.64)
Constant		-6.707 (-2.06)
Nr Observations F-Statistic R-squared		3003 6243.88 0.9441

t-values in parentheses

Table 4.2 The Net Income Variability Model outcome.

We could make a long list of all the items impacting on the unusual ones. As a summary we can mention:

- Accounting adjustments: Adjustments applicable to prior years
- Accounting adjustments: Adjustments for Domestic & International companies
- Sale of properties: Discontinued operations of foreign companies, etc..
- Dividend Income
- Equity in earnings of a non-consolidated subsidiary
- Any significant non-recurring items

- Restructuring expenditures charged to Headquarters
- Tax carry-forwards and carry-backs, etc…

The main incentives to capitalize on these unusual items have been the following:

- Short-term pressure from Shareholders to get the results
- The increasing importance of Mergers & Acquisitions to grow the business, and being an easy source of extraordinary and special items to take into account
- Restructuring operations to Puerto Rico, Mexico, and recently to China
- Management being eager to grow the business and professionally changing in businesses, through so many changes that they lack the specialized knowledge of the sector to grow the business and it is easier under a global management label to be focused on Earnings Manipulations (selling operations to get the results,...)
- Management compensation through stock options linked to share price
- Permissive reduction of the role of internal Auditors in Large Companies
- Career concerns, when the teams are managing at the edge of legality. Being operationally focus could get you fired
- When the Management target is to get a promotion in less than two years, it is easier to act in unusuals than in the business operations

All the previous items are the most common to encourage Management to push short-term actions to increase Net Income to any price

4.4.5 Conclusion

Our research takes the Officer (1973) approach of using a standard deviation which moves forward through time measured over a subsample and, at the same time, we correct the data taking care of the linear trend of the different variables, which provides a more accurate measurement of the standard deviation.

The transformation of variables has allowed us to regress all the standard deviations of the profit and loss variables against the standard deviation of the adjusted net income to determine the contribution of the different variables.

The Extraordinary items, Special items, Discontinued operations and Non operating income/expenditures have shown the highest level of significance to the bottom line adjusted net income for the analysed period 1983-2002. The importance of the acquisition processes and the actions in the non operating variables to get results through unusuals are the main explanations for the results of our empirical research.

4.5 Credit Risk. Default Probability Model

4.5.1 Previous Research on Default Probability and Bankruptcy Models

We have identified the first studies on default probability and bankruptcy prediction models. They were setting the ground for a large literature on this subject. The summary is the following:

Beaver (1966) [120] used a paired-sample design to analyse the differences between accounting ratios. His approach was univariate and the higher discrimination power was provided by the cash flow to total debt ratio. In consequence, it was the best predictor of failure five years before failure occurred. He found that the ratio distributions differed among industries: the ratios of returns become more stable as larger the companies with the implication that larger firms are more solvent than smaller ones even if the ratios are the same, and larger companies have a lower probability of failure.

Beaver was working with a sample of failed and non-failed companies. The data was showing a high degree of consistency, and the empirical evidence indicates that the ratio analysis can be useful in the prediction of failure for at least five years before failure.

Altman (1968)[121] studied the characteristics of bankruptcy companies and developed a model based on a Multiple Discriminant Analysis. He found a high discriminant and accuracy power with the MDA Model to predict bankruptcy and he used five different financial and economic ratios as predictive variables, out of the twenty-two ratios which were initially considered.

---

[120] See Beaver, W., 1966, "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, Vol. 4, 71-111.

[121] See Altman, E., 1968, "The Prediction of Corporate Bankruptcy: A Discriminant Analysis", *Journal of Finance*, Vol. 23, No 1, 193-194.

The five variables are measures of corporate liquidity, profitability, solvency and capital turnover. He emphasized that the investigation revealed that the deterioration in the ratios was mainly shown in the third and second year prior to bankruptcy.

Ohlson (1980)[122] developed three models based on the McFadden's conditional logit model[123] and he used the nine independent variables that mostly appeared in the literature. The three models were based on the years of prediction. Model 1 predicts bankruptcy within one year. Model 2 predicts bankruptcy within two years, and Model 3 predicts bankruptcy within one or two years. He identified four factors statistically significant to assess the probability of bankruptcy. These were: size, financial leverage, performance measure, and a measure of current liquidity.

Ohlson´s contribution is also very important in terms of challenging previous work on the basis of the information data available, and the fact that significant improvements in the prediction of bankruptcy require additional predictor variables.

Beaver (1968)[124] studied the significant association between changes in the market prices of shares and the prediction of failure. The empirical evidence demonstrates that the unexpected deterioration in the company solvency induces lower ex post returns for the failed firms. It is also demonstrated that the Investors forecast failure sooner than any of the ratios, and they use them to adjust the prices of shares to the new solvency situation. However, it seems that they do not only use ratios for their financial decisions.

Dambolena and Khoury (1980)[125] studied a sample of failed and non failed firms developing a discriminant function model that incorporates financial ratios and the stability ratios of some of them. They have finally validated three classifications at 1, 3 and 5 years, which included the ratios of net profits to sales, net profits to total assets, fixed assets to net worth, funded debt to net working capital, total debt to total assets, and the standard deviations of inventory to net working capital, and of the fixed assets to net worth.

---

[122] Ohlson, J., 1980, "Financial Ratios and the Probabilistic Prediction of Bankruptcy", *Journal of Accounting Research*, Vol. 18, No 1, 109-131.
[123] McFadden, D., 1974, "Conditional logit analysis of qualitative choice behavior", *Frontiers in Econometrics*, 105-142.
[124] Beaver, W., 1968, "Market Prices, Financial Ratios, and the Prediction of Failure", *Journal of Accounting Research*, Vol. 6, No 2, 179-192.
[125] Dambolena, I., and Khoury, S., 1980, "Ratio Stability and Corporate Failure", *Journal of Finance*, Vol. 35, No 4, 1017-1026.

The results of the model in terms of the ability of the discriminant function to predict failure represents a real improvement over previously research due to the inclusion of the stability ratios.

Crouhy, Galai, and Mark (2000)[126] described the current credit risk models. CreditMetrics is based on the probability of moving from one credit quality to another. KMV is based on the asset value model as developed by Merton (1974) which relates the probability of default to the firm's capital structure, the volatility of the assets returns, and the current asset value. CreditRisk+ is focused on the default, and follows a Poisson distribution and CreditPortfolioView is based on the default probabilities as a function of macro-variables like unemployment, the level of interest rates, the growth rate of the economy, etc..

It is worth mentioning the work of McNeil, Frey and Embrechts (2005)[127], which describes the above mentioned Structural Models of Default with details related to the credit risk modelling of them all.

Our research differs from the previous studies in two items. First, our main objective is to analyse the significance of the industry variables and, secondly, to make an assessment and identify alternative variables for the default probability. There is no consensus in the main industry variables. Due to the fact that we have been using the Compustat (North America) database we take the current Standard and Poor's variables as the industry ones, but we recognize that there are differences when compared with Moody's, etc... We have adopted the econometric analysis which walks away from the discriminant functions widely used in these studies. We understand that the financial distress is a continuous process, and we prefer the default probability models.

Looking at the default probability function, we can see that there are two differentiated areas: the default probability reaching a 1.76% and the rest until achieving the 100%. To better identify the first area we take the S&P 500 Database with the objective to evaluate the significance of the industry variables for a Default Probability model, and for the second area we take the S&P Bankruptcy Database with 1864 Companies for a Bankruptcy model and both covering the period from 1983 till 2002.

---

[126] Crouhy, M., Galai, D., and Mark, R., 2000, "A comparative analysis of current credit risk models", *Journal of Banking & Finance*, 24, 59-117.

[127] McNeil, A., Frey, R. and Embrechts, P., 2005, *Quantitative Risk Management*, Princeton Series in Finance, Princeton University Press, 8, 331-343.

The main objective of the estimation of a model for the first area of low default probabilities and the biased S&P 500 Database with the larger companies, is limited to estimate the credit risk on loans and to set prices for those.

The main objective of the estimation of a model for the second area of high default probabilities and the failed companies of the S&P Bankruptcy Database, is to calibrate a model with an alternative Dependent Variable and the industry variables. It is clear that, in this case, the benefits are pricing the loans, internal management, and the prediction of failure. It allows us to benchmark the model with all the other variables as the dependent ones.

4.5.2 Data and Resources

The data used in the research come from several sources. Company data are from Standard & Poor's 500 Compustat – North America (500 Companies). After excluding Banks, Diversified Financials, Insurance, and Real Estate, the sample covered 397 Companies, 20 years by cross-section (1983-2002). The Industry classifications are updated to the new GICS-Global Industry Classification Standard (23 Industry groups in total, and after omitting the financial groups 19 groups). The total number of observations in the panel is 4559.

Net sales have been adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes for every sector supplied by the US Bureau of Labour Statistics, and all the other variables by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

The Software used is Stata-SE, release 8.0.

The enclosed table summarizes the correlation or covariance matrix for the group of variables to be considered in the econometric model. The first coefficient higher than 0.5 in absolute value relates the EBIT interest coverage and EBITDA interest coverage. We prefer to keep a cash flow variable before depreciations like the EBITDA interest coverage, because it is more homogeneous in financial comparisons. High correlation can also be found between Funds from operations to total debt, Free operating cash flow to total debt against EBITDA interest coverage and we keep the latest due to its higher significance. Finally there is also correlation between Total debt to capitalization and Long term debt to Capitalization and we keep the last one due to its higher significance.

	Default Probability ln(DP/100)	EBIT Interest coverage	EBITDA Interest coverage	Funds from Operations to total Debt	Free Operat. Cash Flow to total Debt	Pretax return on Capital	Oper. Income bef. Deprec. to Sales	Long term Debt to Capitalization	Total Debt to Capitalization
Default Probability. Ln(DP/100)	1.000								
EBIT interest coverage	-0.053	1.000							
EBITDA interest coverage	-0.043	0.996	1.000						
Funds from Operations to Debt	-0.001	0.705	0.720	1.000					
Free Operat. Cash Flow to Debt	0.009	0.588	0.604	0.915	1.000				
Pretax return on Capital	-0.266	0.225	0.192	0.054	0.029	1.000			
Op. Income bef. Dep. to Sales	-0.131	0.017	0.011	-0.007	-0.010	0.183	1.000		
Long term Debt to Capitalization	0.270	-0.093	-0.089	-0.030	-0.022	-0.338	0.087	1.000	
Total Debt to Capitalization	0.024	-0.052	-0.052	-0.016	-0.012	-0.207	0.299	0.573	1.000

Table 4.3 Correlation or covariance matrix of the explanatory variables

4.5.3 The Default Probability Model

After checking the efficiency of taking a logistic function as a proxy of the DP-Default Probability dependent variable, we find that we introduce a very important distortion due to the fact that the Default Probability curve has two very clear linear adjustments without the typical saturation of the logistic one. Based on the above mentioned fact, we adopt the log of the Default Probability as the best dependent variable.

It is important to clarify that the Default Probability adopted in our research is the probability for a business that will be default in payments the following year. The Default Probability Data has been sourced from Standard and Poor's[128]. The related tables are shown in Table 4.4.

The Default Probability model can be expressed as the log of the Default Probability against the industry variables, expressed in a generic notation (X_{it}) for simplicity, and estimated through a fixed effects OLS robust estimation[129]. The model is as follows:

$$Ln(DP/100)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \qquad (4.5.3.1)$$

Where the dependent variable is (See Appendix 5a for a fuller variables description):

$Ln(DP/100)_{it}$ = Natural logarithm of the Default Probability

and the independent or industry variables are:

128 Standard and Poor's, 2005,"Annual Default Study: Corporate Defaults Poised to Rise in 2005", *Global Fixed Income Research*, Table 13, Column Y1, 18.

129 Greene, W., 2000,"Heteroscedasticity consistent covariance matriz estimation", *Econometric Analysis*, Prentice Hall, 14, 579.

EBIT Interest Coverage

EBITDA Interest Coverage

Funds from Operations to Total Debt

Free Operating Cash Flow to Total Debt

Pretax Return on Capital

Operating Income before Depreciation to Sales

Long Term Debt to Capitalization

Total Debt to Capitalization

Code	S&P Rating	DP-Default Probability	DP %	LN(DP/100)
1	Unassigned		0.00	
2	AAA	0.00	0.00	
3	Unassigned		0.00	
4	AA+	0.00	0.00	
5	AA	0.00	0.01	-9.210
6	AA-	0.02	0.02	-8.517
7	A+	0.05	0.05	-7.601
8	A	0.04	0.04	-7.824
9	A-	0.04	0.04	-7.824
10	BBB+	0.22	0.22	-6.119
11	BBB	0.28	0.28	-5.878
12	BBB-	0.39	0.39	-5.547
13	BB+	0.56	0.56	-5.185
14	BB	0.95	0.95	-4.656
15	BB-	1.76	1.76	-4.040
16	B+	3.01	3.01	-3.503
17	B	8.34	8.34	-2.484
18	B-	12.15	12.15	-2.108
19	CCC+		20.49	-1.585
20	CCC	28.83	28.83	-1.244
21	CCC-		38.99	-0.942
22	Unassigned		49.16	-0.710
23	CC		59.33	-0.522
24	C		69.49	-0.364
25	Unassigned		79.66	-0.227
26	CI		89.83	-0.107
27	D	100.00	100.00	0.000
28	Not meaningful			
90	Suspended			

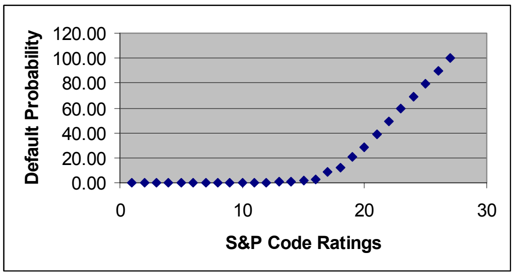


Table 4.4 & Figure 4.1. Ratings Code & Default Probability (DP in percentage). Standard and Poor's. (adapted and completed by the Author)

The proposed Default Probability Model will be estimated using the HCCME-Heteroskedasticity-consistent covariance matrix estimator for the fixed OLS[130] in order to get consistent estimates for the parameters. The estimator, named "areg" in Stata, is the robust

[130] See Davidson, R. and MacKinnon, J., 1993, *Estimation and Inference in Econometrics*, Oxford University Press, 11, 401 and 16, 552-56

Hubert-White[131] sandwich estimator of variance which produces consistent standard errors for the OLS regression coefficient estimates in the presence of heteroskedasticity.

4.5.4 Detailed discussion of the Econometric estimates

We started running the fixed and random effects estimators, and the Hausman test with chi2(table)=15.51 < Statistic=42.03. This means that the null hypothesis of "Ho: Individual effects are uncorrelated with other regressors" is rejected, and the consistent estimator is a fixed effects OLS.

If we regress the log of Default Probability against all the above mentioned variables, and proceed with eliminations due to multicollinearity and low significance, the final results can be seen in the Table 4.5.

EBITDA Interest Coverage, Pretax Return on Capital, and Operating Income before Depreciation to Sales ratio show a significant negative contribution to the Default Probability, and the Long Term Debt to Capitalization shows a significant positive contribution to the Default Probability. The previous mentioned variables are the four key metrics to predict the Payments Default for a Company. In essence, the capability to generate Cash, Profits, and the level of Debt are the key ingredients driving to the payments default if the financial situation is deteriorating.

The main difference with the Rating Agencies is that they include all the industry variables, even with high multicollinearity, with the objective to gain in forecasting, however this is not our objective in the research. The non significance of all the Industry metrics was already identified by Stern Stewart (1990), and solved with a different set of variables.

Additionally to the significance of the Industry variables, there are some issues related to the ratings which are very important to mention when trying to apply and set up a Credit Monitoring System in practice to a Firm:

- When a Company sets up a credit monitoring of Customers there is a key variable like the age of the Company, which is very important, especially for small customers

[131] See White, H., 1980, "Heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity", *Econometrica*, 48, 817-838.

and this variable is not usually mentioned in the Commercial Packages handling credit.

- The fact that the main Customers of the Rating Agencies are the large Companies to be rated, and which also give the approval to publish the rating. This is a serious issue because some Companies in trouble do not agree to publish a bad rating, what introduces a lag in the true rating against the declared one.
- It is very important to add to the historical data some projected ratios to estimate today's situation, and validating these estimated ratios with the current situation of payments default. This can be done with regressions based on annual data.
- To be practical, it is clear that we do not recommend to work with global regressions. We need to keep updated sector based regressions, which are affected by the specific economic situation of that sector.

4.5.5 The Default Probability Model based on the Logistic Function

In this section, we use the same explanatory variables as previously defined and we take as a proxy of the dependent variable the logistic function of the Default Probability, through a fixed effects OLS robust estimation. The model is as follows:

$$Ln(DP_{it}/1\text{-}DP_{it}) = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \qquad (4.5.5.1)$$

In summary, the final significant variables have been exactly the same as in the ln(DP) model. The Default Probabilities in percentage have been previously divided by one hundred. The Table 4.5 shows the similarity and consistency of the estimates.

Both regressions provide similar results in terms of coefficients, statistics, and tests. The logistic regression gives an elegant way of solving the estimation, but the real Default Probability function does not show the saturation level. It is better to adopt the ln(DP) as the best choice, and especially in our case based on our objectives for the estimates and the S&P-500 Database.

	Dependent Variables	
	Ln(DP)	LN(DP/1-DP)
Independent Variables	Fixed Effects OLS - areg Robust	Fixed Effects OLS - areg Robust
EBITDA interest coverage	-5.67E-06 (-2.11)	-5.66E-06 (-2.11)
Pretax Return on Capital	-0.0207 (-7.62)	-0.0210 (-7.38)
Operating Income bef. Depreciation to Sales	-0.0072 (-3.55)	-0.0073 (-3.49)
Long term Debt to Capitalization	0.0038 (6.57)	0.0038 (6.61)
Constant	-6.8913 -138.19	-6.8835 (-134.29)
Nr Observations F-Statistic R-squared Adj R-squared	4559 54.65 0.7866 0.7660	4559 51.62 0.7857 0.7650

Table 4.5 Comparison of alternative estimates of Default Probability.
(t-values in parentheses)

4.5.6 Conclusion

We have analysed the Credit Industry variables and found that the EBIT interest coverage has been eliminated due to multicollinearity and Funds from operations to total debt, Free operating cash flow to total debt and Total Debt to Capitalization also eliminated due to multicollinearity and low significance.

We have estimated a Default Probability Model and not a forecasting one. The most important significant variables have been the EBITDA Interest coverage, Pretax return on capital, Operating income before depreciation to sales and Long term debt to capitalization. This is clearly showing how important the generation of cash, profits and the level of debt to predict a financial distress are.

A very important conclusion is the benchmark between the ln(DP) and the logistic function version of the default probability, like ln(DP/1-DP). The similarity of the econometric outcome allows us to recommend the use of the ln(DP) as a simplified version to get the same results as the logistic function.

4.6 Credit Risk. Bankruptcy Model

4.6.1 Previous Research on Bankruptcy Models

This item has been explained in this chapter 4, section 4.5.1.

4.6.2 Data and Resources

The data used in the research come from several sources. Company data are from the Standard & Poor's Bankruptcy File (1864 Companies). After data cleaning the final sample compiles 1440 Companies, 20 years by cross-section (1983-2002). The total number of observations in the panel is 28800.

Net sales have been adjusted to constant 2002 US Dollars with the PPI-Producer Price Indexes for every sector supplied by the US Bureau of Labour Statistics, and all the other variables by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis.

Software used is Stata-SE, release 8.0.

The enclosed table summarizes the correlation or covariance matrix for the group of variables to be considered in the econometric model. The first coefficient higher than 0.5 in absolute value relates the EBIT interest coverage and EBITDA interest coverage. We prefer to keep a cash flow variable before depreciations like the EBITDA interest coverage, which is more homogeneous in financial comparisons. High correlation can also be found between Total debt to capitalization and Long term debt to Capitalization and we keep the first due to its higher significance.

	Total Assets to Liabilities ln(AT/LT)	EBIT Interest coverage	EBITDA Interest Coverage	Funds from Operations to Total Debt	Free Operat. Cash Flow to Total Debt	Pretax Return on Capital	Oper. Income bef. Deprec. to Sales	Long term Debt to Capitalization	Total Debt to Capitalization
Total Assets to Liabilities	1.000								
EBIT Interest Coverage	-0.032	1.000							
EBITDA Interest Coverage	0.025	0.939	1.000						
Funds from Operations To Debt	0.056	0.189	0.227	1.000					
Free Oper. Cash Flow to Debt	-0.121	0.464	0.464	0.216	1.000				
Pretax Return on Capital	0.378	0.149	0.151	0.157	0.061	1.000			
Oper. Income bef. Depr. To Sales	0.039	0.178	0.182	0.044	0.086	0.267	1.000		
Long term Debt to Capitalization	-0.072	0.006	0.001	0.001	0.005	0.000	0.000	1.000	
Total Debt to Capitalization	-0.114	0.006	0.000	0.001	0.007	-0.008	0.006	0.806	1.000

Table 4.6 Correlation or covariance matrix of the explanatory variables

4.6.3 The Bankruptcy Model

As previously stated**,** the main objective is to regress and test industry variables to a proposed dependent one to analyse the capability of the credit ratings variables to predict bankruptcy and how their parameters are impacted.

A Bankruptcy situation is faced when the assets value falls below the value of the firm's liabilities. Based on this fact, we adopt the log of the year end Total Assets to Total Liabilities ratio as the dependent variable, and the industry variables as the independent ones. It has the advantage that we trace the evolution of the financial situation of one company with the Industry variables, then, if the situation is worsening, we do not need to change variables to find out with the Z-Score, and we continue working with the same set of industry variables.

The Bankruptcy model can be expressed as the log of the Total Assets to Liabilities ratio against the industry variables, expressed in a generic notation (X_{it}) for simplicity, and estimated through a fixed effects OLS robust estimation[132]. The model is as follows:

$$Ln(AT/LT)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \qquad (4.6.3.1)$$

Where the dependent variable is (See Appendix 6a for a fuller variables description):

$Ln(AT/LT)_{it}$ = Natural logarithm of year end Total Assets to Total Liabilities

and the independent or industry variables are:

EBIT Interest Coverage

EBITDA Interest Coverage

[132] Greene, W., 2000,"Heteroscedasticity consistent covariance matriz estimation", *Econometric Analysis*, Prentice Hall, 14, 579.

Funds from Operations to Total Debt

Free Operating Cash Flow to Total Debt

Pretax Return on Capital

Operating Income before Depreciation to Sales

Long Term Debt to Capitalization

Total Debt to Capitalization

4.6.4 Detailed discussion of the Econometric estimates

We started running the fixed and random effects estimators, and the Hausman test with chi2(table)=15.51 < Statistic=96.23. This means that the null hypothesis of "Ho: Individual effects are uncorrelated with other regressors" is rejected, and the consistent estimator is a fixed effects OLS.

If we regress the Total Assets to Total Liabilities against all the above mentioned variables, and proceed with eliminations due to multicollinearity and low significance of some variables, we get the following final results:

Variable Definition	Fixed Effects OLS-areg Robust
Explanatory Variable	Coeff. & (t-Student)
EBITDA Interest Coverage	0.00001 (+2.18)
Pretax Return on Capital	0.00157 (+7.97)
Free Operating cash Flow to Total Debt.	-0.00006 (-2.27)
Total Debt to Capitalization	-7.45e-06 (-3.49)
Constant	4.95782 (+401.57)
F-Statistic	22.65
R-squared	0.5889
Adj R-squared	0.5242
Number of Observations	2171

Table 4.7 The Bankruptcy Model estimates (t-values in parentheses)

The EBITDA Interest Coverage, and the Pretax Return on Capital show a significant positive contribution to the log of the Total Assets to Liabilities. The Free Operating Cash Flow to Total Debt and the Total Debt to Capitalization show a significant negative contribution to the log of the Total Assets to Liabilities.

In consequence, EBITDA Interest Coverage, Pretax Return on Capital, Free Operating Cash Flow to Total Debt, and the Total Debt to Capitalization are the key variables to predict Bankruptcy based on the Industry Credit Ratings variables.

Additionally we can compare the Coefficients and the t-Student significance of parameters between the Default Probability and the Bankruptcy Model ones. We find the following:

Variables Definition	Default Probability Model	Bankruptcy Model
Dependent Variable	$Ln(DP_{it}/100)$	$Ln(AT/LT)_{it}$
Explanatory Variable	Coeff. & (t-Student)	Coeff. & (t-Student)
EBITDA Interest Coverage	-5.66e-06 (-2.11)	0.00001 (+2.18)
Pretax Return on Capital	-0.0207 (-7.62)	0.00157 (+7.97)
Operating Income before Depreciation to Sales	-0.0072 (-3.55)	
Free Operating cash Flow to Total Debt.		-0.00006 (-2.27)
Long Term Debt to Capitalization	0.0038 (+6.57)	
Total Debt to Capitalization		-7.45e-06 (-3.49)

Table 4.8 The Default Probability and Bankruptcy models (t-values in parentheses)

Two equal independent variables have been identified as significant in the two models. The differences are very important and are clearly due to the different dependent variables and the information data coming from the different considered databases.

The EBITDA Interest Coverage and Pretax Return on Capital are significant in both models. The Default Probability Model emphasizes the Operating Income and Long Term Debt, whereas the Bankruptcy one is more related to the generation of Free Operating Cash Flow and the level of Total Debt.

Beaver (1966)[133] found Cash (defined as Funds) Flows to Total Debt to be the best univariate predictor. In our research Pretax Return on Capital shows the highest significance, and Free Operating Cash Flow to Total Debt is also identified as a significant variable.

Gentry (1985) found the Dividends Flow as the most significant variable. The Capital Expenditures, and Debt Financing were among the variables that were not significant in his studies. He also found that models based on combined cash flow and financial ratios were much better than models based on cash flow or financial ratios alone. We can emphasize that none of these variables are commonly considered among the Industry ones.

4.6.5 Benchmarking of Variables

Let us analyse a true example extracted from the Standard and Poor's Bankruptcy database. The enclosed table shows the most relevant variables from a company worsening its financial situation. This is as follows:

years	S&Poor's Rating Code	AT/LT year end	Z-Scores	Default Probability %	years	ln(AT/LT)	Z-Scores	ln(DP)
1984		2.0908	3.8390	0.04	1984	0.7375	3.8390	-3.2189
1985	8	1.9902	3.6270	0.04	1985	0.6882	3.6270	-3.2189
1986	8	1.7649	3.1590	0.04	1986	0.5681	3.1590	-3.2189
1987	8	1.7399	3.0290	0.04	1987	0.5538	3.0290	-3.2189
1988	8	1.8055	3.4820	0.04	1988	0.5909	3.4820	-3.2189
1989	9	1.5924	2.8560	0.04	1989	0.4652	2.8560	-3.2189
1990	11	1.3673	1.8960	0.28	1990	0.3129	1.8960	-1.2730
1991	13	1.4080	2.1170	0.56	1991	0.3421	2.1170	-0.5798
1992	13	1.2658	1.8400	0.56	1992	0.2357	1.8400	-0.5798
1993	13	1.4031	2.3200	0.56	1993	0.3387	2.3200	-0.5798
1994	12	1.6644	2.4110	0.39	1994	0.5094	2.4110	-0.9416
1995	12	1.4788	2.0880	0.39	1995	0.3912	2.0880	-0.9416
1996	13	1.2802	1.7930	0.56	1996	0.2470	1.7930	-0.5798
1997	14	1.2577	2.3390	0.95	1997	0.2293	2.3390	-0.0513
1998	13	1.2497	0.9570	0.56	1998	0.2229	0.9570	-0.5798
1999	13	1.2637	1.0450	0.56	1999	0.2340	1.0450	-0.5798
2000	16	1.1781	0.7100	3.01	2000	0.1639	0.7100	1.1019
2001	27	1.0485	0.5290	100	2001	0.0474	0.5290	4.6052

Table 4.9 Benchmarking of Variables. Period: 1984-2001

This example helps to visualize the evolution of a true financial distress. This worsening evolution of the variables can be seen many times in the Bankruptcy Files. The AT/LT, and the Altman's Z-Score can be seen steadily decreasing along the years, and the S&P's Rating

133 See Beaver, W., 1966, "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, Vol. 4, 71-111.

Code and the ln(DP) increasing accordingly. As we can see, the Rating Code suddenly jumps from 16 to 27. This big jump happens many times and it comes as a surprise to the Financial Companies and Investors.

It is very clear that the AT/LT, and the Altman's Z-Score, due to the continuous nature of the variables, have more power of prediction of Bankruptcy than the Rating Codes. The evolution of the AT/LT and the Z-Score can be extrapolated with measure to the future, but the jump from 16 to 27 cannot. We can visualize the trends in the enclosed graph:

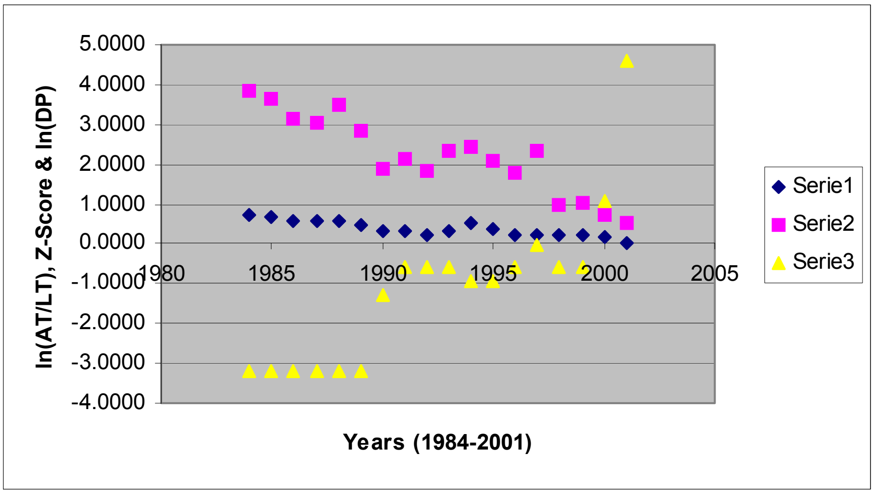


Figure 4.2 Evolution of the main Variables to predict Bankruptcy

(Rating Codes not shown due to the scale)

Serie 1 = Ln(AT/LT), Serie 2 = Z-Score Serie 3 = Ln(DP)

We can find multicollinearity mainly between ln(AT/LT) and Z-Score with the correlation coefficient at 0.72, and lower than 0.5 we have: ln(DP) and ln(AT/LT) at –0.49, and ln(DP) and Z-Score at –0.48.

Regressing the different variables between them allows us to find the equivalent data points. As a summary of the equivalences among them, we can build the following table:

Dependent Variables	AT/LT	Ln(AT/LT)	Z-Scores	DP	Ln(DP)	S&P's Rating Code
Non-Bankrupt	AT/LT > 1.0742	Ln(AT/LT) > 0.0716	Z > -9.1805	DP < 8.34%	Ln(DP) < 2.1211	Code < 17
Zone of Ignorance	1.0742 > AT/LT > 0.8272	0.0716 > Ln(AT/LT) > -0.1896	-9.1805 > Z > -9.4227	8.34 < DP < 100%	2.1211 < Ln(DP) < 4.6052	17 < Code < 27
Bankrupt	0.8272	-0.1896	-9.4227	100%	4.6052	27

Table 4.10 Benchmarking of the main Bankruptcy variables

Altman[134] was discriminating between manufacturing publicly traded, private, and service sector companies. We need to develop the models specifically related to every sector and to find out the specific coefficients by sector to be useful in the Financial Industry.

Based on all the above mentioned aspects, we can state that the Altman's Z-Score and our proposed variable Ln(AT/LT) and AT/LT are able to capture, in a continuous way, the evolution of a financial distress and are able to predict a bankruptcy situation in a much better way than the current Ln(DP), Ln(DP/1-DP) or Rating Codes. This is due to how these variables are built. Additionally the AT/LT, Ln(AT/LT) and the Altman's Z-Score avoid the issue of the surprising jumps to the Financial Companies and Investors.

Looking at the power of prediction through extrapolation the Altman's Z-Score is more powerful than the AT/LT variable. Additionally the Ln(DP), Ln(DP/1-DP) and the Rating Codes suffer unexpected jumps.

Based on the variables to be considered the Ln(AT/LT), Ln(DP), and Ln(DP/1-DP) have very similar independent industry variables, and the Altman's Z-Score has a complete different set of variables.

4.6.6 Conclusion

The benchmarking of variables shown in table 4.9 demonstrates that the DGP-Data generating process[135] is very important. The Default probability model is based on the 500

[134] See Altman, E., 1993, *Corporate Financial Distress and Bankruptcy*, John Wiley & Sons, Ch. 8.

companies of the Standard and Poor's-500 and the Bankruptcy model on the 1440 companies of the bankruptcy files of Standard and Poor's. These are two very different data samples. The first one shows the results of the most important 500 companies with less difficulties in getting funding and the second sample shows the results of the companies with a financial distress at some point in time.

Both regressions started with the same industry variables and in the end they provided different sets of significant variables. The EBITDA interest coverage and Pretax return on capital have been significant in both models. The Operating income before depreciation to sales and the Long term debt to capitalization have been significant in the Default probability model. The Free operating cash flow to total debt and the total debt to capitalization have been significant in the Bankruptcy model. The Default probability model gives more emphasis on the income and the level of the long term debt, whereas the Bankruptcy model on the free cash flow and the level of the total debt.

This demonstrates how important Industry considers the sector analysis and the need to use a forecasting model[136] with multicollinearity between the variables. This is the best way to capture all the variables due to the fact that a sector data sample has companies without problems and others with a certain degree of financial distress.

Our research shows through an example the advantages to use the Altman's Z-Score and the Assets to total liabilities ratios in absolute or logs amounts instead of the Default Probabilities so closely related to the Standard and Poor's rating codes. The latest variables show a jump in the last period of financial distress which is very difficult to predict and comes as a surprise to the financial community.

---

[135] See Davidson, R. and MacKinnon, J., 1993, "Models and Data-generating process", *Estimation and inference in Econometrics*, Oxford University Press, 2, 53-54.

[136] See Ramanathan, R., 1989, "Multicollinearity", *Introductory Econometrics with Applications*, 4th Ed., The Dryden Press, 5, 238.

Chapter 5

The Created Shareholder and Market Value Models

5.1 Introduction

In this chapter we will not analyse the long standing debate between the Stakeholder Society and the Shareholder Value theories[137]. We understand that the maximization of shareholder value and the value based management techniques provide a clear framework linked to the management incentives (bonuses and stock options…) that match better with the evolution of the Market Capitalization[138] of the Company when compared with some traditional measures, such as ROE, etc…. The previous mentioned association between creating shareholder value and market capitalization, stock prices, or stock returns will depend on the shareholder value measure that we may adopt. We can find some proxy measures of shareholder value with very low predictive power of the Market Capitalization[139]. We will adopt the created shareholder value[140] as the excess of the true shareholder value added over the expectations on the equity market value (equity market value affected by the required return on equity).

Our first objective is to study the main business and investors' processes impacting the created shareholder value of the company. The second one is to analyse if the changes of the created shareholder value are perceived by the Investors and are affecting the Market Capitalization. The business and investors' processes have been chosen based on the four main groups of variables: the external market influences, simplified model variables, analysts and investors' expectations, and the fundamental variables. The main ones described in the previous groups have been used in stock valuation models, except the over and undervalued

[137] See Tirole, J., 2006, "Shareholder Value or Stakeholder Society?", *The Theory of Corporate Finance*, Princeton, 1, 56-62.
[138] See Warner, A., and Hennell, A., 2001, *Shareholder Value Explained*, 2nd Ed., Pearson Education, 7, 90.
[139] See Biddle, G., Bowen, R., and Wallace, J., 1997, "Does EVA beat Earnings ?. Evidence on Associations with Stock Returns and Firm Value", *Journal of Accounting and Economics*, 24, 3, 275-300.
[140] See Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, 1, 8.

shares, and in the potential growth path, which have been defined to capture the forward-looking expectations of the analysts' calculations and the investors' behaviour.

The first objective will be pursued by the created shareholder value model, and we will identify the main business and investors' processes affecting it in section 5.5. The second objective is mainly focused on market capitalization, and it will show how it is affected by the created shareholder value, which will be described in section 5.7, and we will finally show how the Market Capitalization is affected by the business and investors' processes, which will be studied in section 5.8.

5.2 Previous Research on Shareholder Value.

A summary of the most important work previously done on this subject based on definition and econometric models is the following:

The main theories on Shareholder Value start with the Value Based framework, which is based on the assumption that changes in economic value measures changes on shareholder wealth more closely than traditional accounting measures. The economic value measures are the residual income and the internal rate of return. The residual income is defined as the earnings in excess of the cost of capital employed to generate those earnings. The main earlier authors have been: Solomons (1965), Morse & Zimmerman (1997) and later Horngren, Datar & Foster (2006).

Fruhan (1979)[141] described how a group of US non financial companies have consistently managed to earn rates of return that exceed the cost of their equity capital. The Return on common stockholders' equity was used as the measure of success and the characteristics identified were the entry barriers, such as unique products, economies of scale, absolute cost advantages, and capital requirements. Additional characteristics were focused on product line, redundant cash and overvaluation by investors.

Fruhan identified the capital structure decision, the reduction of business risks, and the obtaining of benefits of the competitive advantage as the best opportunities for value

141 See Fruhan, W., 1979, *Financial Strategy, Studies in the Creation, Transfer and Destruction of Shareholder Value*, Homewood, Illinois, Richard D. Irwin.

creation and the value transfer realized by acquisition, share repurchases, and other financial management techniques.

Biddle, Bowen and Wallace (1997) [142] provide a test that Earnings (R^2=12.8%) is significantly more highly associated with market-adjusted annual stock returns than are Residual Income (R^2=7.3%), EVA (R^2=6.5%), and Operating cash flow (R^2=2.8%). They additionally tested if the EVA and/or Residual Income components were contributing significantly to the market stock returns. They concluded that, while cash flow and accrual components were consistently significant, the EVA components such as capital charge and accounting adjustments were typically not significant.

In summary, neither EVA nor Residual Income appears to dominate earnings in its association with stock market returns, and they recognise that EVA may be an effective tool for internal decision making, performance measurement and incentive compensation.

Zimmerman (1997) [143] studied the divisional performance of EVA and came to the conclusion that the firm EVA can closely track changes in stock price. However, the divisional EVA measures may be highly misleading indicators of value creation and may be leading to the wrong incentives.

Rappaport (1986, 1998)[144] defined the concepts of Shareholder Value, Shareholder Value Added and ERI-Expectations Risk Index. He offered a complete framework of Value Creation applied to the business planning, performance evaluation, executive compensation, mergers and acquisitions, stock market signals, and organizational implementation.

Rappaport linked the business value to the seven financial or macro value drivers: sales growth, operating profit margin, incremental fixed capital investment, incremental working capital investment, cash tax rate, cost of capital, and value growth duration. He additionally emphasized the importance of identifying the micro value drivers linked to the macro ones, but those more actionable by Management and specific to the related business. This is also named the LEK/Alcar's SVA (Shareholder Value Added).

---

[142] See Biddle, G., Bowen, R., and Wallace, J., 1997, "Does EVA beat Earnings?: Evidence on associations with stock returns and firm values", *Journal of Accounting and Economics*, 24, 301-336.

[143] See Zimmerman, J., 1997, "EVA and Divisional Performance Measurement: Capturing Synergies and Other Issues", *Journal of Applied Corporate Finance*, 10, 98-109.

[144] See Rappaport, A., 1998, *Creating Shareholder Value*, 2nd Ed., The Free Press, New York.

Chen and Dodd[145] found that the three profitability measures: Operating Income, Residual Income and EVA have information content in terms of value-relevance. They conducted the research based on the Easton and Harris stock returns valuation model and found a higher explanatory power with the Operating Income (R^2=6.2%) and Residual Income (R^2=5.0%) than the EVA at (R^2=2.3%). These findings were consistent with the Biddle et. al. (1997) research above mentioned, and were against some popular press and practitioner journals which were quoting EVA as the replacement to the traditional corporate measures.

Copeland, Koller and Murrin (1990, 1994, 2000)[146] defined the Economic Profit as an after-tax operating profits less a charge for the capital used by the company. They mainly applied their value creation framework for valuation of companies and acquisitions. The McKinsey consulting company has embraced the Economic Profit as the main measure for its framework of value creation.

Benneth Stewart III (1991, 1999)[147] developed the EVA-Economic Value Added and the MVA-Market Value Added as the essential measures for Value Creation. He created the Stern Stewart Performance 1000 list of companies ranking the Market Value Added for the related year. The Company Risk and Financial restructuring were two matters widely explained in the book. The EVA concept was based on the residual income measure, and tried to eliminate the distortions of the traditional accounting measures, but the corrections to the accounting variables have been widely criticized due to their complexity. The Stern Stewart consulting company has embraced the EVA and MVA measures for its framework of value creation.

Stern, Shiely and Ross (2001)[148] clarified the road map to value creation through the reconfiguration of structure and systems, and the reengineering of designs and processes. How to use EVA with acquisitions and incentives has also been widely explained.

Madden (1999, 2000)[149] developed the CFROI-Cash Flow Return in Investment as an inflation-adjusted measure of economic performance. He also created the Holt's Dual-grade

145 See Chen, S. and Dodd, J., 1998, "Usefulness of Operating Income, Residual Income, and EVA: A Value-Relevance Perspective", Working Paper, *Drake University*, Des Moines, Iowa.

146 See Copeland, T., Koller, T., and Murrin, J., 2000, *Valuation: Measuring and Managing the Value of Companies*, 3rd Ed., John Wiley and Sons, New York.

147 See Stewart III, G.B., 1991-1999, *The Quest for Value*, Harper, New York.

148 See Stern, J., Shiely, J., and Ross, I., *The EVA Challenge*, John Wiley & Sons, New York.

performance scorecard: #1 Near term forecast +1-year CFROI grade and #2 Long term % future grade. The CFROI is similar to the long term internal rate of return and is calculated by dividing inflation-adjusted cash flow by the inflation-adjusted cash investment.

O'Byrne (1999)[150] described the basic objective of EVA as an alternative to the discounted cash flow valuation and highly correlated with the current market value. Additionally, he emphasized the poor correlation between free cash flow and the current market value because the free cash flow failed to match investment outlays with the future periods they benefit from.

O'Byrne argued about the Biddle, Bowen and Wallace's findings mainly in three areas. First the BBW's regression analysis shows that investors put great weight on the cost of debt, while apparently ignoring the cost of equity. Secondly, in the analysis of the market value levels, the explanatory power they attribute to NOPAT is really attributable to NOPAT and Capital. Thirdly, he argued that the BBW's analysis of the expected performance did not make any attempt to derive a model of expected EVA improvement from the EVA valuation equation.

Dechow, Hutton and Sloan (1999) [151] found that their implementation of Ohlson's residual income valuation model provided only minor improvements over existing attempts to implement the dividend-discounting model by capitalizing short-term earnings forecasts in perpetuity. In the empirical implementation of Ohlson's valuation model, they claim only modest improvements in explanatory power over past empirical research using analysts' forecast of next year's earnings.

Garvey and Milbourn (2000)[152] developed a model where they regressed the adopters and not adopters of EVA and the relevant variables. They emphasized the positive contribution of EVA to the value added and they also showed that the simple correlation between EVA and stock returns is a relevant factor in the choice of performance measures and it is a reliable guide as an incentive tool and measure for compensation.

---

[149] See Madden, B., 1999-2000, *CFROI Valuation. A Total System Approach to Valuing the Firm*, Oxford: Butterworth-Heinemann.

[150] See O'Byrne, S., 1999, "EVA and its Critics", *Journal of Applied Corporate Finance*, Vol. 12, No 2, 92-96.

[151] See Dechow, P., Hutton, A., and Sloan, R., "An empirical assessment of the residual income valuation model", *Journal of Accounting and Economics*", 26, 1-34.

[152] See Garvey, G., and Milbourn, T., 2000, "EVA versus Earnings: Does it matter which is more highly correlated with Stocks Returns?", *Journal of Accounting Research*, Vol. 38, Supplement: Studies on Accounting Information and the Economics of the Firm, 209-245

Garvey and Milbourn stressed the fact that it is not so important if EVA beats earnings per se, but under which circumstances does EVA beat earnings and why. EVA should be adopted by a Company depending on the EVA and earnings current correlation to the stock returns and the ability to explain them at the same time. They described non adopters firms with high correlation between EVA and stock returns, and with negative correlation between earnings and stock returns.

They considered that the adoption of EVA is positively related to the firm's cumulative distribution function of the proportion of firms with a percentage value added from adopting EVA, leverage and tangible assets, and negatively related to the size (total assets) and Tobin's q. There are some industry patterns for the adoption of EVA, and the explanatory power of the regressions are modest (R^2=7.2% and 12.8%).

Ittner and Larcker (2001)[153] reviewed the empirical research in managerial accounting under a value-based management perspective. Additionally, they described the main issues and offered suggestions for a future research.

Nissim and Penman (2001)[154], who based their work on a residual income framework, investigated the effects of interest rates on residual earnings. The econometric analysis was based on a Panel Data covering 36 years from 1964 till 1999 and all the companies listed in the NYSE. They found that the positive correlation between interest rates changes and unexpected earnings and book value only partially offset the negative effect of the change in the required return. The effect of changes in interest rates on residual earnings and value is negative. They also confirmed the negative correlation between changes in interest rates and stock returns that has been widely documented.

Pandey (2005)[155] based his work on a panel data of 220 Malaysian firms for nine years (1994 to 2002) and used GMM estimation. He studied the shareholder value, measured by the market-to-book value ratio and found a strong positive relationship with economic profitability; that is, the spread between return on equity and the risk-adjusted cost of equity,

[153] See Ittner, C., and Larcker, D., 2001, "Assessing empirical research in managerial accounting: a value-based management perspective", *Journal of Accounting and Economics*, 32, 349-410.

[154] See Nissim, D., and Penman, 2001, "An Empirical Analysis of the Effect of Changes in Interest Rates on Accounting Rates of Return, Growth, and Equity Values", *Columbia University*, *Graduate School of Business.*

[155] See Pandey, I., 2005, "What Drives Shareholder Value", *Indian Institute of Management, Ahmedabad*, Working Paper No 2005-09-04.

the negative contribution of growth, and the positive contribution of the interaction variable between economic profitability and growth.

The results also indicate a positive contribution of the business risk, financial risk, and capital intensity, and a negative contribution of the firm size to the market-to-book value ratio.

5.3 Previous research on Market Value Models

A summary of the most important work previously done on this subject based on econometric models is the following:

Griliches (1981)[156] found a significant and positive contribution of the intangible capital to the market value of the firm based on a panel data for large US firms over the period 1968-1974. The intangible capital was proxied by the R&D expenditures and the number of patents applied for. He studied six different types of models, and the main three are the following: The first model shows the Q-ratio[157] regressed against a construct of the current and five lags of R&D expenditures and the number of patents. The second autoregressive model shows the Q-ratio regressed against its lag, the "surprise" in R&D and in patents[158], and in the third model we can see the change of the Q-ratio regressed against the "surprise" in R&D and in patents.

Hirschey (1985)[159] studied two dependent variables: the excess market value to the book value of tangible assets to the sales ratio and the Tobin's Q ratio[160] regressed against the market structure proxy for market power (market share, relative firm size, or concentration), research and development to sales ratio, advertising expenditures to sales ratio, growth, and the stock price beta measure of risk.

Hirschey came to the conclusion that market value is more closely related to the R&D, advertising intensity, and growth than other variables reflecting the size of the firms. He also

[156] See Griliches, Z., 1981, "Market Value, R&D and Patents", *Economic Letters*, 7, 183-187.

[157] The Q-ratio is equal to the Current Market Value (equity plus debt) divided by the current conventional Assets (plant, equipment, inventories and financial assets)

[158] "Surprise" in R&D and in Patents means the current value of R&D and Patents minus the respective predicted ones. Variables predicted from a regression with the first lags of R&D, Patents and the Q-ratio in logs.

[159] See Hirschey, M., 1985, "Market Structure and Market Value", *Journal of Business*, Vol. 58, No 1, 89-98.

[160] Tobin's Q ratio is measured as the market value to the replacement cost of tangible assets ratio.

found a negative contribution of the effect of concentration on market value. His main finding is the lack of consistent relationship between traditional market structure variables and the market value.

Abel (1985)[161] developed a stochastic model of the production and investment behaviour. Under the framework of the q theory of investment, he imposed a restriction on the production function which needed to be a Cobb-Douglas. The adjustment technology must also have a constant elasticity. He concluded that the value of the firm is a linearly homogeneous function of the state variables and the firm's capital stock, and investment is an increasing function of the slope of this value function.

Jaffe (1986)[162] developed a market value model in levels and first differences where the dependent variable was the log of Tobin's Q and the independent variables were the stock of accumulated research and development to capital ratio, the interaction of the previous measure and the log of the spillover pool, the log of the share, and the log of the four-firm concentration ratio.

The above mentioned independent variables had a positive contribution to the Tobin's q except the spillover pool and the four-firm concentration ratio with a negative contribution. This means that increasing the four-firm concentration lowers the market value of the average firm.

Griliches, Hall and Pakes (1988)[163] tried to identify the existence of information in the patent numbers on the rate of output of inventive activity. They also sought to distinguish between the demand pull and the technological opportunity factors as they affect the rate of inventive activity. After trying several approaches, the patent numbers failed to be informative.

They found that the fluctuations in the market evaluation of the patented portion of the firm's R&D programmes could account for a five percent of the total variance in market value surprises and just one-fifth might be associated with current patent applications.

---

161 See Abel, A., 1985, "A Stochastic Model of Investment, Marginal q and the Market Value of the Firm", *International Economic Review*, Vol. 26, No 2, 305-322.

162 See Jaffe, A., 1986, "Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value, *American Economic Review*, Vol. 76, 5, 984-1001.

163 See Griliches, Z., Hall, B. and Pakes, A., 1988, "R&D, Patents, and Market Value revisited: Is there a second (technological opportunity) factor?, *NBER National Bureau of Economic Research*, Working Paper No 2624.

The use of the number of current patents would account for less than 0.1 percent of the total variance.

Blundell, Bond, Devereaux and Schiantarelli (1992)[164] studied the importance of Tobin's Q in the determination of the investment decisions at the firm level. They found that the Tobin's Q has a significant positive contribution to the firm investments, but the coefficient was small. Additionally, they added cash flow to the model and provided a positive contribution, as well as the output provided a negative one. This negative contribution of the output was suggestive of monopoly effects.

Hall (1993)[165] studied a market value model based on the physical capital, two-year moving average of cash flow to capital ratio, the growth rate of sales in the current year, the R&D expenditures to capital ratio, the stock of R&D to capital ratio, and the advertising expenditures to capital ratio. The estimates show a significant and positive contribution of all the above mentioned variables to the market value of the firm. When the R&D expenditures to capital ratio was included in the regressions, it is obvious that the stock of R&D to capital ratio was not and vice versa.

Hall found that the market was dropping the valuation of the intangible assets when compared to the valuation of the tangible assets and the advertising expenditures from 1973 to the mid 1980's.

Blundell, Griffith and Van Reenen (1999)[166] studied an innovation model and a market value model based on a panel data of novel firms. They found that the high market share firms were able to commercialise a much higher number of innovations, and a direct effect of these innovations was also found in the stock market value model (in levels and differences).

The Authors' interpretation of the research outcome suggests that the high market firms have marketing advantages over the other forms in the market, and these marketing skills allow them to perform a better promotion and marketing of their innovations. The ability to promote and market an innovation is more related to the firm size than to the market share.

---

[164] See Blundell, R., Bond, S., Devereaux, M. and Schiantarelli, F., 1992, "Investment and Tobin's Q", *Journal of Econometrics*, 51, 233-257.

[165] See Hall, B., 1993, "The Stock Market's Valuation of R&D Investment during the 1980's", *American Economic Review*, Vol. 83, 2, 259-264.

[166] See Blundell, R., Griffith, R., and Van Reenen, J., 1999, "Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms", *Review of Economic Studies*, Vol. 66, No 3, 529-554.

Hall, Jaffe and Trajtenberg (2000)[167] explored the contributions of R&D spending, patents, and citation-weighted patents to the Tobin's Q for a panel of 4800 manufacturing firms in the United States and 30 years of patenting activity (1965-1995). The inventive output was proxied by the patents and the knowledge flew by citations in the research. The distribution of the patents is very skewed and represents an extremely noisy measure to contribute to the market value of the firm. Therefore, we cannot expect a high correlation with R&D or market value monetary measures. R&D showed a higher explanatory power than patents and citation-weighted patents for the market value in the earlier years, and, by 1984-86, the R&D and citation-weighted have similar explanatory power.

5.4 Previous research on Stock Valuation Models

There is a large literature covering the stock returns, assets prices and market value, and we will concentrate our description mainly in the most important and recent research related to the multivariate models of stock valuation.

Bower and Bower (1970)[168] studied four Price-Earnings multivariate models based on seven annual cross-sections of 99 US Companies for the period 1960-1966. The highest adjusted coefficients of determination from 0.53 to 0.845 were achieved with the following independent variables: Intra-year price variability of the stock, the estimated target payout rate on earnings, the estimated payout adjustment rate, the expected return on the stocks, the systematic risk of the stock, the residual risk of the stock, marketability or size of the market for the stock, and the firm effects measured by the difference between the current price-earnings ratio and the predicted one for each stock.

Ohlson (1979)[169] developed the conceptual framework to determine a valuation (equilibrium security prices) model. The main concepts are based on the facts that the behaviour of security prices cannot be related a priori to financial variables, and the future states of the financial variables can only be predicted due to their stochastic time-series

167 See Hall, B., Jaffe, A. and Trajtenberg, M., 2000, "Market Value and Patent Citations: A First Look", *NBER National Bureau of Economic Research*, Working Paper 7741.
168 See Bower, D., and Bower, R., 1969, "Test of a Stock Valuation Model", *Journal of Finance*, Vol. 25, No 2, 483-492.
169 See Ohlson, J., 1979, "Risk, Return, Security-Valuation and the Stochastic Behavior of Accounting Numbers", *Journal of Finance and Quantitative Analysis*, Vol. XIV, No 2, 317-336.

behaviour. The Ohlson's theoretical assumptions are that the environment is Markovian[170] and Investors have homogeneous beliefs. The valuation model is a function of the information variables and the exogenous process of dividends. This analysis used for a single security can be extended to the determination of prices and returns on the market portfolio.

Kleidon (1986)[171] shows that a high percentage of the price changes is explained by the changes in expectations of future cash flows and is demonstrated by the use of simple models and a few information variables. He states that earnings and investments are the fundamental variables more representative to set the stock prices.

Easton and Harris (1991)[172] demonstrate the association between earnings per share and stock returns. They have studied two univariate and one multivariate models. The first model associates stock returns to the earnings per share divided by price at the beginning of the period (R^2=7.5%). The second model associates the stock returns to the changes of earnings per share also divided by price at the beginning of the period (R^2=4%), and the third one combines the previous explanatory variables in one model (R^2=7.7%). In all of them, the coefficients have been found significantly different from zero.

Ohlson (1991 and 1995) and Edwards and Bell (1961) developed the abnormal earnings or EBO model[173], which is also called the Edwards-Bell-Ohlson (EBO) model. It defines the market value of equity of the firm in terms of the opening book value, return on equity, and the abnormal earnings. The abnormal earnings are defined as the excess of the net income and the expectations on the equity book value (this is the equity book value affected by the required rate of return).

Fama and French (1996)[174] summarized the up to date current research. The firm's average returns on common stocks are related to the size (market value), book-to-market equity, earnings/price, cash flow/price, past sales growth, long-term past return, and short-term past return. They developed a three-factor model where the expected return on a portfolio in

[170] See Campbell, J., Lo, A., and MacKinlay, A., 1997, "Parameter Estimation of Asset Price Dynamics", *The Econometrics of Financial Markets*, Princeton University Press, 9, 357.
[171] See Kleidon, A., 1986, "Variance Bounds Tests and Stock Price Valuation Models", *Journal of Political Economy*, Vol. 94, No 5, 953-1001.
[172] See Easton, P., and Harris, T., 1991, "Earnings As an Explanatory Variable for Returns", *Journal of Accounting Research*, Vol. 29, No 1, 19-36.
[173] See White, G., Sondhi, A., and Fried, D., 1997, "The Abnormal earnings or EBO model", *The Analysis and Use of Financial Statements*, 2nd Ed., John Wiley & Sons, 19, 1062,
[174] See Fama, E., and French, K., 1996, "Multifactor Explanations of Asset Pricing Anomalies", *Journal of Finance*, Vol. 51, No 1, 55-84.

excess of the risk-free rate is explained by the excess return on a broad market portfolio, the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks, and the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks.

Ang and Liu (1998)[175] developed the General Affine Earnings Valuation Model, also called the AL model. It is a structured model based on the Linear Information Model developed in Ohlson (1995) and Feltham and Ohlson (1995). It can be applied to the stocks with negative earnings. They described the book value of equity growth process, and, additionally, they modelled how the Price-to-book ratio of a firm is affected by the stochastic interest rates, a rate of return measure based on profitability (accounting returns of earnings in excess of the risk-free rate) and firm growth.

Bakshi and Chen (1998 and 2004)[176] developed a stock valuation model based on earnings, instead of dividends. The stock valuation model has three variables as the main inputs: net earnings per share, expected earnings growth, and interest rate. At the time of implementation the model produced lower pricing errors than existing models, but they recognized that there must be market-wide or firm specific factors missing from the model.

Chang, Chen, and Dong (1999)[177] studied the performance of several stock valuation models. The first one was developed by Bakshi and Chen (1998), as previously mentioned, and was extended by Dong (1998). It is also called the BCD Model. It relates the stock's fair value to the firm's net earnings per share, the expected future EPS growth, and the stochastic 30-year treasury yield.

The second one is the Lee-Myers-Swaminathan (1998) residual income model. They regressed the Value to price ratio to the book to market ratio, the earnings to price ratio, size, and the past return momentum. They recommend it as an investment strategy to combine the forecast based on the BCD model, momentum, size and the Lee-Myers-Swaminathan Value to price ratio rankings to form a stock portfolio.

175 See Ang, A., and Liu, J., 1998 and 2001, "A General Affine Earnings Valuation Model", *Columbia University,* UCLA and NBER.

176 See Bakshi, G., and Chen, Z., 1998 and 2004, "Stock Valuation in Dynamic Economies", *Ohio State University,* Working Paper.

177 See Chang, C., Chen, Z., and Dong, M., 1999, "Investing with a Stock Valuation Model ", *Ohio State University,* Department of Finance.

Dong (2000)[178] studied a general model of stock valuation based on the Bakshi and Chen (1998) and made it applicable to stocks with negative earnings. He added a new earnings adjustment parameter (buffer earnings), and introduced the adjusted earnings and the adjusted earnings growth concept. The introduction of the buffer earnings variable makes possible that a company with negative earnings may have a positive stock price. The empirical performance of the new model has been shown to be better than the BC model: smaller pricing errors, more stability, and a stronger mean-reversion of the model mispricing for the stocks.

Ang and Bekaert (2006)[179] found the dividend yield to be a poor predictor of the future returns in univariate regressions. At the same time, they found strong evidence of predictability at short horizons using both dividend yields and short rates as instruments. At short horizons, the short rate predicted excess returns strongly and negatively, whereas at long horizons the predictive power of the dividend yield was weak.

Additionally, they detected a strong role for the earnings yield as a predictive instrument not for excess returns, but for future cash-flows.

Balachandran and Mohanram (2006)[180] questioned the prior research, which indicated that residual income has limited practical usefulness. They modelled several alternative models for the stock returns, but the most clarifying one is when the stock returns are based on the changes in earnings and those in residual income. Their results suggest that contemporaneous returns do not fully impound the implications of earnings which do not exceed the cost of capital, as changes in current residual income predict future returns.

Jansen and Wang (2006)[181] evaluated the FED Model. This model predicts the level of the stock market as measured by the earnings yield on the S&P 500 to the yield on the bond yield (10-year government bonds). They found that, for stock prices, the Fed Model improves on the univariate model for longer-horizon forecasts, and the non-linear vector error correction model performs even better than its linear version.

---

178 See Dong, M., 2000, "A General Model of Stock Valuation", *Ohio State University,* Department of Finance.

179 See Ang, A., and Bekaert, G., 2006, "Stock Return Predictability: Is it there?", *Columbia University and NBER.*

180 See Balachandran, S., and Mohanram, P., 2006, "Is Residual Income Really Uninformative About Stock Returns?", *Columbia Business School.*

181 See Jansen, D., and Wang, Z., 2006, "Evaluating the FED Model of Stock Price Valuation: An out-of-sample forecasting perspective", *Econometric Analysis of Financial and Economic Time Series/Part B, Advances in Econometrics,* Vol. 20, 179-204.

Chen and Zhang (2007)[182] studied how the accounting fundamentals explain cross-sectional variations in stock returns. They modelled the stock returns related to the earnings yield, capital investment, changes in profitability, growth opportunities, and changes in the discount rate. The information content is mainly based on the four independent variables, which are cash-flow factors, and the discount rate plays a minor role.

They emphasized that the theoretical and empirical results of their research enhance the understanding of how stock returns relate to the accounting fundamentals. These results provide more explanation power than the common risk factors models developed in the finance literature. An important remark is that previous studies have used market-to-book ratio as a proxy for growth opportunity, but in this case they used the consensus analyst forecast of the firm's long-term growth rate as a proxy for growth opportunity and the revisions of the consensus as the changes in growth opportunities.

Our research differs from the previous one in the following aspects: First, it differs in the objectives, second, in the variables used, thirdly, in the methodology and lastly in the conclusions. In our research, the Created Shareholder Value econometric model identifies the main business and investors' processes affecting it. The previous research has been mainly focused on the definition of the Shareholder Value identifying its components and value enhancement based on definition models. However, it does not identify the significant variables based on the firm panel data econometrics and does not analyse at the investors behaviour level as we do. In our Market Value model, based on the created shareholder value, we find that the changes in market value are highly explained by the created shareholder value in the analysed period. Biddle, Bowen and Wallace (1997) found a very low association between market-adjusted annual Stock Returns and EVA and Residual Income respectively. The differences between our research and the BBW's research are due to the variables used and the created shareholder value differs considerably from the EVA and Residual Income definitions[183]. In our research, the Market Value econometric model identifies the main business and investors' processes affecting it and, additionally, we refine and challenge the results obtained in our created shareholder value model.

---

182 See Chen, P., and Zhang, G., 2007, "How do accounting variables explain stock price movements? Theory and Evidence", *Journal of Accounting and Economics*, Vol. 43, 219-244.

183 See Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, Elsevier Science, 14, 309.

Secondly, our research differs in the variables used. We have been adopting the traditional accounting variables in this type of research and have been introducing the investor's behaviour variables trying to replicate the investor's way of thinking in selecting new investments. One of these variables is: the "Over and undervalued shares gap" is the difference between the estimated share price based on the net present value of the future forecasted quarterly free cash flows deducing the current debt and the current price. The second is the "Potential growth path" which is the difference between the maximum share price in the previous twelve months less the current one.

The first variable allows us to identify the potential for growth, and this hypothesis very clearly assumes that the free cash flow stream growth will be kept for the future. Chen and Zhang[184] used the consensus analyst forecast as a proxy for the firm's long term growth rate and other authors have used the beginning market to book ratio. In our research the earnings consensus analyst forecast has been considered as a variable, but we did not find any significant contribution neither to the growth of the Created Shareholder Value nor to the one of the Market Value.

The second variable assumes that the share prices drop because of external and internal shocks, but sooner or later they will return back to the highest level under normal circumstances. The first variable is tracking the potential growth because of the firms characteristics, and the second one is the potential growth due to the market moves with the notion to move up after reaching the lower bound (support level) and to drop after reaching the high bound (resistance level)[185].

Thirdly, we differ in the implemented methodology. The variables (#18) have been classified in four groups and the regressions have been performed based on the Hendry-LSE approach[186]. This is also named as the "general to simple approach". The method starts with a general model and then it is reduced by eliminating the variables one at a time with the least significant coefficient. Additionally, we have taken the first lag and differences for every variable, except those which are already calculated as a difference.

---

[184] See Chen, P., and Zhang, G., 2007, "How do accounting variables explain stock price movements? Theory and evidence", *Journal of Accounting and Economics*, 43, 227.

[185] See Siegel, J., 2002, *Stocks for the Long Run*, 3rd Ed., McGraw Hill, Part 4, 17, 288.

[186] See Ramanathan, R., 1989, *Introductory Econometrics with Applications*, 4th Ed., The Dryden Press, 6, 284

Fourthly, our research based on econometric models identifies the accounting variables affecting the shareholder value creation, how the changes in market value are positively associated to the shareholder value creation and finally the accounting variables affecting the changes in market value. The created shareholder value has been calculated by Pablo Fernandez's formulation approach. Our results are consistent with Chen and Zhang[187] in terms of the importance of the profitability changes, and the free cash flow variables. We differ on identifying the capital investment, and the consensus analyst forecast as significant to the market value changes. In our research, we have identified the invested capital as positively associated to the changes in the created shareholder value.

5.5 Data and Resources.

The data used in the research has been based on the Standard & Poor's 100 (100 Companies). In the end it resulted in 92 Companies after some cleaning and missing data, 48 Quarters by Cross Section (Q2-1991 until Q1-2003), sourced by Standard and Poor's-Compustat (North America) Data. The total number of observations in the panel is 4416.

Look Forward Earnings per Share Data were supplied by IBES-Thompson Financial.

All values are nominal and end of quarterly data as recommended when dealing with quarterly share prices, dividends, market values and earnings per share data.

Software used is Stata-SE, release 8.0.

We have classified the independent variables in four sets according to the current literature. These are:

- The External Market Influences
- The Simplified Model Variables
- The Analysts and Investors Expectations
- The Fundamental Variables

The definition of the variables, where lower case letters indicate that a variable has been transformed into a natural logarithm or ratios, are the following (See Appendix 7a):

[187] Chen, P., and Zhang, G., 2007, "How do accounting variables explain stock price movements? Theory and evidence", *Journal of Accounting and Economics*, 43, 242.

5.5.1 Dependent Variables

Created Shareholder Value[188], Lcsv = Log of the Created Shareholder Value Qtly. The Created Shareholder Value reflects the shareholder value added excess to the equity market value adjusted by the required return to equity. These last two variables measured at the beginning-of-period.

Created Shareholder Value = Shareholder value Added – (Equity Market Value$_{-1}$ *.Ke*$_{-1}$*)*

Where Ke is the required return to equity.

Shareholder Value Added = Increase of Equity Market Value + Dividends + Other Payments to Shareholders (Buybacks,...) – Outlays by Shareholders – Convertible Debentures converted.

The enclosed table shows the process:

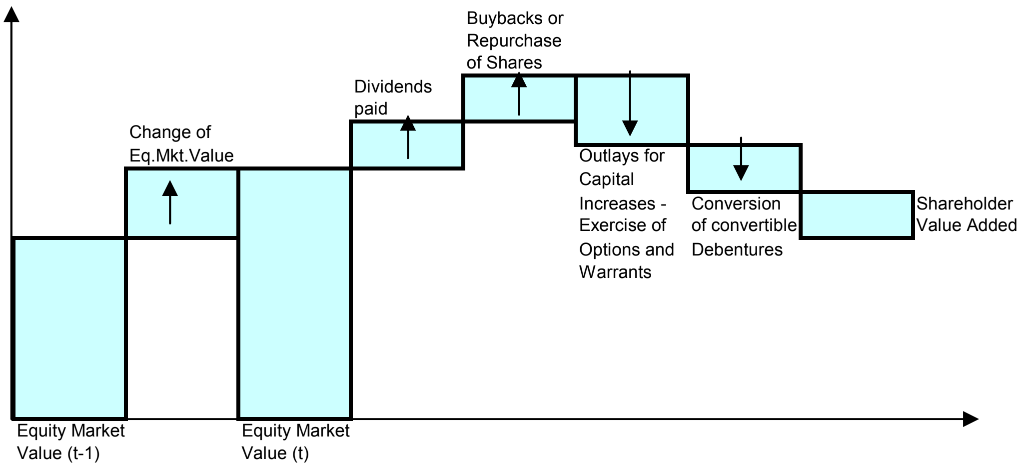


Figure 5.1 Shareholder Value Added processes

Market Value, m = log of the Equity Market Value at the closing of the Quarter.

The independent variables are the following:

5.5.2 The External Market Influences

Standard & Poor's – Quarterly Index. sp = ln(S&P 500 Quarterly index).

188 See Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, Elsevier Science, 1, 9.

The Quarterly Index measured at the closing of the quarter. This variable captures the market shocks non controllable by the firm.

5.5.3 The Simplified Model Variables

This set of variables compiles the most basic variables. The Assets Efficiency and the Strategic Index are borrowed from the Slywotzky and Morrison[189] simplified model.

Free Cash Flow, f = log of the free cash flow at the closing of the quarter.

Net Income, ni = log of the net income at the closing of the quarter.

Assets Efficiency. ef = Average total assets to the sales ratio, both variables measured at the closing of the quarter.

Strategic Index. si = The stock of the research and development capital to the sales ratio, both variables measured at the closing of the quarter.

Total Debt, td = log of the total debt at the closing of the quarter. This variable captures the effects in the market value of the total debt reductions.

5.5.4 The Analysts and Investors Expectations

Over and Undervalued Shares Gap, v = log of the difference between the estimated share price based on the net present value of the future forecasted quarterly free cash flows less the debt and the current share price.

This variable provides a measure of how over or undervalued is the share price calculated by the Financial Entities (Investment Banks, Private Equity…) for the Investors. The formulation is the following:

The NPV-Net Present Value of the Free Cash Flows Qtly is:

$$\text{NPV(FCFQ)} = \sum \frac{FREECFLQ\ (1+g)^{i-1}}{(1+wacc)^{i}} = \frac{FREECFLQ}{wacc - g} \qquad (5.5.4.1)$$

189 See Slywotzky, A., and Morrison, D., 1997, *The Profit Zone*, Times Books, Random House, New York, Appendix 1.

The weighted average cost of capital is:

$$\text{wacc} = \frac{(MKVALQ * Ke) + (DTQ * Kd * (1-T))}{MKVALQ + DTQ} \quad (5.5.4.2)$$

g = Qtly Free Cash Flow growth rate against same period of the previous year.

$$g = \text{FCFQ growth rate} = \frac{(FREECFLQ - FREECFLQ_{-4}) * 100}{FRRECFLQ_{-4}} \quad (5.5.4.3)$$

The difference between the projected share price from the FCF and the current will be:

$$v = \ln\left(\left(\frac{FREECFLQ}{wacc - g} - DTQ\right)\frac{1}{CSHOQ} - \frac{MKVALQ}{CSHOQ}\right) \quad (5.5.4.4)$$

v = Over and Undervalued Shares Gap in logs

Another way to look at the effect of the Over and Undervalued Share process contributing to the creation of shareholder value can be explained in the following way: when we benchmark the shares of a portfolio and identify which are over or undervalued with the two graphs used by the Financial Entities (Investment Banks, Private Equities, etc..), what we are doing is drawing attention to the Investors to invest in the undervalued shares if the fundamentals are correct and, in consequence, boost the share price. The two graphs above mentioned are:

- The linear regression of the EV/CE (enterprise value to capital employed ratio) against the difference: ROCE-WACC (return on capital employed minus weighted average cost of capital), or alternatively
- The linear regression of the EV/CE (enterprise value to capital employed ratio) against the ROCE to WACC ratio (return on capital employed to weighted average cost of capital ratio)[190]

In both graphs the shares above the line are overvalued (expensive) and below the line are undervalued (cheap).

Potential Growth Path, p = ln ((PRCHM12 – PRCCM)*CSHOQ) (5.5.4.5)

PRCHM12 = Price monthly high 12 months

[190] Benneth Stewart III, G., 2000, *The Quest for Value*, Spanish Edition, 3, 97.

PRCCM = Price monthly close

CSHOQ = Common shares outstanding quarterly

The Potential Growth Path is the log of the difference between the maximum market value in the previous twelve months less the current one.

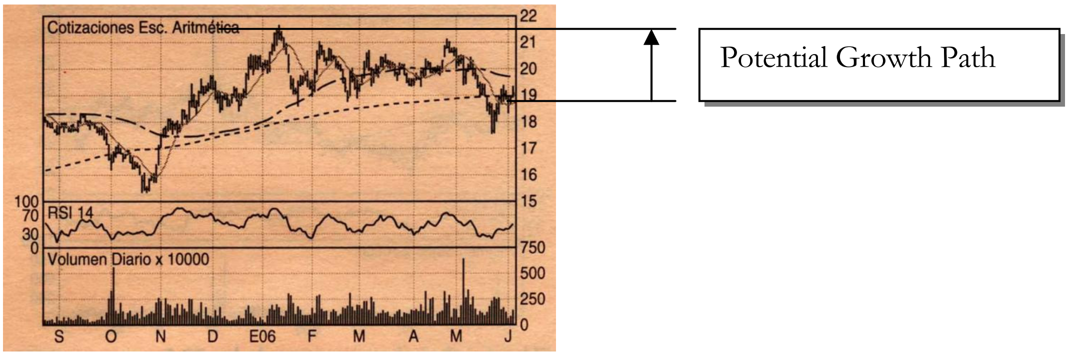


Figure 5.2 Potential Growth Path

The Potential Growth Path variable captures the Investors Behaviour under the assumption that the share prices drop because of external and internal shocks, but sooner or later they will return back to the highest level, and they can continue growing depending on the future expectations. Trying to capture this concept of coming back to the top price the definition of the Growth Path variable is the log of the difference between the highest monthly price of the last 12 months, and the price of the monthly close at the end of the quarter and this gap multiplied by the number of common shares outstanding quarterly, as above mentioned in terms of market value. The enclosed Figure 5.2 shows the share prices gap.

<u>Look Forward EPS diluted to current</u>, L = log of the difference between the look forward EPS diluted excluding extraordinary items for the current year and the current one at the closing of the quarter.

This measure captures the potential growth from the Analysts' point of view.

<u>Free Cash Flow to Total Assets ratio</u>, fa = Free cash flow to the average total assets ratio, both variables measured at the closing of the quarter.

5.5.5 The Fundamental Variables.

Payment of Cash Dividends, di = log of the payment of cash dividends measured at the closing of the quarter.
Repurchase of Shares, r = log of the purchase of common and preferred shares measured at the closing of the quarter.
Sale of Common and Preferred Shares, s = log of the sale of common and preferred shares measured at the closing of the quarter.
Retirement of Long Term Debt, rd = log of the retirement of the long term debt measured at the closing of the quarter.
Investing Activities, ia = log of the investment activities measured at the closing of the quarter.
Retained Earnings, re = log of the retained earnings measured at the closing of the quarter.
Invested Capital, ic = log of the invested capital measured at the closing of the quarter.
Investments (Capital Expenditures), px = log of the capital expenditures measured at the closing of the quarter.

The Table 5.1 summarizes the statistics on the key variables.

As already mentioned, the period covers from Q2-1991 to Q1-2003. The average company market value of the sample is US$34170.73 million and ranges from US$73.99 million to $571197.3 million. The average created shareholder value is negative US$7328.32 million and ranges from a negative US$145724.3 to a positive US$82602.22 million. This result is very consistent with Fernandez's findings[191]. We can only see 93 companies with a positive created shareholder value from the 130 most selected US Companies for the period 1998 to 2000 in his table 1.8.

The average free cash flow of the sample is US$136.67 million and ranges from a negative US$35630 million to a positive US$24594 million. The average net income is US$352.19 million and ranges from a negative US$54244 million to a positive US$17646 million.

[191] Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, Elsevier Science, 1, 11.

The S&P 500 Index grew from a 371.16 in Q1-1991 to a maximum at 1498.58 in Q1-2000 and then continuously dropping due to the telecom companies' crisis to a 848.18 in Q1-2003 in the researched period.

Dependent and Explanatory Variables	Mnemonic	Obs	Mean	Std. Dev.	Min	Max
THE DEPENDENT VARIABLES						
Created Shareholder Value	lcsv	1123	-4.250	7.168	-11.889	11.322
Market Value	m	4301	9.654	1.320	4.304	13.255
THE EXTERNAL MARKET INFLUENCES						
S&P500 Index	sp	4491	6.623	0.451	5.917	7.312
	dsp	4490	0.000	0.142	-0.826	0.235
THE SIMPLIFIED MODEL VARIABLES						
Free Cash Flow	f	3203	1.412	5.376	-10.481	10.110
	df	3110	0.039	7.028	-19.912	19.734
Net Income	ni	4057	4.392	3.448	-10.901	9.778
	dni	3957	0.064	3.730	-16.225	16.943
Assets Efficiency	ae	3914	9.797	12.084	0.845	70.880
	dae	3812	0.086	2.065	-27.192	30.947
Strategic Index	si	600	37.520	35.403	0.000	189.139
	dsi	570	0.871	8.190	-43.407	67.092
Total Debt	td	4099	8.461	1.758	-1.470	12.862
	dtd	3998	0.028	0.269	-3.683	3.879
THE ANALYSTS AND INVESTORS EXPECTATIONS						
Over & Undervalued Shares Gap	v	1367	-4.001	0.942	-10.763	6.272
Potential Growth Path	p	3994	7.657	1.787	0.306	12.327
Look Forward EPS diluted to current	l	3939	0.162	0.952	-4.605	18.245
FCF to T.Assets ratio	fa	3203	0.103	1.230	-5.354	5.278
	dfa	3110	0.009	1.721	-6.834	6.753
THE FUNDAMENTAL VARIABLES						
Payment of Cash Dividends	di	2859	5.279	1.339	-4.605	8.876
	ddi	2756	0.041	0.830	-4.479	3.970
Repurchase of Shares	r	2115	5.345	1.826	-3.219	9.030
	dr	1926	0.095	1.197	-9.036	7.135
Sale of Common & Preferred Shares	s	2479	3.935	1.667	-4.605	9.251
	ds	2309	0.033	1.237	-8.455	8.460
Retirement of Long Term Debt	rd	2843	5.305	2.466	-3.507	10.770
	drd	2641	0.060	1.546	-8.252	7.040
Investing Activities	ia	3556	-5.318	3.733	-11.133	9.077
	dia	3464	-0.026	3.383	-17.022	18.537
Retained Earnings	re	3850	7.441	3.533	-11.536	11.461
	dre	3696	0.009	1.233	-16.726	14.245
Invested Capital	ic	4025	9.126	1.286	-6.066	12.534
	dic	3926	0.027	0.348	-13.417	14.361
Investments (Cap. Expenditures)	px	3168	5.975	1.493	-1.171	10.409
	dpx	3074	0.030	0.947	-2.763	2.055

Table 5.1 Mean, standard deviation, and range of each variable

The average Over and Undervalued Shares Gap of the sample is a negative –4.00 and ranges from –10.76 to +6.27. This means that the current price has been consistently higher than the projected share price and in consequence the outcome sign is negative. The market was overvalued during this period, and this was one of the reasons of the crisis on Q1-2000.

The average Potential Growth Path of the sample is 7.65 and ranges from 0.30 to 12.32. Considering that the average price monthly close is at 32.82, it means that the average potential for growth has been a 23.31% at the closing of the quarters.

The enclosed table summarizes the correlation or covariance matrix for the group of significant variables in the econometric models.

Explanatory Variables	S&P 500 Index (1st-Diff.) dsp	Net Income (1st-Diff.) dni	Strategic Index (1st-Lag) si_1	Over & Under-valued Shares Gap v	Potential Growth Path p	Cash Dividends (1st-Lag) di_1	Cash Dividends (1st-Diff.) ddi	Sale of Com. & Pref. Shares (1st-Lag) s_1	Sale of Com. & Pref. Shares (1st-Diff.) ds	Retirement of LT Debt (1st-Lag) rd_1	Invested Capital (1st-Diff.) dic
dsp	1.000										
dni	-0.118	1.000									
si_1	-0.024	-0.004	1.000								
v	-0.023	-0.011	0.282	1.000							
p	-0.192	-0.035	0.400	0.145	1.000						
di_1	0.009	-0.012	0.135	-0.183	0.208	1.000					
ddi	-0.013	-0.092	-0.128	-0.020	0.036	-0.387	1.000				
s_1	0.057	0.004	0.148	-0.057	0.133	0.271	-0.300	1.000			
ds	0.079	-0.136	-0.080	-0.011	-0.105	-0.334	0.788	-0.362	1.000		
rd_1	0.073	-0.135	-0.250	-0.252	-0.215	0.116	-0.239	0.179	-0.159	1.000	
dic	-0.026	-0.082	0.020	-0.053	-0.019	-0.054	0.079	0.056	0.049	-0.075	1.000

Table 5.2 Correlation or covariance matrix of the explanatory variables.

Due to the definition of the different explanatory variables, we are not confronted with a severe collinearity problem. There is one coefficient higher than 0.5 in absolute value. This is the case with the Cash Dividends (1st-Diff.) and the Sale of common and preferred shares (1st-Diff.) at 0.788. We will not face, at any time, both explanatory variables in the same model. The Cash Dividends have been identified significant in the Created shareholder value model as well as the Sale of common and preferred shares in the market value. The previous correlation matrix compiles the significant explanatory variables of both the created shareholder and the market value models.

5.6 The Created Shareholder Value Model specification.

The Shareholder Value Creation and Value Based Management Theories provide the framework to develop a strategy that generates future cash flows with a positive net present value that exceeds expectations, or internal rates of return higher than the cost of capital. There is a wide academic literature defining the value key drivers. For example we can refer to Rappaport[192] in his book *Creating Shareholder Value* in which he defines the seven value drivers: sales growth rate, operating profit margin, income tax rate, working capital

192 Rappaport, A., 1998, *Creating Shareholder Value: a guide for managers and investors*, 2nd Ed., The Free Press, 3, 55.

investment, fixed capital investment, cost of capital and value growth duration. In our case we will have eighteen variables (#18) to be checked.

Following our objective to identify the key processes contributing to the Created Shareholder Value, we adopt the dependent variable calculated under the Fernandez's formulation already described in item 5.5.1 and the explanatory or independent variables as in the items 5.5.2 to 5.5.5. We will consider the (1st-lag) and (1st-diff.) of every variable.

Adopting a generic notation the model will be as follows:

$$lcsv_{it} = \Sigma(\beta_1 X_{i,t-1} + \beta_2 dX_{it}) + \eta_i + \varepsilon_{it} \qquad (5.6.1)$$

The dependent variable is expressed in natural logarithms but, as some of the explanatory variables are ratios, the coefficients are not always elasticities and the interpretation will not be so straightforward (See Appendix 7a for a fuller variables description).

5.6.1 Description and discussion of results.

After conducting all the econometrics estimators for the specified model and selecting the most adequate ones according to the different relevant tests, we can describe and discuss the following results. Section 5.6.2 provides the detailed econometric outcomes:

Change of the S&P500 Index. The global stock market evolution shows a positive contribution to the created shareholder value. The S&P500 Index grew a compound annual growth rate at 17.8% from a 403.69 in March, 92 to a maximum at 1498.58 in March, 2000, and dropped a compound growth rate at –17.3% to 848.18 in March 2003. Looking at the whole analysed period the S&P500 Index grew a compound annual growth rate at +6.9% from March, 92 to March, 2003.

The shareholder value added definition includes the increase of equity market value as a positive contributor. This is why the change of the S&P500 index contributes in a positive way to the shareholder value added and, in consequence, to the created shareholder value as well. This has been confirmed by the econometric outcome.

Change of the Net Income. The change of the net income vs the previous quarter shows a negative contribution to the created shareholder value. As previously mentioned, the average company was not creating value and the net income was positive and slightly growing in the analysed period. As the average created shareholder value is negative and the change of the net income positive for the whole period, the negative contribution of the latter is clear.

Strategic Index. The strategic index shows a positive contribution to the created shareholder value. This is a very important result because a variable such as the stock of R&D capital to sales ratio, used more in models with annual data, is showing a significant positive contribution in a quarterly based model and in lags, not in first differences. This means that making strategic investments in long-term is much better than short-term small innovations to move the creation of shareholder value up.

Over and Undervalued Shares Gap. The over and undervalued shares gap shows a negative contribution to the created shareholder value. Considering that the over and undervalued shares gap is defined as the net present value of the future forecasted quarterly free cash flows less the debt with the right adjustments and the current share price was negative, this means that the current share price was higher than the net present value of the expectations and the shares were overvalued for the period.

The evolution of the over and undervalued shares for the period was positive, which means that the overvalued gap was reduced for the period. This was also due to the IT-bubble shock in 2000 with the share prices drop during which the overvalued gap was reduced and was not contributing to the negative evolution of the creation of shareholder value. This is the reason for the negative contribution stated in the last paragraph.

Potential Growth Path. The potential growth path shows a negative contribution to the created shareholder value. The potential growth path was always positive and, in this case, growing for the whole analysed period. It is very clear that the potential growth path with this evolution was not contributing to the drop of the created shareholder value. As an example, the IT companies state of highs for the period the potential growth path was specially positive from the peaking in March, 2000 until the end of the period Q1-2003.

Cash Dividends. The payment of cash dividends shows a positive contribution to the created shareholder value. The shareholder value added definition includes the change in market value, cash dividends, and repurchase of shares as the positive contributors and, in consequence, to the created shareholder value as well. The econometric outcome confirms this fact.

Sale of Common and Preferred Shares. The sale of common and preferred shares shows a negative contribution to the created shareholder value. The definition of the shareholder value added includes the outlays by shareholders (outlays for capital increases, exercise of options and warrants and sale of common and preferred shares,..) and conversion of convertible debentures as negative contributors. The econometric outcome confirms that the sale of common and preferred shares is a negative contributor to the shareholder value added and, in consequence, to the created shareholder value.

Retirement of Long-term Debt. The retirement (reduction) of long-term debt shows a negative contribution to the created shareholder value. The retirement of long-term debt was positive for the whole period and had a positive evolution. It is clear that, with this positive evolution, the reduction of debt does not contribute to the negative evolution of the created shareholder value for the period, and the retirement of long-term debt becomes a negative contributor.

The long-term debt is commonly considered together with the owner's funds as the capital employed[193] of the company, and in this sense any sale of the common and preferred shares or retirement of the long-term debt is considered a negative contributor to the created shareholder value. As we have seen, the econometric outcome shows the retirement of the capital employed as a negative contributor. In this context we do not include short-term bank borrowings as permanent funds and to be part of the capital employed.

Change of the Invested Capital[194]. The change of the invested capital shows a positive contribution to the created shareholder value. The definition of shareholder value added includes the change of the equity market value as a positive contributor and, in consequence, to the created shareholder value[195] as well. This has been confirmed by the econometric outcome.

The econometric outcome emphasizes the fact that we need to consider the change of invested capital as a positive contributor, or, alternatively, the sale of common and preferred shares and the retirement of long-term debt as negative contributors to the created shareholder value. Both results are equivalent.

---

193 See Walsh, C., 1996, *Key Management Ratios*, FT Pitman Publishing, 3, 28.

194 Invested Capital includes common equity, long-term debt, minority interest, and preferred stock. Standard & Poors, 1998, *Compustat (North America) Data Guide*, 4, 30.

195 See Fernandez, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, Elsevier Science, 1, 9.

5.6.2 Detailed discussion of the Econometric estimates

We started running the fixed and random effects estimators, and the Hausman test indicates that the random effects estimator has degenerated to a pooled OLS estimation. Additionally we can also confirm the high correlation between the individual effects and the regressors: corr(u_1,X)= -0.8802. This result clearly indicates that the estimator is a fixed effects one.

The proposed Created shareholder value model will be estimated using the heteroskedasticity and robust covariance matrix estimators[196] in order to get consistent estimates for the parameters. Two estimators have been considered: the first is the robust Huber-White[197] sandwich estimator of variance which produces consistent standard errors for the OLS regression coefficient estimates in the presence of heteroskedasticity, the estimator is named "areg" in Stata. The second is the Newey-West[198] variance estimator which is an extension that produces the consistent estimates when there is autocorrelation in addition to possible heteroskedasticity. The estimator is named "newey2" in Stata.

Both estimators show the test of overall significance of the regression higher than the tabular value of F. This indicates that the regression coefficients are not all equal to zero and the R-squared is significantly different from zero. The "areg" estimator shows an F equal to 17.36 higher than the tabular F(7, 225)=2.04 and the R-squared equal to 0.327. The "newey2" estimator shows and F equal to 25.93 higher than the tabular F(6, 319)=2.13.

The strategic index and the cash dividends have been contributing in a positive way to the created shareholder value in the "newey2" as well as "areg" estimators outcomes. Both variables have been measured in levels.

The change of net income and the potential growth path are contributing in a negative way to the created shareholder value in the "newey2" as well as "areg" estimators outcomes. It is important to remark that the net income is measured in first differences, and the potential

---

[196] See Greene, W., 2000, *Econometric Analysis*, 4th Ed., Prentice Hall, 14, 579.

[197] Huber-White HCCME. "Heteroskedasticity consistent covariance matrix estimator". See Davidson, R. and MacKinnon, J., 1993, "Covariance matrix estimation", *Estimation and inference in econometrics*, Oxford University Press, 17.5, 607-611.

[198] Newey-West HACCME. "Heteroskedasticity and autocorrelation consistent covariance matrix estimator". See Davidson, R. and MacKinnon, J., 1993, "Covariance matrix estimation", *Estimation and inference in econometrics*, Oxford University Press, 17.5, 612.

growth path is the difference between the higher 12 months and the closing monthly price, which is in essence a change in share prices.

The change of the S&P500 Index and that of the invested capital are contributing in a positive way to the created shareholder value in the "newey2" estimator outcome. Both variables have been measured in first differences.

The over and undervalued shares gap, the sale of common & preferred shares, and the retirement of long-term debt are contributing in a negative way to the created shareholder value in the "areg" estimator outcome. The above mentioned variables have been measured in levels.

Created Shareholder Value	lcsv	Fixed Effects OLS	HACCME newey2 Robust	HCCME FE OLS-areg Robust
S&P Index (1st-Diff.)	dsp		9.522 (3.00)	
Net Income (1st-Diff.)	dni	-0.183 (-1.72)	-0.171 (-2.52)	-0.245 (-2.65)
Strategic Index (1st-Lag)	si_1	0.076 (1.55)	0.038 (3.02)	0.111 (2.66)
Over & Undervalued Shares Gap	v	-6.000 (-3.09)		-3.918 (-2.41)
Potential Growth Path	p	-3.518 (-7.26)	-2.686 (-9.86)	-3.291 (-8.26)
Cash Dividends (1st-Lag)	di_1	5.323 (3.85)	0.897 (2.32)	3.352 (3.25)
Cash Dividends (1st-Diff.)	ddi	1.669 (1.91)		
Sale of Common & Preferred Shares (1st-Lag)	s_1	-1.240 (-1.82)		-1.286 (-2.10)
Retirement LT Debt (1st-Lag)	rd_1	-0.855 (-2.14)		-0.979 (-2.94)
Invested Capital (1st-Diff.)	dic		6.813 (2.94)	
Constant	cons	-18.267 (-1.55)	13.573 (5.24)	-1.475 (-0.15)
Nr Observations F-Statistic R-squared Adj R-squared		218 10.04 0.1261	326 25.93	233 17.36 0.3269 0.2307

t-values in parentheses

Table 5.3 The created shareholder value estimates

The fact that the over and undervalued shares gap, the sale of common & preferred shares and the retirement of long-term debt have been identified significant in the "areg" econometric outcome is a strong feature in favour of the "areg" estimator instead of the "newey2" one.

The long-term significant variables expressed by the first lag are the strategic index, the cash dividends, the sale of common & preferred shares, and the retirement of long-term debt.

The short-term significant variables expressed by first differences or changes are the net income, the over and undervalued shares gap, the potential growth path, and the invested capital.

5.6.2a The Created Shareholder Value Model. Panel unit root tests.

Based on a pooled data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the strategic index (1^{st}-lag), the over and undervalued shares gap and the cash dividends (1^{st}-lag) are non stationary and they are integrated of order one, I(1). All the other variables are stationary, which are all I(0).

THE CREATED SHAREHOLDER VALUE MODEL - AUGMENTED DICKEY FULLER TEST

	Levels		1st- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
lcsv	-11.167	1.975		
dni	-39.472	2.006		
si_1	0.961	1.818	-12.795	1.994
v	-0.988	1.955	-15.980	1.959
p	-10.036	2.022		
di_1	-0.567	1.889	-20.317	1.996
s_1	-10.700	1.887		
rd_1	-5.521	1.914		
1% Critical Value	-3.961			
5% Critical Value	-3.411			
10% Critical Value	-3.127			

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (si_1, v and di_1)

Table 5.4 The Augmented Dickey-Fuller test.

Based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the p-values of the four tests between 0.765 and 0.846 and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 7b). We can state that the panel is a non-stationary one and the model must be reestimated based on a first differenced variables model.

5.6.2b The Created Shareholver Value Model. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[199]. The outcome of the test shows that the null hypothesis of at most 1 cointegrating vector cannot be rejected since the trace statistic of 18.52 does not exceed the 5% critical value of 29.68. The trace test indicates one cointegrating equation, and the normalized outcome gives us one equation.

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.210256	63.37805	47.21	54.46
At most 1	0.078561	18.52925	29.68	35.65
At most 2	0.014290	2.983750	15.41	20.04
At most 3	0.001310	0.249004	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Table 5.5 The Johansen Cointegration test (Trace)

Based on a pooled data of the panel we have used the Engle and Granger test[200]. This is the residual-based test where in the first stage the cointegrating OLS regression of the created shareholder value on the strategic index (1^{st}-lag), the over and undervalued shares gap, the cash dividends (1^{st}-lag) and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1^{st} lag of the residuals is performed. The outcome shows that the t-statistic of -5.12 is more negative than the critical value of -4.70 at the 1% level and it rejects the null hypothesis of non-cointegration. It means

199 Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

200 Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometria*, 55, 2, 251-276.

that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[201] Table 2 for N=4 variables.

5.6.2c The Created Shareholder Value Model. Vector error correction estimates.

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. In this case, the long-run relationship is captured by the cointegrating equation. The cointegrating equation[202] is the following:

$$\text{CointEq1} = \text{lcsv\_1} + \underset{(0.642)}{0.5495}\ \text{v\_1} - \underset{(-2.058)}{0.8004}\ \text{di\_1} + 10.3776 \qquad (5.6.2.1)$$

To perform the Vector error correction estimates we have selected the specification with intercept, no trend, lags interval 1 to 2 in the first differences and including four exogenous variables, net income (1^{st}-diff.), potential growth path, sale of common and preferred shares (1^{st}-lag) and retirement of long-term debt (1^{st}-lag). The outcome of the VECM shows that the convergence has been achieved after three iterations and the restrictions[203] identify all cointegrating vectors. The LR test for binding restrictions shows that the statistic chi-square(1)=1.76 does not exceed the critical value of 3.84 at the 5% level. This means that the null hypothesis, that the restrictions are accepted, is not rejected. The error correction equation corresponding to the first differences of the created shareholder value shows the highest coefficient of multiple determination (R-squared) of 0.724 and the highest value of the test of the overall significance of the regression (F-statistic) of 32.747. Additionally, the vector error correction models related to the first differences of the strategic index (1^{st}-lag), the over and undervalued shares gap, and cash dividends (1^{st}-lag) do not rely in the long-run cointegrating equation due to the non-significance of the related coefficients.

The final outcome of the error correction model of the created shareholder value (1^{st}-diff.) shows the coefficient of the cointegrating equation very significant and contributing in a negative way to the created shareholder value (1^{st}-diff.). The cash dividends (1^{st}-lag) contributes in a high positive and very significant to the adjustments in the created shareholder value (1^{st}-diff.), due to its negative and high significant contribution in the

---

[201] Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157.

[202] t-Statistics shown in parentheses

[203] See cointegration restrictins in Appendix 1b.

cointegrating equation. All the other coefficients are significant, except the first differences of the strategic index (1^{st}-lag), of the over and undervalued shares gap and of the cash dividends (1^{st}-lag). They are also non-significant the net income (1^{st}-diff.) and the retirement of long-term debt (1^{st}-lag), both in levels, as they are exogenous variables in the model. It is very important to remark the high negative and significant contribution of the potential growth path to the created shareholder value (1^{st}-diff.).

We can also estimate the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegration regression using the pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses) :

$$
\begin{aligned}
Lcsv = {} & 0.003\ si\_1 - 2.486\ v - 0.390\ di\_1 - 11.704 \\
& (0.23) \quad (-2.71) \quad (-0.95) \quad (-2.93) \\
& R\text{-}sq = 0.027 \\
& F(3, 319) = 3.01
\end{aligned}
\tag{5.6.2.2}
$$

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.
The t-statistic = -2.531 is not more negative than the critical value of t = -3.430 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root cannot be rejected.
The Durbin-Watson d-statistic (7, 253) = 1.77. It is in between the critical values of 1.57 and 1.78, then there is no evidence of autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$
\begin{aligned}
\Delta lcsv = {} & -0.248\ \Delta dni + 0.107\ \Delta si\_1 - 9.376\ \Delta v - 5.343\ \Delta p + 3.865\ \Delta di\_1 - 1.037\ \Delta s\_1 \\
& (-2.71) \quad (1.34) \quad (-2.57) \quad (-7.08) \quad (2.50) \quad (-1.00) \\
& - 1.806\ \Delta rd\_1 - 0.417\ ehat\_1 - 1.681 \\
& (-2.90) \quad (-0.58) \\
& R\text{-}sq = 0.377 \\
& F(8, 181) = 13.70
\end{aligned}
\tag{5.6.2.3}
$$

The error correction model based on the Engle-Granger 2-step method in first differences is not reliable due to the non-stationarity of the residuals considered in the regression. Trying to correct the previous issue we can estimate the cointegrating equation based in the first differences. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$\Delta Lcsv = 0.164\ \Delta si\_1 - 16.015\ \Delta v - 0.359\ \Delta di\_1 + 0.112 \qquad (5.6.2.4)$$

(2.31) (-5.95) (-0.43) (0.18)

R-sq = 0.132

F(3, 289) = 14.69

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.
The t-statistic = -8.290 is more negative than the critical value t = -3.433 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin-Watson d-statistic (7, 228) = 1.038 does not exceed the critical value of 1.57 and there is evidence of autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$\Delta\Delta lcsv = -\ 0.207\ \Delta\Delta dni + 0.086\ \Delta\Delta si\_1 - 8.687\ \Delta\Delta v - 6.133\ \Delta\Delta p + 2.343\ \Delta\Delta di\_1$$

(-1.95) (0.81) (-1.43) (-7.06) (1.31)

$$+\ 0.426\ \Delta\Delta s\_1 - 2.026\ \Delta\Delta rd\_1 - 0.936\ ehat\_1 + 0.149$$

(0.34) (-2.82) (-1.70) (0.12)

R-sq = 0.470

F(8, 150) = 16.65 (5.6.2.5)

The ADF test for a unit root of the residuals of the cointegrating equation in first differences shows the stationarity of the residuals and a clear autocorrelation, which is improving the previous outcome of the cointegrating equation in levels. We may expect the outcome of the model re-estimation in second differences more reliable than the first differences one.

The coefficient of the residuals is negative and slightly significant. This means that the dependent variable the created shareholder value (1st-diff.) was above its equilibrium value in the period (t-1) and it will decrease in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is -0.936, which is a high amount and the speed of adjustment will also be high.

The outcome of the error correction model in second differences shows the net income (1st-diff.), the potential growth path, the retirement of long-term debt (1st-diff.) and the residuals (1st-lag) significant to the adjustments of the created shareholder value.

5.6.2d The Created Shareholder Value. Pairwise Granger Causality test

Based on the Granger causality Wald test the null hypothesis that the net income (1^{st}-diff.) does not Granger cause the created shareholder value cannot be rejected, the F-statistic = 1.43 does not exceed the critical value of F(7, 930) = 2.02 at the 5% level. This means that the created shareholder value cannot be predicted by the history of the net income (1^{st}-diff.).

Additionally, the null hypothesis, that all the other variables, does not Granger cause the created shareholder value is rejected. In consequence, the created shareholder value can be predicted by the strategic index (1^{st}-lag), the over and undervalued shares gap, the potential growth path, the cash dividends (1^{st}-lag), the sale of common and preferred shares (1^{st}-lag) and the retirement of long-term debt (1^{st}-lag) (see Appendix 7b). These results indicate that the previous variables help in the prediction of the created shareholder value, but it does not indicate causality in the common use of the term[204].

5.6.2e The Created Shareholder Value. Model re-estimation

Due to the fact that we were using non-stationary data the outcome of the model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the models (see table 5.3). Due to the fact that the Engle-Granger 2-step method was showing evidence of the higher reliability of the vector error correction model in second differences, we will proceed to re-estimate the model in second differences. We will also show the outcome in first differences for comparison purposes.

Based on a panel data we have implemented the fixed and random effects OLS estimators in second differences and the Hausman test. It indicates that the random effects estimator has degenerated to a pooled OLS. The Newey-West [205] variance estimator produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity, and it computes the pooled OLS estimates for panel data sets.

---

204 E-Views 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.

205 Newey, W.K. and West, K.D., 1987, "A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica*, 55, 703-708.

Error Correction:	D(LCSV)	D(SI_1)	D(V)	D(DI_1)
CointEq1	-1.497 [-10.45]	-0.187 [-0.90]	0.002 [0.52]	0.002 [0.13]
D(LCSV(-1))	0.246 [2.18]	0.112 [0.68]	-0.006 [-1.63]	0.006 [0.61]
D(LCSV(-2))	0.137 [2.09]	0.093 [0.98]	-0.003 [-1.42]	0.000 [0.04]
D(SI_1(-1))	0.006 [0.08]	-0.323 [-3.23]	0.001 [0.23]	0.000 [-0.05]
D(SI_1(-2))	-0.029 [-0.54]	-0.143 [-1.85]	0.000 [-0.15]	0.003 [0.60]
D(V(-1))	1.862 [0.61]	3.234 [0.74]	-0.347 [-3.73]	0.652 [2.41]
D(V(-2))	1.018 [0.31]	-3.025 [-0.64]	0.022 [0.21]	0.693 [2.39]
D(DI_1(-1))	0.179 [0.26]	0.249 [0.25]	-0.045 [-2.16]	-0.549 [-9.13]
D(DI_1(-2))	-0.874 [-1.26]	0.753 [0.75]	0.010 [0.49]	-0.409 [-6.62]
C	23.274 [5.40]	-0.332 [-0.05]	-0.636 [-4.79]	-0.977 [-2.53]
DNI	-0.160 [-1.49]	0.059 [0.38]	0.000 [0.09]	0.012 [1.30]
P	-2.989 [-6.88]	0.135 [0.21]	0.079 [5.91]	-0.027 [-0.69]
S_1	0.966 [2.40]	0.060 [0.10]	-0.024 [-1.93]	0.200 [5.55]
RD_1	-0.223 [-0.75]	-0.058 [-0.13]	0.012 [1.27]	0.065 [2.47]
R-squared	0.724	0.104	0.277	0.487
Adj. R-squared	0.702	0.032	0.219	0.446
F-statistic	32.747	1.451	4.782	11.815
Log likelihood	-566.148	-630.374	46.594	-141.275
Akaike AIC	6.593	7.322	-0.370	1.764
Schwarz SC	6.845	7.575	-0.118	2.017

t-values in square brackets

Table 5.6 The Created Shareholder Value. Vector error correction models

The outcome of the "newey2" HAC-Heteroskedasticity autocorrelation consistent covariance estimators are the following:

Panel data	First Differences	HAC newey2 Pooled OLS robust	Second Differences	HAC newey2 Pooled OLS robust
Net Income (1st-Diff.)	d.dni	-0.243 [-3.01]	d2.dni	-0.221 [-2.17]
Strategic Index (1st-Lag)	d.si_1	0.108 [1.97]	d2.si_1	0.154 [3.01]
Over & Undervalued Shares Gap	d.v	-9.896 [-2.70]	d2.v	-15.305 [-2.73]
Potential Growth Path	d.p	-5.374 [-8.31]	d2.p	-6.435 [-8.76]
Cash Dividends (1st-Lag)	d.di_1	3.863 [2.29]	d2.di_1	2.722 [1.38]
Sale of Common & Preferred Shares (1st-Lag)	d.s_1	-1.041 [-1.00]	d2.s_1	0.250 [0.21]
Retirement LT Debt (1st-Lag)	d.rd_1	-1.820 [-2.67]	d2.rd_1	-2.067 [-2.98]
constant	cons	-0.042 [-0.06]	cons	-0.026 [-0.02]
Nr Observations F-statistic		190 22.92		159 36.50

t-values in square brackets

Table 5.7 The Created Shareholder Value Model in first and second differences estimates

The outcomes of the first and second differences estimates are quite similar, the differences are mainly the non significance of the cash dividends in the second differences and the negative sign of the sale of common and preferred shares gap in the first differences estimation. Based on the economic theory the sign of the common and preferred shares gap must be negative, and we can state that the first differences regression is the correct one.

It is important to remark that all the variables show a significant contribution to the created shareholder value (1^{st}-diff.), excepts the sale of common and preferred shares which is non significant. All the signs of the coefficients are consistent with the economic theory.

5.7 The Market Value. Model I specification.

Based on the Fernández's definitions described at the beginning of the item 5.5.1, we can make the following transformations:

The Shareholder value added is equal to the change in equity market value plus all the other variables. In a generic notation and for a single company we can deduce:

$$SVA_t = MV_t - MV_{t-1} + \psi_t \qquad (5.7.1)$$

The Created shareholder value is equal to the excess of the shareholder value added over the equity market value adjusted by the required return to equity:

$$CSV_t = SVA_t - (MV_{t-1}\, Ke_{t-1}) \quad \text{then} \qquad (5.7.2)$$

$$SVA_t = CSV_t + (MV_{t-1}\, Ke_{t-1}) \qquad (5.7.3)$$

and combining the previous equations (1) and (2):

$$MV_t - MV_{t-1} + \psi_t = CSV_t + (MV_{t-1}\, Ke_{t-1}) \qquad (5.7.4)$$

$$\Delta MV_t = Ke_{t-1}\, MV_{t-1} + CSV_t - \psi t \qquad (5.7.5)$$

$$MV_t = (1+Ke_{t-1})\, MV_{t-1} + CSV_t - \psi_t \qquad (5.7.6)$$

where:

SVA_t = Shareholder Value Added

MV_t = Equity Market Value

CSV_t = Created Shareholder Value

Ke = Required return to equity

ψ_t = Dividends +Other Payments to Shareholders (Buybacks,..) – Outlays by Shareholders – Convertible Debentures converted. (5.7.7)

We can take as a proxy the dynamic model below expressed, which will allow us in an empirical approach to check if the changes in the Market Value can be explained by the Created Shareholder Value variable for the analysed period. This is as follows:

$$MV_{it} = \alpha' MV_{i,t-1} + \beta_1\, CSV_{it} + \eta_i + \varepsilon_{it} \qquad (5.7.8)$$

In the created shareholder value model described in the item 5.6 the "areg" estimator was showing that the S&P500 Index was not significant. We will include the external market influences making sure that the external market shocks are captured in the model.

Then the final specification with the correct transformations and the cross-section time-series notation will be:

$$mv_{it} = \alpha\, mv_{i,t-1} + \beta_1\, sp_{i,t-1} + \beta_2\, dsp_{it} + \beta_3\, csv_{it} + \eta_i + \varepsilon_{it} \quad (5.7.9)$$

where (See Appendix 7a for a fuller variables description):

mv_{it} = Natural logarithm of the Quarterly Market Value

$mv_{i,t-1}$= Natural logarithm of the lag of the Quarterly Market Value

$sp_{i,t-1}$= Natural logarithm of the S&P500 Quarterly Index (1^{st}-Lag)

dsp_{it}= Natural logarithm of the S&P500 Quarterly Index (1^{st}-Diff.)

csv_{it} = Natural logarithm of the Created Shareholder Value

η_i = Intercept

ε_{it} = Residuals. It will capture the effects of all the other variables not directly traced in the model.

It is important to remark that we are not considering the 1^{st}-Lag and 1^{st}-Diff of the log of the created shareholder value, as we have done in previous models. We define the model according to the above mentioned definition model (4). It is also important to note that the correlation coefficient between the 1^{st}-Lag and 1^{st}-Diff of the log of the created shareholder value is at -0.729 and that both variables are perfectly correlated. This is a clear argument in favour of taking the log of the created shareholder value in levels as stated by the economic theory.

The enclosed table summarizes the correlation or covariance matrix for the group of significant variables in the econometric model.

Explanatory Variables	S&P 500 Index (1st-Lag) sp_1	S&P 500 Index (1st-Diff.) dsp	Created Shareholder Value lcsv
sp_1	1.000		
dsp	-0.168	1.000	
lcsv	-0.037	0.222	1.000

Table 5.8 Correlation or covariance matrix of the explanatory variables

5.7.1 Description and discussion of results.

After conducting all the econometrics estimators for the specified model and selecting the most adequate ones according to the different relevant tests, we can describe and discuss the following results. Section 5.7.2 provides the detailed econometric outcomes:

The S&P500 Index (1^{st}-Lag). The external market influence shows a positive contribution to the change of the equity market value. The S&P500 Index and the change of the equity market value are both decreasing along the analysed period and this is the reason of the significant and positive association between both variables.

Change of the S&P500 Index (1^{st}-Diff.). The change of the S&P 500 Index shows a positive contribution to the change of the market value. The change of the S&P 500 Index and that of the market value are both decreasing along the analysed period and this is the reason of the significant and positive association between both variables.

Created Shareholder Value. The created shareholder value shows a positive contribution to the change of the equity market value. The definition of the market value in the equation (3) above mentioned in item 5.7 includes the created shareholder value as a positive contributor. The econometric outcome confirms this fact.

The created shareholder value and the change of the market value have a negative evolution for the analysed period (Q1-1991 to Q2-2003), which confirms the positive contribution of the created shareholder value to the change of the equity market value.

The equity market value had a positive evolution during the analysed period. However, the fact that it grew to a maximum at the closing of Q1-2000 and then decreased, indicates it was forcing the change of the market value to have a negative trend for the analysed period.

5.7.2 Detailed discussion of the Econometric estimates

The Equity Market Value was estimated using the Dynamic Panel Data estimators: Difference and System GMM-Generalized Method of Moments. The first estimator was developed by Arellano-Bond (1991), and the second one by Arellano and Bover (1995) and Blundell and Bond (1998) in order to get consistent estimates for the parameters. Several econometric estimators (one and two-steps and robust versions) have been performed to control the impact of the different proposed variables affecting the Market Value. Based on the best estimates we can conclude the following:

After regressing all the alternative estimators (Difference and System GMM (one and two steps, and robust versions)), we have used the variables in levels as instruments, as recommended by Arellano (1989)[206]. We can confirm that the System GMM-2 estimator provides the most consistent estimates of the coefficients. The test for AR(2) does not reject the null hypothesis of no second-order autocorrelation in the first-differenced residuals (-1.96<-0.32). This implies that the estimates are consistent.

The Hansen test for the two-step homoskedastic estimator does not reject the null hypothesis that the over-identifying restrictions are valid (chi2(425)=70.61 <chi2(table)=473.01).

Market Value (1^{st}-Lag). The coefficient at 1.008 shows us that the current market value relies on the previous year and it is consistent with the economic theory that the α-value must be higher than one, as expected in the equation (3) in item 5.7.

S&P500 Index (1^{st}-Lag). The coefficient at 0.123 shows a positive contribution of the S&P500 Index to the change of the market value in the long-term. This is consistent with the negative slope of the log of the S&P500 Index (1^{st}-Lag) at –0.019 and the negative slope of the change of the market value at –0.010 for the analysed period.

S&P500 Index (1^{st}-Diff.). The coefficient at 0.476 shows a positive contribution of the change of the S&P500 Index to the change of the equity market value in the short-term. This is consistent with the negative slope of the change of the S&P500 Index at –0.009 and the negative slope of the change of the equity market value at –0.010 for the analysed period.

[206] See Greene, W., 2000, "Models for Panel Data", *Econometric Analysis*, 4th Ed., Prentice Hall, 14, 584.

Log of the Created Shareholder Value. The coefficient at 0.020 shows a positive contribution of the created shareholder value to the change of the market value in the long-term. This is consistent with the negative slope of the log of the created shareholder value at –0.152 and the negative slope of the change of the market value at –0.001 for the analysed period.

The System GMM-2 shows the Student's t parameter of significance of the log of the created shareholder value at 68.05. This demonstrates the high significance of the created shareholder value contributing to the market value growth. Companies have been pushing in the quarterly improvement of Net Income, Dividends paid, Repurchase of Shares, etc... implementing different approaches based on the SVA, Economic Profit, EVA, and CFROI, but in the end, Companies even without a structured Value Based Management approach were improving the created shareholder value, and this is what our model is showing.

	Fixed Effects OLS	Fixed Effects OLS	System GMM-2	System GMM-2
Market Value (1st-Lag)	0.954 (67.48)	0.934 (63.85)	1.008 (685.77)	1.008 (1369.49)
S&P500 (1st-Lag)		0.171 (5.19)		0.123 (9.88)
S&P500 (1st-Diff.)		0.461 (9.21)		0.476 (34.30)
Created Shareholder Value	0.022 (28.93)	0.021 (27.34)	0.023 (161.61)	0.020 (68.05)
constant	0.533 (3.74)	-0.482 (-2.07)	-0.001 (-0.11)	-0.885 (-10.22)
Nr Observations F-Statistic R-squared	1067 2391.74 0.9798	1061 1286.23 0.9812	1067 252082.21	1061 2.79E+06
Hansen chi2(..)= (d.f.) Test for AR(1) Test for AR(2)			71.27 346 -4.92 -0.86	70.61 425 -4.83 -0.32
t-values in parentheses				

Table 5.9 The Market Value Model I estimates.

5.7.2a The Market Value Model I. Panel unit root tests.

Based on a pooled data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the S&P500 Index (1^{st}-lag) is integrated of order 1, I(1) and the S&P500 Index (1^{st}-diff.) is integrated of order 2, I(2). All the other variables are stationary, which are all I(0).

THE MARKET VALUE MODEL I.
AUGMENTED DICKEY FULLER TEST

Variables	Levels t-Statistic	Levels D-W Statistic	1st- Differences t-Statistic	1st- Differences D-W Statistic	2nd- Differences t-Statistic	2nd- Differences D-W Statistic
m	-7.352	2.009				
m_1	-7.372	2.004				
sp_1	-19.121	2.100	-18.671	2.007	-38.016	1.827
dsp	-22.609	1.886	-42.107	1.776	-53.936	2.314
lcsv	-11.197	2.006				
1% Critical Value	-3.963					
5% Critical Value	-3.412					
10% Critical Value	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (sp_1 and dsp)

Table 5.10 The Augmented Dickey-Fuller test.

Based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the p-values of the four tests between 0.936 and 1.000 and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 7d). We can state that the panel data is a non-stationary one and the model must be reestimated on a first differenced variables model.

5.7.2b The Market Value Model I. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[207]. The outcome of the test shows that the null hypothesis of at most 2 cointegrating vector is rejected since the trace statistic of 51.70 is greater than the 5% critical value of 3.76. The trace test

207 Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

indicates three cointegrating equations, and the normalized outcome gives us two equations. Based on a pooled data of the panel we have used the Engle and Granger test[208]. This is the residual-based test where in the first stage the cointegrating OLS regression of market value on the S&P500 Index (1^{st}-lag) and (1^{st}-diff.) and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1^{st} lag of the residuals is performed. The outcome shows that the t-statistic of -12.44 is more negative than the critical value of -3.78 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[209] Table 2 for N=3 variables.

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.403649	1144.467	29.68	35.65
At most 1 **	0.154446	319.4524	15.41	20.04
At most 2 **	0.031876	51.70190	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 3 cointegrating equation(s) at both 5% and 1% levels

Table 5.11 The Johansen Cointegrating test (Trace)

5.7.2c The Market Value Model I. Vector error correction estimates.

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. In this case, the long-run relationships are captured by the cointegrating equations. The cointegrating equations[210] are the following:

$$CointEq1 = m\_1 - \underset{(-7.49)}{2.1881}\, dsp\_1 - 10.1367 \qquad (5.7.2.1)$$

$$CointEq2 = (sp\_1)\_1 - \underset{(-45.08)}{15.8503}\, dsp\_1 - 7.3073 \qquad (5.7.2.2)$$

To perform the Vector error correction estimates we have selected the specification with intercept, no trend, lags interval 1 to 2 in the first differences and including two exogenous

[208] Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometria*, 55, 2, 251-276.
[209] Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157.
[210] t-Statistics shown in parentheses

variables, the market value (1st-lag) and the created shareholder value. The outcome of the VECM shows that the convergence has been achieved after 24 iterations and the restrictions[211] identify all cointegrating vectors. The LR test for binding restrictions shows that the statistic chi-square(2)=0.98 does not exceed the critical value of 5.99 at the 5% level. This means that the null hypothesis, that the restrictions are accepted, cannot be rejected. The error correction equation corresponding to the first differences of the market value shows the highest coefficient of multiple determination (R-squared) of 0.864 and the highest value of the test of the overall significance of the regression (F-statistic) of 660.68. Additionally. The vector error correction model of the first differences of the market value rely in the long-run cointegrating equations due to the significance of the related coefficients. The vector error correction model of the first differences of the S&P500 Index (1st-lag) and (1st-diff.) rely in the long-run cointegrating equation due to the significance of the related coefficient of the cointegrating equation "CointEq2".

The final outcome of the error correction model of the market value shows the coefficients of the cointegrating equations very significant and contributing in a negative way the "CointEq1" and positive the "CointEq2" to the market value (1st-diff.). All the other coefficients are significant, except the first differences of the market value (1st and 2nd-lag). It is important to remark the significant and positive contribution of the market value (1st-lag) and the created shareholder value to the market value (1st-diff.).

We can also estimate the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegration regression using the pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$m = \underset{(4.16)}{0.754}\, sp\_1 + \underset{(1.87)}{0.554}\, dsp + \underset{(3.78)}{4.866} \qquad (5.7.2.3)$$

R-sq = 0.011
F(2, 1628) = 9.36

[211] See cointegration restrictins in Appendix 1b.

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.
The t-statistic = -19.458 is more negative than the critical value of t = -3.410 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin-Watson d-statistic (7, 1635) = 2.18. It is in between the critical values of 1.78 and 2.22, then there is evidence of no autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$\Delta m = +0.811\ \Delta m\_1 + 0.269\ \Delta sp\_1 + 0.435\ \Delta dsp + 0.019\ \Delta lcsv + 0.025\ ehat\_1 - 0.263$$
$$(39.99) \quad (3.22) \quad (6.98) \quad (27.93) \quad (0.44) \quad (-0.44)$$
$$R\text{-}sq = 0.662$$
$$F(5, 977) = 384.09 \quad (5.7.2.4)$$

The error correction model based on the Engle-Granger 2-step method in first differences is reliable due to the stationarity of the residuals considered in the regression. We can try to improve the Durbin-Watson d-statistic closer to two, in consequence we estimate the cointegrating equation based in the first differences. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$\Delta m = 0.832\ \Delta sp\_1 + 0.695\ \Delta dsp - 0.002 \quad (5.7.2.5)$$
$$(6.81) \quad (7.97) \quad (-0.21)$$
$$R\text{-}sq = 0.041$$
$$F(2, 1621) = 35.46$$

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.
The t-statistic = -18.177 is more negative than the critical value t = -3.410 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin-Watson d-statistic (3, 1624) = 1.994, this is between 1.74 and 2.26 at the 5% level, there is evidence of no autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$\Delta\Delta m = 0.707\ \Delta\Delta m\_1 + 0.257\ \Delta\Delta sp\_1 + 0.380\ \Delta\Delta dsp + 0.018\ \Delta\Delta lcsv$$
$$(28.73) \quad (1.71) \quad (3.83) \quad (26.98)$$
$$- 0.021\ ehat\_1 - 0.004$$
$$(-0.11) \quad (-0.42)$$
$$R\text{-}sq = 0.558$$
$$F(5, 921) = 232.74 \quad (5.7.2.6)$$

The coefficient of the residuals (1^{st}-lag) is negative and non significant. This means that the dependent variable the market value (1^{st}-diff.) was above its equilibrium value in the period (t-1) and it will decrease in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is -0.021, which is a low amount and the speed of adjustment will be also very low.

The outcome of the error correction model in second differences shows all the variables with a positive and significant contribution to the market value, excepts the residuals (1^{st}-lag). This means that the short-run disequilibrium adjustment is not significant.

Error Correction:	D(M)	D(SP_1)	D(DSP)
CointEq1	-0.984 [-77.52]	0.000 [NA]	0.000 [NA]
CointEq2	0.209 [9.94]	-0.109 [-30.18]	0.112 [9.15]
D(M(-1))	0.013 [1.10]	0.000 [-0.005]	-0.005 [-0.69]
D(M(-2))	0.000 [-0.02]	-0.001 [-0.56]	-0.006 [-0.83]
D(SP_1(-1))	0.563 [3.57]	-0.206 [-7.57]	0.418 [4.53]
D(SP_1(-2))	0.337 [2.20]	-0.347 [-13.17]	0.150 [1.68]
D(DSP(-1))	1.222 [3.99]	-0.683 [-12.93]	0.690 [3.86]
D(DSP(-2))	0.508 [2.93]	-0.276 [-9.25]	0.333 [3.29]
C	-9.924 [-72.86]	0.017 [0.73]	0.039 [0.49]
M_1	0.990 [73.54]	-0.002 [-0.90]	-0.002 [-0.27]
LCSV	0.022 [28.46]	0.001 [5.11]	0.003 [6.95]
R-squared	0.864	0.925	0.563
Adj. R-squared	0.863	0.924	0.559
F-statistic	660.682	1280.550	133.746
Log likelihood	336.656	2180.857	902.308
Akaike AIC	-0.620	-4.133	-1.698
Schwarz SC	-0.568	-4.081	-1.646

t-values in square brackets

Table 5.12 The Market Value Model I. Vector error correction models

5.7.2d The Market Value Model I. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that the market value (1^{st}-lag) and the created shareholder value does not Granger cause the market value cannot be rejected, the F-statistics are lower than the critical F(4, 1611)=2.37 at the 5% level of confidence. This means that the market value cannot be predicted by the history of the market value (1^{st}-lag) and the created shareholder value. Additionally, the null hypothesis that the S&P500 Index (1^{st}-lag and 1^{st}-diff.) does not Granger cause the market value is rejected. In consequence, the current market value can be predicted by the S&P500 Index(1^{st}-lag and 1^{st}-diff.) (see Appendix 7d). These results indicate that the previous variables help in the prediction of the market value, but it does not indicate causality in the common use of the term[212].

I very important outcome is that the null hypothesis that the market value does not Granger cause the created shareholder value is rejected, in consequence the market value helps in the prediction of the created shareholder value.

5.7.2e The Market Value Model I. Model re-estimation

Due to the fact that we were using non-stationary data the outcome of the model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the models (see table 5.9). The fact is that the Engle-Granger 2-step method was showing evidence of the higher reliability of the vector error correction model in first differences, and we will proceed to re-estimate the model in first differences. We will also show the outcome in second differences for comparison purposes.

Based on a panel data we have implemented a MLE-maximum likelihood estimation of the model, due to the fact that we have an autoregressive model, then the MLE[213] estimator is consistent.

212 EViews 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.
213 Hsiao, C., 2003, *Analysis of Panel Data*, 2nd Ed., Cambridge, 4.2, 70.

The MLE-Maximum likelihood estimator assumes that the regressors and residuals are uncorrelated, adding the assumption that the distributions of the residuals are normal[214].

The outcome of the MLE estimation in first differences shows the coefficient of the market value (1st-lag) positive and significant contribution to the market value. The value of 0.047 is consistent with the economic theory[215] and equal to the value identified in the market value model II estimates (see Table 5.14). All the other variables show a positive and significant contribution to the market value.

The outcome of the MLE estimator in second differences shows a negative coefficient of the market value (1st-lag). This is not consistent with the economic theory, and in consequence we adopt the regression in first differences as the correct one. It confirms that the short-run adjustments shown by the vector error correction estimates in first differences were correct, and more adequate than the second differences one.

Panel Data	First Differences	MLE Estimator	Second Differences	MLE Estimator
Market Value (1st-lag)	d.m_1	0.047 [4.22]	d2.m_1	-0.417 [-21.18]
S&P500 Index (1st-lag)	d.sp_1	0.793 [10.78]	d2.sp_1	0.791 [5.41]
S&P500 Index (1st-diff.)	d.dsp	0.541 [8.91]	d2.dsp	0.400 [4.46]
Created Shareholder Value	d.lcsv	0.011 [18.04]	d2.lcsv	0.006 [8.24]
constant	cons	-0.007 [-1.19]	cons	0.011 [0.74]
Nº Observations LR chi2(..) (d.f.) Log likelihood		980 397.10 4 242.08		924 551.39 4 -435.64

t-values in square brackets

Table 5.13 The Market Value Model I in first and second differences estimates.

214 Baum, C.F., 2006, *An Introduction to Modern Econometrics using Stata*, A Stata Press Publication, 9, 229.

215 See Section 5.7 The Market Value. Model I specification. Equation (3)

5.8 The Market Value. Model II specification.

Our objective in this section will be to identify the key processes contributing to the Market Value. In section 5.6 and based on the Fernandez's formulation, described in item 5.5.1, we found the main processes contributing to the created shareholder value.

In this section the dependent variable will be the log of the market value and the explanatory or independent ones as in the items 5.5.2 to 5.5.5. We will consider the (1^{st}-lag) and (1^{st}-diff.) of every variable.

Adopting a generic notation the model will be as follows:

$$m_{it} = \alpha\, m_{i,t-1} + \Sigma(\beta_1 X_{i,t-1} + \beta_2\, dX_{it}) + \eta_i + \varepsilon_{it} \qquad (5.8.1)$$

As already described, the dependent variable is expressed in natural logarithms but some of the explanatory variables are ratios (See Appendix 7a for a fuller variables description). As such, the coefficients are not always elasticities and the interpretation will not be so straightforward.

We can consider the Market Value Model II as an improvement of the Model I because it drills down and splits the Created Shareholder Value into the key business processes.

5.8.1 Description and discussion of results.

After conducting all the econometric estimators for the specified model and selecting the most adequate ones according to the different relevant tests, we can describe and discuss the following results. Section 5.8.2 provides the detailed econometric outcomes:

Change of the S&P500 Index (1^{st}-Diff). The change of the S&P500 Index shows a positive contribution to the change of the market value. The change of the S&P500 Index and that of the market value are both decreasing along the analysed period and this is the reason for the significant and positive association between both variables.

Net Income (1st-Diff). The change of the net income shows a positive contribution to the change of the market value. The change of the net income and that of the market value are both decreasing along the analysed period and this is the reason for the significant and positive association between both variables. This result is consistent with Easton and Harris' findings[216] about the change of earnings being positively associated with the stock returns.

Over and Undervalued Shares Gap. The over and undervalued shares gap shows a negative contribution to the change of the market value. The over and undervalued shares gap is increasing and the change of the market value is decreasing along the analysed period and this is the reason of the negative association between both variables.

The Over and undervalued shares gap had a negative mean and a positive evolution along the analysed period, which means that the overvalued gap was reduced. Due to this positive evolution of the over and undervalued shares gap and the negative evolution of the change of the market value the association between both variables is negative as above mentioned.

Potential Growth Path. The potential growth path shows a negative contribution to the change of the market value. The potential growth path was always positive and growing, whereas the change of the market value was decreasing. This is the reason there is a negative association between both variables.

Cash Dividends (1st-Lag). Cash dividends show a positive contribution to the change of the market value. The definition of the shareholder value added includes the change in market value, cash dividends, and repurchase of shares as the positive contributors to the created shareholder value and, in consequence, to the change of the market value as well. The econometric outcome confirms this fact and this is the reason there is a significant and positive association between both variables.

Sale of Common and Preferred Shares (1st-Diff). The change of the sale of common and preferred shares shows a positive contribution to the change of the market value. The change of the sale of common and preferred shares and that of the market value are both decreasing along the analysed period. This decrease is the reason there is a significant and positive association between both variables.

[216] Easton, P., and Harris, T., 1991, "Earnings as an explanatory variable for returns", *Journal of Accounting Research*, Vol. 29, No 1, 27.

5.8.2 Detailed discussion of the Econometric estimates

The Market Value was estimated using the Dynamic Panel Data estimators: Difference and System GMM-Generalized Method of Moments. The first estimator was developed by Arellano-Bond (1991), and the second one by Arellano and Bover (1995) and Blundell and Bond (1998), in order to get consistent estimates for the parameters. Several econometric estimators (one and two-steps and robust versions) have been performed to control the impact of the different proposed variables affecting the Market Value. Based on the best estimates we can conclude the following:

After regressing all the alternative estimators (Difference and System GMM (one and two steps, and robust versions)), we have used the variables in levels as instruments, as recommended by Arellano (1989)[217]. We can confirm that the System GMM-2 estimator provides the most consistent estimates of the coefficients. The test for AR(2) does not reject the null hypothesis of no second-order autocorrelation in the first-differenced residuals (0.68<1.96). This implies that the estimates are consistent.

The Sargan test for the two-step homoskedastic estimator does not reject the null hypothesis that the over-identifying restrictions are valid (chi2(499)=56.30< chi2(table)=552.07).

The coefficient of the market value (1^{st}-Lag) at 1.048 shows us that the current market value relies on the previous year and is consistent with the economic theory that the α-value is higher than one as expected in the equation (3) in item 5.7. The econometric outcome shows that the required return to equity for the period is Ke_{t-1} = 4.8% in quarterly basis.

The change of the S&P500 Index, that of the net income, and that of the sale of common & preferred shares are contributing in a positive way to the change of the market value as shown in the econometric outcome. All of them have been measured in first differences.

The cash dividends are contributing in a positive way to the change of the market value as shown in the econometric outcome. It has been measured in levels.

---

[217] See Greene, W., 2000, "Models for Panel Data", *Econometric Analysis*, 4th Ed., Prentice Hall, 14, 584.

The over and undervalued shares gap and the potential growth path are contributing in a negative way to the change of the market value as shown in the econometric outcome. Both variables have been measured in changes of share prices.

The short-term significant variables expressed by first differences or changes are the S&P 500 Index, the net income, the over and undervalued shares gap, the potential growth path, and the sale of common & preferred shares which are contributing to the change of the market value.

The long-term significant variable corresponds with that of the first lag of the cash dividends which contributes to the change of the market value.

Market Value	m	Fixed Effects OLS	System GMM-2
Market Value (1st-Lag)	m_1	0.767 (32.17)	1.048 (193.72)
S&P 500 Index (1st-Diff.)	dsp	0.505 (8.77)	0.564 (26.77)
Net Income (1st-Diff.)	dni		0.001 (2.62)
Over & Undervalued Shares Gap	v	-0.107 (-6.91)	-0.032 (-3.83)
Potential Growth Path	p	-0.096 (-14.81)	-0.075 (-21.81)
Cash Dividends (1st-Lag)	di_1	0.049 (4.00)	0.016 (5.01)
Sale of Common & Preferred Shares (1st-Diff.)	ds	0.012 (2.01)	0.010 (5.34)
Retirement LT Debt (1st-Lag)	rd_1	-0.013 (-2.53)	
Constant	cons	2.601 (11.40)	-0.063 (-0.75)
Nr Observations F-Statistic R-squared		708 238.1 0.9633	601 91074.5
Hansen chi2(..)= (d.f.) Test for AR(1) Test for AR(2)			56.3 499 -3.96 0.68

t-values in parentheses

Table 5.14 The Market Value. Model II estimates.

It is important to remark the following aspects:

- The over and undervalued shares gap was showing a very high correlation index against the look forward EPS to current (Analysts forecast) at the level of -0.671, but the latest was showing lower significant t-values in the first regression estimates and, in consequence, it was excluded from the regressions.
- The over and undervalued shares gap and the potential growth path show a very low correlation index at the level of 0.145 and this confirms the independence of these processes.
- The repurchase of shares is not shown as a significant variable and the reason is that the change of sale of common & preferred shares and that of the repurchase of shares are highly correlated at the level of 0.777. Additionally, if we use the change of the repurchase of shares then the change of net income falls into non-significance. These are the reasons the repurchase of shares must be excluded from the regression. Eckbo and Masulis (1995)[218] emphasized the importance of share repurchases after a decline in share prices. It is also important to mention the volatile character of the share repurchases as mentioned by Tirole[219], and the observed increase of repurchases during booms and of decrease during recessions. There are other items to be considered like challenging this usage of cash in share repurchases instead of dividends, increasing investments or reducing debt.

  The repurchase of shares has been widely used to boost the share prices along the years, but it is especially important for three reasons: first, it is the usage of cash with tax advantages, second, is the fact that boosting the share price is making the possibility of hostile takeovers more difficult and, thirdly, if there is a lack of acquisition opportunities or, in case they are more difficult to identify, it is better to invest in oneself.
- The strategic index (1st-Lag), retirement of long-term debt (1st-Lag) and the invested capital (1st-Diff) were significant variables in the created shareholder value model. They were bringing a long-term view to the process, but they have not been significant in the market value one. The dynamic market value model is more focused

218 See Tirole, J., 2006, "Citation 81", *The Theory of Corporate Finance*, Princeton University Press, 2, 101.
219 See Tirole, J., 2006, "Share Repurchases", *The Theory of Corporate Finance*, Princeton University Press, 2, 100.

on the change of the dependent variable and this long-term view perceived in the created shareholder value model does not exist in the dynamic one.

5.8.2a The Market Value Model II. Panel unit root tests

Based on a pooled data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows that the S&P500 Index (1st-diff.) is non-stationary and it is integrated of order two, I(2). All the other variables are stationary, which are all I(0).

THE MARKET VALUE MODEL II.
AUGMENTED DICKEY FULLER TEST

	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
m	-7.551	2.006				
m_1	-7.710	2.009				
dsp	-31.820	1.848	-43.037	1.944	-45.913	2.070
dni	-22.013	1.985				
v	-4.550	1.930				
p	-8.362	2.004				
di_1	-5.274	1.921				
ds	-13.006	1.917				
1% Critical Value	-3.965					
5% Critical Value	-3.413					
10% Critical Value	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (dsp)

Table 5.15 The Augmented Dickey-Fuller test

Based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows that the Inverse chi-squared(184) "P" and the Modified inv. Chi-squared "Pm" tests reject the null hypothesis, and the Inverse normal "Z" and the Inverse logit t(384) "L*" tests cannot reject the null hypothesis that all panels contain unit roots. Choi (2001)[220] recommends to use the Inverse normal Z-test. It offers the best trade-off between size and power. In consequence, all panels contain unit roots.

220 Choi, I., 2001, Unit root tests for Panel Data, *Journal of International Money and Finance*, 20, 249-272.

5.8.2b The Market Value Model II. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[221]. The outcome of the test shows that the null hypothesis of at most 1 cointegrating vector is rejected since the trace statistic of 56.58 is greater than the 5% critical value of 3.76. The trace test indicates two cointegrating equations, and the normalized outcome gives us one equation.

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.446551	788.3787	15.41	20.04
At most 1 **	0.044715	56.58775	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels

Table 5.16 The Johansen Cointegration test (Trace)

Based on a pooled data of the panel we have used the Engle and Granger test[222]. This is the residual-based test where in the first stage the cointegrating OLS regression of market value on the S&P500 Index (1st-diff.) and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1st lag of the residuals is performed. The outcome shows that the t-statistic of -42.50 is more negative than the critical value of -3.67 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[223] Table 2 for N=2 variables.

---

221 Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

222 Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometria*, 55, 2, 251-276.

223 Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157.

5.8.2c The Market Value Model II. Vector error correction estimates

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. In this case, the long-run relationship is captured by the cointegrating equation. The cointegrating equation[224] is the following:

$$CointEq1 = m\_1 - \underset{(-4.12)}{0.6230}\ dsp\_1 - 10.3139 \qquad (5.8.2.1)$$

To perform the Vector error correction estimates we have selected the specification with intercept, no trend, lags interval 1 to 2 in the first differences and including six exogenous variables, the market value (1st-lag), the net income (1st-diff.), the over and undervalued shares gap, the potential growth path, the cash dividends (1st-lag) and the sale of common & preferred shares (1st-diff.). The outcome of the VECM shows that the convergence has been achieved after 5 iterations and the restrictions[225] identify all cointegrating vectors. The LR test for binding restrictions shows that the statistic chi-square(1)=0.023 does not exceed the critical value of 3.84 at the 5% level. This means that the null hypothesis, that the restrictions are accepted, cannot be rejected. The error correction equation corresponding to the first differences of the market value shows the highest coefficient of multiple determination (R-squared) of 0.856 and the highest value of the test of the overall significance of the regression (F-statistic) of 311.52. Additionally. The vector error correction model of the first differences of the market value rely in the long-run cointegrating equation due to the significance of the related coefficient. The vector error correction model of the first differences of the S&P500 Index (1st-diff.) does not rely in the long-run cointegrating equation due to the non significance of the related coefficient of the cointegrating equation "CointEq1".

The final outcome of the error correction model of the market value shows the coefficient of the cointegrating equation "CointEq1" very significant and contributing in a negative way to the market value (1st-diff.). All the other coefficients are significant, except the first differences of the market value (1st and 2nd-lag), and the first differences of the net income. It is important to remark the significant and negative contribution of the over and undervalued shares gap, and the potential growth path, as well as the significant and positive

224 t-Statistics shown in parentheses

225 See cointegration restrictins in Appendix 1b.

contribution of the market value (1st-lag), cash dividends (1st-lag) and the sale of common and preferred shares (1st-diff.) to the market value (1st-diff.).

We can also estimate the error correction model based on the Engle-Granger 2-step method. First, we estimate the cointegration regression using the pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$m = 0.463\ dsp + 10.202 \qquad (5.8.2.2)$$
$$\quad (1.30) \qquad (274.57)$$

R-sq = 0.0013
F(1, 1265) = 1.69

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.

The t-statistic = -31.899 is more negative than the critical value of t = -3.410 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.

The Durbin-Watson d-statistic (7, 1269) = 1.846, this is between 1.78 and 2.22 at the 5% level, and there is evidence of no autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$\Delta m = +0.686\ \Delta m\_1 + 0.515\ \Delta dsp + 0.00007\ \Delta dni - 0.053\ \Delta v - 0.126\ \Delta p + 0.067\ \Delta di\_1$$
$$(21.52) \quad (5.00) \quad (0.05) \quad (-3.36) \quad (-11.50) \quad (4.70)$$

$$+ 0.016\ \Delta ds + 0.563\ ehat\_1 - 5.750$$
$$(2.64) \quad (1.62) \quad (-1.63)$$

R-sq = 0.539
F(8, 532) = 77.84 (5.8.2.3)

The error correction model based on the Engle-Granger 2-step method in first differences is reliable due to the stationarity of the residuals considered in the regression. We can try to improve the Durbin-Watson d-statistic closer to two, in consequence we estimate the cointegrating equation based in the first differences. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$\Delta m = 0.485\ \Delta dsp - 0.004 \qquad (5.8.2.4)$$
$$(5.11) \qquad (-0.31)$$

R-sq = 0.020
F(1, 1259) = 26.11

- Augmented Dickey-Fuller test. Stationarity of residuals. Lags(4) and trend.

The t-statistic = -43.144 is more negative than the critical value t = -3.410 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin-Watson d-statistic (7, 1268) = 1.944, this is between 1.72 and 2.22 at the 5% level, there is evidence of no autocorrelation of residuals.

- The error correction model (t-values in parentheses):

$$\Delta\Delta m = \underset{(13.54)}{0.515\ \Delta\Delta m\_1} + \underset{(4.85)}{0.602\ \Delta\Delta dsp} - \underset{(-0.27)}{0.0003\ \Delta\Delta dni} - \underset{(-3.84)}{0.056\ \Delta\Delta v} - \underset{(-11.93)}{0.137\ \Delta\Delta p}$$

$$+ \underset{(5.21)}{0.080\ \Delta\Delta di\_1} + \underset{(4.12)}{0.025\ \Delta\Delta ds} + \underset{(2.42)}{1.126\ ehat\_1} + \underset{(0.01)}{0.0002}$$

$$R\text{-}sq = 0.425$$

$$F(8, 479) = 44.39 \qquad (5.8.2.5)$$

The coefficient of the residuals (1st-lag) is positive and significant. This means that the dependent variable the market value (1st-diff.) was below its equilibrium value in the period (t-1) and it will increase in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrating model in the long-term. In our case this amount is +1.126, which is a high amount and the speed of adjustment will be also very fast.

The outcome of the error correction model in second differences shows all the variables with a positive and significant contribution to the market value, excepts the over and undervalued shares gap, the potential growth path with a negative and significant contribution, and the net income (1st-diff.) not significant. The residuals (1st-lag) show a positive and significant contribution, and this means that the short-run disequilibrium adjustment is significant.

5.8.2d The Market Value Model II. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that the market value (1st-lag), the net income (1st-diff.), and the over and undervalued shares gap does not Granger cause the market value cannot be rejected, the F-statistics are lower than the critical F(7, 1247)=2.01 at the 5% level of confidence. This means that the market value cannot be predicted by the history of the market value (1st-lag), the net income (1st-diff.) and the over and undervalued shares gap.

Additionally, the null hypothesis that the S&P500 Index (1st-diff.), the potential growth path, the cash dividends (1st-lag), and the sale of common and preferred shares (1st-diff.) does not Granger cause the market value is rejected. In consequence, the market value can be predicted by the S&P500 Index (1st-diff.), the potential growth path, the cash dividends (1st-lag), and the sale of common and preferred shares (1st-diff.) (see Appendix 7e). These results

Error Correction:	D(M)	D(DSP)
CointEq1	-1.030 [-61.43]	0.000 [NA]
D(M(-1))	-0.025 [-1.56]	-0.012 [-1.23]
D(M(-2))	0.001 [0.03]	-0.012 [-1.34]
D(DSP(-1))	-0.442 [-5.76]	-0.758 [-16.10]
D(DSP(-2))	-0.293 [-4.46]	-0.253 [-6.26]
C	-10.531 [-54.00]	0.068 [0.57]
M_1	1.067 [51.02]	-0.014 [-1.11]
DNI	0.000 [-0.06]	-0.003 [-2.23]
V	-0.023 [-2.36]	0.002 [0.37]
P	-0.081 [-9.82]	-0.001 [-0.21]
DI_1	0.025 [3.14]	0.017 [3.40]
DS	0.014 [1.77]	-0.001 [-0.21]
R-squared	0.856	0.401
Adj. R-squared	0.853	0.390
F-statistic	311.520	35.092
Log likelihood	133.901	420.475
Akaike AIC	-0.415	-1.389
Schwarz SC	-0.325	-1.300

t-values in square brackets

Table 5.17 The Market Value Model II. Vector error correction models indicate that the previous variables help in the prediction of the market value, but it does not indicate causality in the common use of the term[226].

5.8.2e The Market Value Model II. Model re-estimation

Due to the fact that we were using non-stationary data the outcome of the model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the models (see table 5.14). The fact is that the Engle-Granger 2-step method was showing evidence of the higher reliability of the vector error correction model in first differences, and we will proceed to re-estimate the model in first differences. We will also show the outcome in second differences for comparison purposes.

Based on a panel data we have implemented a MLE-Maximum likelihood estimation of the model, due to the fact that we have an autoregressive model, then the MLE[227] estimator is consistent. The MLE-Maximum likelihood estimator assumes that the regressors and residuals are uncorrelated, adding the assumption that the distributions of the residuals are normal[228].

We have also implemented the fixed and random effects OLS estimators in first differences and the Hausman test. It indicates that the random effects estimator has degenerated to a pooled OLS and the Wald test from "xthausman" may not be appropriate. The Newey-West variance estimator produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity, and it computes the pooled OLS estimates for panel data sets.

The outcome of the MLE estimation in first differences shows the coefficient of the market value (1st-lag) positive and significant contribution to the market value. The value of 0.042 is consistent with the economic theory and equal to the value identified in the market value model II estimates (see Table 5.14). The S&P500 Index (1st-diff.) shows a positive and significant contribution, and the over and undervalued shares gap and the potential growth

226 EViews 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.
227 Hsiao, C., 2003, *Analysis of Panel Data*, 2nd Ed., Cambridge, 4.2, 70
228 Baum, C.F., 2006, *An Introduction to Modern Econometrics using Stata*, A Stata Press Publication, 9, 229.

path show a negative and significant contribution to the market value (1st-diff.). All the other variables are not significant.

The outcome of the MLE estimator in second differences shows a negative coefficient of the market value (1st-lag). This is not consistent with the economic theory, and in consequence we adopt the MLE estimator in first differences as the correct one.

Panel Data	First Differences	MLE Estimator	HAC newey2 Pooled OLS robust	Second Differences	MLE Estimator	HAC newey2 Pooled OLS robust	HAC newey2 Pooled OLS robust
Market Value (1st-lag)	d.m_1	0.042 [3.38]	0.042 [2.11]	d2.m_1	-0.338 [-14.27]	-0.339 [-4.37]	
S&P500 Index (1st-diff.)	d.dsp	0.146 [3.10]	0.146 [3.00]	d2.dsp	0.070 [1.15]	0.070 [1.27]	0.172 [2.77]
Net Income (1st-diff.)	d.dni	0.001 [1.14]	0.001 [1.15]	d2.dni	0.002 [2.31]	0.002 [2.15]	0.001 [1.51]
Over & Undervalued Shares Gap	d.v	-0.047 [-4.19]	-0.047 [-2.55]	d2.v	-0.035 [-2.55]	-0.036 [-1.92]	-0.044 [-2.01]
Potential Growth Path	d.p	-0.125 [-16.40]	-0.125 [-13.27]	d2.p	-0.106 [-10.28]	-0.106 [-8.51]	-0.136 [-9.18]
Cash Dividends (1st-lag)	d.di_1	0.007 [0.76]	0.007 [0.62]	d2.di_1	0.003 [0.26]	0.003 [0.18]	0.001 [0.06]
Sale of common & preferred shares (1st-diff.)	d.ds	-0.00003 [-0.01]	-0.00003 [-0.01]	d2.ds	0.004 [0.72]	0.004 [0.49]	0.002 [0.24]
Constant	cons	-0.032 [-4.76]	-0.032 [-4.72]	cons	-0.024 [-1.40]	-0.024 [-1.61]	-0.023 [-1.28]
Nº Observations		537	537		484	484	488
F-statistic			34.54			29.79	21.82
LR chi2(..)		261.42			306.47		
(d.f.)		7			7		
Log likelihood		227.9887			-153.0204		

t-values in square brackets

Table 5.18 The Market Value Model II in first and second differences estimates.

5.9 Conclusion

We have presented the analysis of the main variables and processes impacting the Created Shareholder Value and the Market Value of the Companies. Two models have been specified to identify how critical the short and long-term of the different considered variables are, and additionally, a third model explains the relationship between the Created Shareholder Value and the Market Value

This objective has been widely achieved and, at the same time, an explanation of the significance and impact of every variable on the Created Shareholder Value and the Market Value has been provided. Based on the previous research and literature, we have considered four different group of variables to be controlled. These are: the external market influences, the simplified model variables, the analysts and investors expectations and the fundamental variables.

The outcome of the Created Shareholder Value model, based on quarterly data, was showing the following variables to the created shareholder value as significant: the change in net income, the strategic index, the over and undervalued shares gap, the potential growth path, the cash dividends, the sale of common and preferred shares and the retirement of long term debt. A very detailed description of this impact has been provided in our research. Among others, a very important finding is the significant positive contribution of the Stock of R&D capital to Sales ratio in the long term to enhance the created shareholder value of the company.

The outcome of the Market Value model I, based on quarterly data, was showing the following variables to the change of the market value as significant: the Market Situation, as defined by the S&P 500 in short and long-term, and the Created Shareholder value, which is very highly significant. It is important to mention that the Created Shareholder Value variable was defined according to Fernandez's definition. There are many different definitions of the Value Creation variable and the outcomes are very different from one another.

The outcome of the Market Value model II, based on quarterly data, was showing the following variables to the change of the market value as significant: the change of the S&P 500, the change of the net income, the over and undervalued shares gap, the potential growth path, the cash dividends, and the change in the sale of common and preferred shares.

It is important to remark that the Look Forward EPS diluted to current was eliminated due to the high correlation against the over and undervalued shares gap and it was less significant in the outcome regression than the last one.

The Augmented Dickey-Fuller test for a unit root of each variable and the Fisher-type test have been performed for each model, and they showed that the panels are non-stationary and the models needed to be re-estimated.

Additionally for each model, the Johansen Cointegration test provided the number and the final cointegrating equations to be considered, the Engle-Granger 2-step method confirmed the details of the final estimation in first differences, and the VECM-Vector error correction models estimation provided the LR test of binding restrictions and all the error correction models estimates.

Finally, the created shareholder value and the market value models have been re-estimated with all the variables in first differences. For the Created Shareholder Value model, the outcome of the HAC-Heteroskedasticity autocorrelation consistent covariance estimator in first differences shows the strategic index (1st-lag), the cash dividends (1st-lag) with a positive and significant contribution to the created shareholder value, and the net income (1st-diff.), the over and undervalued shares gap, the potential growth path, the sale of common & preferred shares (1st-lag), and the retirement of long-term debt (1st-lag) with a negative and significant contribution to the created shareholder value. See Section 7.1.7 for a fuller discussion of the conclusions and Appendix 7b for the details of the estimates.

For the Market Value model I, the MLE-Maximum likelihood estimator in first differences is consistent and the outcome shows the market value (1st-lag), the S&P500 (1st-lag and 1st-diff.), and the created shareholder value with a positive and significant contribution to the market value. See Section 7.1.8 for a fuller discussion of the conclusions and Appendix 7d for the details of the estimates.

For the Market Value model II, the MLE-Maximum likelihood estimator in first differences is consistent and the outcome shows the market value (1st-lag), the S&P500 (1st-diff.), the net income (1st-diff.), the cash dividends (1st-lag) with a positive and significant contribution to the market value, and the over and undervalued shares gap, the potential growth path, and the sale of common & preferred shares (1st-diff.) with a negative and significant contribution to the market value. See Section 7.1.9 for a fuller discussion of the conclusions and Appendix 7e for the details of the estimates.

Based on the current research, it is clear that Corporate Management can forecast the main variables impacting the Created Shareholder Value with a direct measurable relationship with the Market Value of the Company. The Created Shareholder Value can be forecasted with a clear objective to create value, increase the business capability to attract capitals, boost the share price according to the expectations and in consequence increase the Market Value. The forecast of the controllable variables implies a clear understanding of the determinants of the share price and the reduction of its volatility.

Chapter 6

The Overall Performance Model

6.1 Introduction

In this chapter we study the main processes impacting the Overall Performance of the firm. There is a wide literature focused on the analysis of the performance measurements, which is mainly based on factor analysis and on identifying the key success factors.

Our first objective is to identify the best measurement for the Overall Performance. With this idea in mind, we have selected the Standard and Poor's framework and created an additive scoring variable. The second objective is to select the main constructs and the key success factor variables based on a factor analysis framework. The third objective is to calculate the impact of the different variables through an overall performance econometric model.

In summary the development of the current research is as follows: Section 6.2 describes the previous research on Corporate Performance Measurements. Section 6.3 shows the previous research on ranking and benchmarking methods. Section 6.4 describes the data and resources as well as the calculation of the dependent and independent variables. Section 6.5 cares for the overall performance model specification. Section 6.6 summarizes our main results. Section 6.7 shows a detailed discussion of the econometric estimates and finally in the Section 6.8 the conclusion.

6.2 Previous research on Corporate Performance Measurements

A summary of the most important work previously done on this subject is the following:

Dess and Robinson (1984)[229] described the difficulties to obtain objective measures of performance in the organizations, and the usefulness of the subjective performance measures to assess organizational performance. The focus of their research was to assess the relationship between the subjective and objective measures of return on assets and sales growth, as well as the relationship between return on assets, sales growth and overall "global" performance measures.

The methodology was based on interviews to CEOs of twenty six manufacturing organizations. The Management team was also involved in the research and provided a subjective perception of the corporate performance relative to similar firms based on the objective measure of return on assets and sales growth. These subjective measures of performance were strongly correlated against the objective measures already mentioned (changes in the return on assets and sales growth for the analysed period). They have also identified and described several aspects related to the multidimensionality of the organizational performance, for example the high reliability of global subjective performance measured at the Management level. And they also found some overlap between the global and economic measures.

Khan (1985)[230] named and described the sets of ratios useful to analyse the financial statements. He emphasized the advantages and limitations of the use of ratios to analyse corporate performance and he also identified the following classification of them: Performance, long-term solvency, liquidity (short-term solvency), capital utilization, operational efficiency and linkage or interconnection between ratios. A description of the bankruptcy prediction models with an up-to-date of the different econometrics and the discriminant multivariate models based on the financial ratios has been included.

Chakravarthy (1986)[231] studied the most useful measures to assess strategic performance. He demonstrated the inadequacy of the traditional measures, and added the quality of the firm's transformation and the satisfaction of all of the firm's stakeholders to complete the framework to measure strategic performance. He searched 14 firms in the computer industry,

---

[229] Dess, G., and Robinson, R., 1984, "Measuring organizational performance in the absence of objective measures: The case of the privately-held firm and conglomerate business unit", *Strategic Management Journal*", Vol. 5, No 3, 265-273.
[230] Khan, A., 1985, "Analysing financial statements for managerial performance measurement and bankruptcy prediction", *Engineering Management International*, 3, 165-174.
[231] Chakravarthy, B., 1986, "Measuring strategic performance", *Strategic Management Journal*, Vol. 7, No 5, 437-458.

seven of which were identified as "excellent" and the rest "non-excellent", and selected 14 quantitative measures: Return on Investment, Return on Sales, Growth on Revenues, Cash Flow/Investment, Market Share, Market Share Gain, Product Quality Relative to Competitors, New Product Activities Relative to Competitors, Direct Cost Relative to Competitors, Product R&D, Process R&D, Variations in ROI, Percentage point change in ROI and Percentage Point Change in Cash Flow/Investment.

Based on the above measures and using the PIMS database, Chakravarthy performed a factor analysis extracting four factors, which are: profitability, relative market position, change in profitability and cash flow, and growth in sales and market share. The profitability factor explained the highest factor at 17.7% of the variance, and the relative market position factor explained a 10.7%.

Chakravarthy found that the conventional measures of performance, such as the ones of profitability, or the financial market measures are not discriminating for "excellence", what is due to three facts: a single measure cannot assess "excellence", the firm transformation processes are excluded, and the claims of other stakeholders besides the stockholders are not taken into account.

The linear discriminant Z-Altman is described as a multifactor of bankruptcy prediction and also as an index of strategic performance. He added to the stockholders' maximization of value the other stakeholders'[232] minimization of dissatisfaction in order to contribute to the long-term excellence and viability of the firm.

A very important contribution of his study was the development of a discriminant function based on "slack" variables with power to discriminate between excellence and non-excellence firms. The final function was:

0.12 CFBYIN – 0.19 SABYEM – 0.10 SABYTA + 0.12 MBYB – 0.28 DTBYEQ
+ 0.34 RDBYSA + 0.19 WCBYSA + 0.29 DIVPAY >= 0.14 for excellence

where the variables are: CFBYIN-Cash Flow to Investment ratio, SABYEM-Sales per Employee, SABYTA-Sales by Total Assets, MBYB-Market to Book Value, DTBYEQ-Debt to Equity ratio, RDBYSA-R&D by Sales ratio, WCBYSA-Working Capital by Sales ratio, and DIVPAY-Dividend Payout ratio.

[232] Firm's Stakeholders such as Stockholders, Customers, Employees, and Community.

Chakravarthy suggested that excellence cannot be measured by a single measure of performance. Alternatively, he proposed the ability of the firm to keep several measures within safe limits simultaneously and the capability to adapt and transform to changes in its environment.

Venkatraman and Ramanujam (1986)[233] searched the different alternative approaches to the measurement of business performance. In a first approach, they emphasized the financial and the operational measures as the key concepts to reach the business performance. The financial performance was represented by the following measures: sales growth, profitability (ratios such as return on investment, return on sale, and return on equity) and earnings per share. Additionally, the value-based measures such as market-to-book, etc… have been considered. The operational performance was represented by the following measures: market share, new product introduction, product quality, marketing effectiveness, manufacturing value added and other measures of technological efficiency.

They added the component of sources of performance data such as primary and secondary. The primary source refers to the data collected from the same organization, and the secondary source to the data sourced from publicly available records.

This framework allowed them to build a classification table showing all the different alternatives to measure business performance. The "within-cells" classifies the four quadrants represented by the sources of data (primary and secondary) in the X-axis, and the conceptualisation of business performance (financial and operational) in the Y-axis. The "across-cells" classifies the adjacent cells, these are:

A. The use of financial indicators with data from the two sources
B. The use of financial and operational indicators with data from secondary sources
C. The use of operational indicators with data from the two sources
D. The use of financial and operational indicators with data from primary sources

Venkatraman and Ramanujam described, in depth, the benefits, limitations, methodological considerations and the reference to the studies of the different alternatives and the recommendations to choose an efficient method depending on the objectives. They also discussed the issue of dimensionality. They reached the conclusion that, with reference

233 Venkatraman, N., and Ramanujam, V., 1986, "Measurement of Business Performance in Strategy Research: A Comparison of Approaches", *Academy of Management Review*, Vol. 11, No 4, 801-814.

to the financial indicators, such as sales growth, net income growth and ROI, the indicators seem to represent different dimensions and cannot be combined in a single composite dimension.

They mentioned the Woo and Willard (1983)[234] research based on a factor analysis of 14 indicators which yielded four different dimensions. These are: profitability/cash flow, relative market position, change in profitability and cash flow, and revenue growth.

Brush and Vanderwerf (1992) [235] studied the best way to gather the performance information and they identified the most frequently used measures, methods and information sources used to measure the performance of new ventures based on a sample of 34 articles published in 1987 and 1988. The use of the term "performance" also included other aspects like "success", "survival" and "growth". They found more than 35 different measures of performance used. The most popular they encountered are: change in sales, changes in employees, and profitability (return on sales, return on investment and net profit). The main preference in data collection was the mail survey followed by personal interviews and managers, executives, founders and owners, which together formed the main sources of information.

The survey was based on a sample of 66 firms in the manufacturing and the State of Massachusetts. They found a high correlation between the sales estimates obtained from archival sources and those from direct interviews. A high correlation was also identified for the sales data from mail questionnaires and telephone interviews.

The competitors' knowledge of the performance of the new ventures was a good source of data, but was inaccurate due to a wrong perception of the other firms. This suggests that, within a defined domain, in this case referred to the new manufacturing ventures, it is possible to reach high accuracy in the performance estimates through the ventures management, archives, and competitors sources of information.

Murphy, Trailer and Hill (1996)[236] studied 51 published studies dealing with performance

---

234 Woo, C.Y., and Willard, G., 1983, "Performance Representation in Strategic Management Research: Discussions and Recommendations", Paper presented at the Annual Meeting of the Academy of Management, Dallas.

235 Brush, C., and Vanderwerf, P., 1992, "A comparison of methods and sources for obtaining estimates of new venture of performance", *Journal of Business Venturing*, Elsevier Science Publishing, 7, 157-170.

236 Murphy, G., Trailer, J., and Hill, R., 1996, "Measuring Performance in Entrepreneurship Research", *Journal of Business Research*, Elsevier Science, 36, 15-23.

measurements and they analysed the most used objective performance measures based on a sample of small businesses.

Murphy et al. classified different aspects of performance and selected eight dimensions, which are: Efficiency, Growth, Profit, Size, Liquidity, Success/Failure, Market Share and Leverage. They also classified the data sources and found 75% of the articles used primary (questionnaire interviews), 25% used secondary (archival data), and 6% used both data sources.

The research was showing that only 60% of the sample were considering one or two dimensions of performance, 11% used three and four, and no single study was covering more than five dimensions.

The control variables to compare performance of different firms were introduced in an homogeneous way. These are: the size of the firm, industry, age of the firm and risk.

Two samples were selected for the empirical research, 995 firms and 19 performance variables for the factorial analysis and the confirmatory sample with 586 firms and 8 performance variables. They extracted nine factors from the factor analysis with a cumulative variance at 70%. In further analysis, no single factor explained more than 14% of the total variance.

The research demonstrated the nature of multiple dimensions to explain performance. The empirical research showed how the statistical tools were rejecting the possibility to validate a unidimensional construct. They emphasized the difficulty to define the "firm performance" in terms of just single variables, such as: net sales, net profit, etc... being the last term quite ambiguous.

They described the implications for further research of the interactions between the different dimensions of performance. The "trade-offs" among the multiple dimensions of performance showed how trying to perform some actions to improve performance in one dimension may depress another.

The Authors made some very important recommendations for future research. These are: First, it will be more informative in the future to discuss the relationship between a variable and a performance dimension due to the lack of a construct validity for the term firm performance. Secondly, the selection of a performance dimension must be explained and justified, otherwise we can draw a conclusion and the underlying association may be spurious.

In the third place, it is very important to include multiple dimensions of performance. The financial measures are not enough to capture the organizational performance and non-financial measures must be included as well. Lastly, the critical control variables cannot be ignored, some differences between companies may arise due to the failure to address the control variables.

Kald and Nilsson (2000)[237] conducted a research with the objective to find out the situation of the performance measurement in the Nordic countries. They developed a questionnaire trying to clarify the structure, processes, use, benefits and shortcomings and, additionally, the use of three well-known models of performance measurement. The questionnaire was sent to 200 business units in each country, a total of 800 in the Nordic area, and a total of 236 were answered.

They found that the most important measures related to the structure of the performance measurement are the ones that reflect profitability, cost effectiveness, distribution of sales, quality, production efficiency, reliability of delivery, market position, and customer satisfaction. They indicated that the business units prefer to measure variables that create value for shareholders rather than value for shareholders itself. It is surprising that measures related to the process development, level of technology, and product development have been scored very low. These measures are not a priority for the businesses, but are very critical for the future competitive strength and not properly attended to.

The findings related to the processes of performance management were showing that there is a strong relation between the strategic planning and the implemented measures. Action plans and budgets were very closely monitored by measures. They found that monitoring performance is very well established to suit the needs of top management, but the performance measurements are not very well implemented at the lower organizational levels. It appears the operating personnel are being left out of the process at the monitoring stage. It has also been found that the measures are not supporting the process orientation and the way the collection of data is implemented largely affects the quality of the planning and monitoring processes.

[237] Kald, M., and Nilsson, F., 2000, "Performance Measurement at Nordic Companies", *European Management Journal*, Vol. 18, No 1, 113-127.

They found that the use of performance measurements is clearly a decision supported at the top management and at the operating level. Scored as important were the monitoring of the customer and product profitability, the accounting measures, to identify needs for changes in strategy, and to facilitate the implementation of the business strategy. The Authors recommend that the businesses must be more attentive to the requirements of the market and customers as the competition is tougher.

They concluded that the benefits of the performance management relate to a better understanding of how the business works. It shows that if the strategy is followed, it facilitates the implementation of change, and it shows the integration between planning and monitoring of the business unit.

The identified shortcomings of performance measurement were the following: overly focused on the past, on the short run, on financial performance, and an overflow of information. The Authors considered that the respondents wanted to see more measures related to the operations and also closely linked to strategy, such as competence, development, quality and service.

They finally evaluated the three performance measurement models introduced during the last decade: The Strategic Management Accounting (SMA), the Balance Scorecard (BSC), and Value Based Management (VBM). The SMA model was used in 22% of the business units and is focused on benchmarking the company with its competitors in areas like strategy, market position and cost structure. The BSC model was used in 27% of the business units, and is focused on financial and non-financial measures. The VBM model was used in 16% of the business units, and the emphasis is on the measures to create value for shareholders at the operations level, not in the measure of value for shareholders itself.

One of the most important implications for corporate management shown in the research is the focus to direct the measurements at more customer and market oriented factors. This was to monitor what the company offers to customers compared against the competitors offering, and the development and benchmarking of production cost against the competition one.

Carton and Hofer (2006)[238] classified five categories of performance measures based on

---

[238] Carton, R., and Hofer, C., 2006, *Measuring Organizational Performance - Metrics for Entrepreneurship and Strategic Management Research,* Edward Elgar, Cheltenham.

the finance and accounting texts. These are: accounting (profitability, growth, leverage-liquidity-cash flow, and efficiency), operational, market-based, survival, and economic value. They were able to identify the most important measures in the main categories of performance based on the most recent empirical studies and to discuss the strengths and weaknesses of each one of the measures.

The research was conducted based on the Standard and Poor's 1500 companies at the 2002 year-end. This sample included 329 industries as listed by the four-digit SIC Code. They developed a financial model of financial performance determining firstly the constructs and testing them for validity.

Carton and Hofer identified the constructs that are discriminant and the corresponding measures that meet the test for convergent validity. Two separate models were developed based on annual and three-year timeframes.

The first model has the annual return to shareholders as the referent[239] used to represent the financial performance and they found the profitability, the change in profitability, growth, the change in economic value, and the change of the market value relative to the book value positively associated to the performance, and the cost of capital negatively associated for annual periods.

The second model has the three-year return to shareholders as the referent used to represent the financial performance and they found the profitability, the change in profitability, growth, and the change of the market value relative to the book value positively associated to the performance, and the cost of capital and the leverage negatively associated for the three-year period. The results in the previous two models have been consistent with the prior studies related to the overall financial performance.

Carton and Hofer developed two composite models of financial performance which are very useful in the cases that the market returns are not available. The main aim was to examine the subdimensions of the financial performance constructs and develop the annual and three-year composite models. They found that the composite model for annual data had the growth rate of assets, the change in liabilities to assets and the change in Altman's Z-score as the most significant and positively associated variables to the financial performance.

---

[239] Carton, R., and Hofer, C., 2006, *Measuring Organizational Performance – Metrics for Entrepreneurship and Strategic Management Research*, Edward Elgar, Cheltenham, 6, 123.

The composite model for three-year data had the above mentioned variables in the annual data and additionally it had the return on assets and the change of the residual income return on investment as the most significant and positively associated variables. They demonstrated that the annual and three-year composite models provide more information than any other individual measure of financial performance, when the market returns measures are not available. And this is the case for new ventures, family businesses and closely held companies.

Our research differs in two main aspects when compared with the above mentioned previous research. Firstly, it differs in the objectives and secondly, in the methodology. Our objective is to define the main business processes leading to the overall business performance. This is consistent with the findings of Kald and Nilsson (2000)[240] who stated that the business units are more interested in finding out the variables creating value to shareholders than in the measure itself.

We differ widely in the Methodology from the current literature, in order to find out the main business processes we perform an econometric model where the dependent variable is built based on the Standard and Poor's benchmarking system. We calculate the scoring as the addition of the different S&P original variables in a scale from a minimum zero to a maximum of 10. The independent variables are defined after conducting a factor analysis, extracting five factors, and selecting the most commonly used in the business units. This methodology mainly differs from that of Carlton and Hofer (2006) in the dependent variable. They selected the one-year return to shareholders as the referent for the financial performance and, in our case, we take a wider scope taking the S&P variables and scoring them. We argue that the return to shareholders is only one aspect among others to care in defining financial performance.

We differ from the Chakravarthy (1986) and Carlton and Hofer (2006) research the selection of variables. As an example, we specially use the Altman Z-Score in the factor analysis, but not in the final models due to the strong loading of the profitability measure.

We fully agree with Woo and Willard's (1983), Chakravarthy (1986), Murphy, Trailer and Hill (1996) and Carlton and Hofer (2006) in the multi-dimension nature of the business performance, not just limited to the financial nature. Depending on the authors, we can find

[240] See Kald, M., and Nilsson, F., 2000, "Performance Measurement at Nordic Countries", *European Management Journal*, Vol. 18, No 1, 124.

different dimensions and approaches, but, in the end, the nature of constructs is a fact in the current literature.

6.3 Previous Research on Ranking and Benchmarking Methods

There is a wide collection of systems pursuing the corporate performance, and some of them rank the companies by sector. A first classification can be established based on the quantitative or qualitative analysis to be performed. The quantitative methods are more related to the rankings published in the economical newspapers and magazines. The most representative quantitative ones are the following:

- Standard and Poor's Performance Ranking. It is issued by the *Business Week* magazine every year, and is based on a set of economic variables. It provides performance grades and ranks the S&P 500 Companies.
- Holt Value – Boston Consulting Group. It is issued at the *Barrons Newspapers* and rank the companies based on the scoring of several CFROI variables.
- The Shareholder Scoreboard – LEK/Alcar Consulting Group. It is issued by the *Wall Street Journal* and it provides rate of returns information for the one thousand US largest companies.
- The Stern Stewart Performance 1000. Based on the MVA ranks the largest 1000 Companies.
- Global 500 Hundred ranking. It is issued by the *Fortune* magazine and is based on the Revenue ranking.
- Value Creation Ranking by Pablo Fernandez. It is issued by the monthly economic magazine *Actualidad Económica* for the IBEX 35.
- The Best Performers Ranking by economic sector. It is issued by the "GRRE Consulting Services" covering the Spanish economic sectors.

The most representative qualitative rankings are the following:

- The Baldrige National Quality Programme by the National Institute of Standards & Technology. The NIST is an agency of the US Department of Commerce and its mission is to promote US innovation and industrial competitiveness.

- The Q-100 Index. It is issued by the Robinson Capital Management.

We agree and adopt the Standard and Poor's measurement approach to corporate performance, which captures different aspects of the performance of the business units and with our additive formulation it is the only measurement system based on multiple quantitative data in a single equation. All the other rankings capture single aspects, such as turnover, etc…

It was impossible to have access to the historical data from the Baldrige or the Robinson Capital Management due to the proprietary rights. It would be very important and enriching research to challenge our performance model with their data as a dependent variable.

6.4 Data and Resources

The data used in the research has been based on the Dow Jones Industrials (35 Companies). After excluding Banks, Diversified Financials, Insurance, and Real Estate, the sample was left with 26 Companies, and 38 years by cross-section (1964-2001). The original data has been the Backdata Database (historical, non restated) sourced by Standard and Poor's. The total number of observations in the panel is 988.

Software used is Stata-SE, release 8.0.

6.4.1 The Dependent Variable

The Scoring is an additive function built based on the Standard and Poor's variables used in the annual Performance Ranking published in the *Business Week*. The variables are:

- One-year Total Return
- Three-year Total Return
- One-year Sales Growth
- Three-year Sales Growth
- One-year Net Income Growth
- Three-year Net Income Growth
- Net Income to Sales in percent

- Return on Equity
- Net Sales
- Long Term Debt to Capital ratio

The aim of the ranking is to capture momentum and the sustainability of the corporate achievements with a clear benefit to the Companies pursuing sustainable and profitable growth. The S&P Performance Ranking shows the grades in letters by variable and Company, and later it is corrected by the Sales and Long Term Debt to Capital. Our Scoring is based on a continuous function instead of a discrete one. It relates the scoring to the situation of the variable in the statistical distribution of the sample.

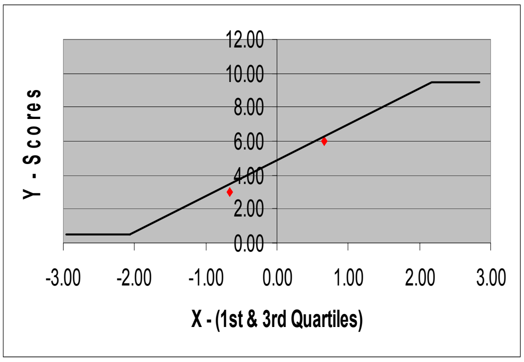


Figure 6.1 Continuous Scoring de-cap function

The continuous scoring will be a linear de-cap function with a zero minimum score and a maximum at 10. The enclosed table shows the main points to determine every function.

Variable	1st Quartile		3rd Quartile	
	X - Variable	Y - Score	X - Variable	Y - Score
1 Yr Total Return	-2.310	3	33.730	6
3 Yr Total Return	3.498	3	25.616	6
1 Yr Sales Growth	4.632	3	18.874	6
3 Yr Sales Growth	5.689	3	17.322	6
1 Yr Net Income Growth	-0.500	3	26.000	6
3 Yr Net Income Growth	2.790	3	21.480	6
Net Income to Sales %	4.727	3	11.537	6
Return on Equity	12.892	3	21.787	6
Net Sales	2878	3	25015	6
Long Term Debt to Capital	5.285	6	22.190	3

Table 6.1 Quartiles and related Scoring main points.

Finally the total scoring by Variable, Year and Company will be an additive amount of the scores of each variable. All variables are treated with the same weight, that is why the growth concepts are repeated for the same variable.

6.4.2 The Independent Variables

We performed a factor analysis on the most used variables in the companies, the definitions of the different variables are:

ZSCORE. The Altman Z-Score measure of bankruptcy risk

MKVSLSR. The market value to sales ratio in percentage

LNCSV. The created shareholder value calculated according to Fernández (2002)[241] in logs

LNSVA. The shareholder value added calculated according to Fernández (2002) in logs

NISLSR. The net income to sales ratio in percentage

ROA. The net income to total assets ratio in percentage

CFLATR. The cash flow to total assets ratio in percentage

ROE. The net income to equity ratio in percentage

STDDEV. The five-year net income standard deviation vs the linear adjustment

VAR. The five-year net income variance vs the linear adjustment

NIG3Y. The three-year net income growth (CAGR-compound average growth rate)

SCORES. The S&P's additive calculation described in the previous item 6.4.1

SLSG1Y. The one-year sales growth

EPSG3Y. The three-year earnings per share basic excluding extra items growth (CAGR-compound average growth rate)

RDSLSR. The research and development expenditures to sales ratio in percentage

RDSTSLSR. The stock of R&D capital to sales ratio in percentage

LNATLT. The total assets to total liabilities ratio in logs

ATLTR. The total assets to total liabilities ratio in percentage

LTDATR. The long term debt to total assets ratio in percentage

ADVSLSR. The advertising expenditures to sales ratio in percentage

---

241 Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation,* Academic Press, Elsevier Science, 1, 9.

ATSLSR. The total assets to sales ratio in percentage
INVSLSR. The total investment to sales ratio in percentage
INVCAP. The total invested capital
SPCODE. The Standard and Poor's corporate debt rating
NIG1Y. The one-year net income growth
EPSG1Y. The one-year earnings per share basic excluding extra items growth
SLSG3Y. The three-year sales growth (CAGR-compound average growth rate)
TRT3Y. The three-year total market return
TRT1Y. The one-year total market return. The market value plus cash dividends vs the previous year market value

The objective to perform a factor analysis is to summarize the data covariance structure in a few dimensions of the data with the objective to identify the underlying factors that best explain the dimensions associated with the large data variability. We conducted the factor analysis based on the principal components, retaining five-factors and rotating by the varimax type of rotation. We finally obtained the following relation between the factors and the groupings of variables:

Factors	Groupings of Variables	% Variance
Factor 1	Return-Profitability, and Risk	21.2%
Factor 2	Expectations and Assets Efficiency	12.4%
Factor 3	Risk, Growth and Strategic Investment	11.2%
Factor 4	Strategic Investment and Risk	11.0%
Factor 5	Growth (sales, net income, EPS) and Strategic Investment	9.7%
	The total recovered variance is equal to	65.5%

The sorted rotated factor loadings and communalities are:

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Communality
nislsr	0.924	-0.010	0.182	0.040	0.107	0.900
zscore	0.852	0.045	-0.071	0.235	0.053	0.791
mkvslsr	0.846	-0.097	-0.142	0.080	0.011	0.752
roa	0.830	0.224	0.408	0.012	-0.052	0.908
cflatr	0.784	0.226	0.298	0.204	-0.090	0.804
roe	0.648	0.158	0.494	-0.254	-0.246	0.814
scores	0.646	0.475	0.338	0.002	0.212	0.802
atltr	0.636	-0.029	-0.154	0.535	0.324	0.820
lnatlt	0.609	0.035	-0.060	0.560	0.346	0.809
lnsva	0.027	0.884	-0.084	-0.026	0.021	0.790
lncsv	0.042	0.876	-0.104	-0.044	0.011	0.782
trt1y	0.125	0.828	-0.035	0.027	0.147	0.725
trt3y	0.445	0.608	0.115	-0.015	0.298	0.670
atslsr	0.397	-0.462	0.385	-0.090	0.286	0.609
stddev	-0.038	-0.074	-0.723	0.043	-0.338	0.646
var	-0.035	0.027	-0.688	0.016	-0.291	0.560
nig3y	0.220	-0.182	0.662	-0.037	0.079	0.527
epsg3y	0.168	-0.189	0.631	-0.074	-0.062	0.472
invcap	0.157	-0.301	-0.523	-0.123	0.198	0.443
spcode	-0.050	-0.262	-0.324	-0.297	0.178	0.296
rdslsr	0.224	-0.052	-0.047	0.885	0.080	0.846
rdstslsr	0.066	-0.120	-0.057	0.865	-0.149	0.792
ltdatr	-0.347	-0.138	-0.135	-0.689	0.232	0.686
advslsr	0.292	-0.042	0.038	-0.537	-0.259	0.444
slsg3y	0.203	0.121	0.153	0.018	0.713	0.588
slsg1y	0.116	0.269	0.285	-0.051	0.665	0.612
invslsr	0.340	-0.225	-0.134	-0.012	0.597	0.541
nig1y	0.077	-0.032	-0.014	-0.019	-0.525	0.284
epsg1y	0.077	-0.018	-0.010	-0.016	-0.515	0.271
Variance	6.1347	3.5943	3.2378	3.1905	2.8248	18.9822
% Var	0.212	0.124	0.112	0.110	0.097	0.655

Table 6.2 Factor analysis. The rotated factor loadings.

The previous factor loadings table indicates the correlations coefficients between the variables and the factors. The highest correlation coefficient by variable in a horizontal inspection shows the factor to which the variable belongs and it is better grouped.

The five factors recover 65.5% of the variance of the original data. They show a good discrimination in terms that the first factor recovers 21.2% of the variance, the second one 12.4%, the third one 11.2%, the fourth one 11.0% and the fifth one recovers 9.7% of the variance.

We can confirm the different groupings through a two dimensional perceptual map and emphasize the segments of variables, the length of the line is an indicator of the variance of that variable explained by the 2D map. The longer this line, the greater is the importance of the variable.

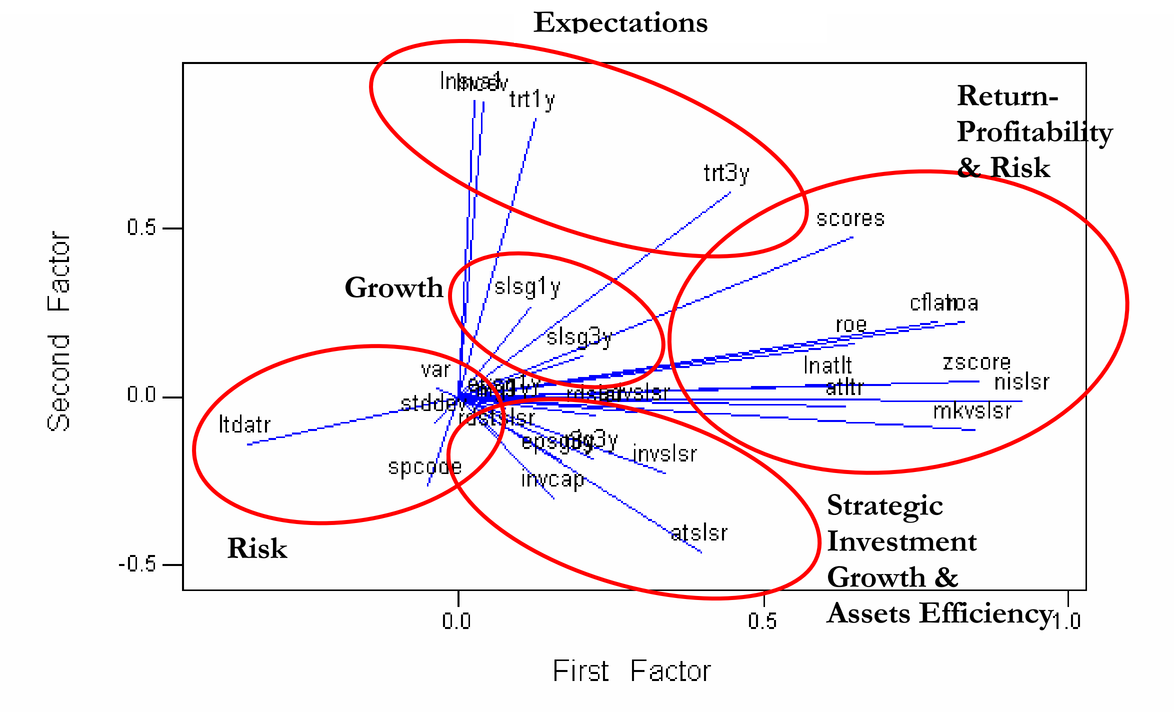


Figure 6.2 Perceptual Map. Five Segments.

After conducting the factor analysis and the perceptual map we can conclude that we have identified the following constructs and the best variables to start the econometric analysis. These are:

Constructs	Main independent variables
Return-Profitability	ROA. The net income to total assets ratio
	CFLATR. The cash flow to total assets ratio
Growth	SLSG3Y. The three-year sales growth (CAGR)
Strategic Investment	RDSLSR. The R&D to sales ratio
	RDSTSLSR. The stock of R&D capital to sales ratio
	INVSLSR. The Total Investment to Sales ratio
Assets Efficiency	ATSLSR. The total assets to sales ratio
Expectations	LNCSV. The created shareholder value in logs
	MKVSLSR. The market value to sales ratio
Risk	LNATLT. The total asset to the total liabilities ratio in logs
	LTDATR. Long-term debt to total assets ratio

We do not choose the Altman Z-Score[242] because it is a linear combination very highly loaded by profitability, and we focus on original variables, not on intermediate linear combinations. The total assets to total liabilities ratio and the Altman's Z-Score correlate at 0.745. The first variable is not a linear combination and in consequence it is the preferred one.

The enclosed table summarizes the statistics on the key variables.

Variable	Observ.	Mean	Std. Dev.	Min	Max
Dependent					
SCORES	911	46.079	13.188	7.789	88.876
Explanatory					
ROA	937	8.530	5.362	-17.474	37.042
CFLATR	937	13.428	5.519	-2.723	42.363
SLSG3Y	859	13.236	13.564	-14.235	144.794
RDSLSR	937	3.526	3.840	0.000	18.043
RDSTSLSR	937	14.237	14.282	0.000	66.768
INVSLSR	911	17.225	19.829	-198.670	188.000
ATSLSR	937	112.063	71.147	20.194	461.420
MKVSLSR	937	184.236	199.623	0.000	2333.370
LNSVA	465	4.760	6.943	-11.578	12.208
LNCSV	465	3.235	7.641	-11.610	12.185
ATLTR	928	2.266	1.007	1.033	10.770
LNATLT	928	0.742	0.372	0.033	2.377
LTDATR	933	14.934	11.864	0.000	52.590

Table 6.3 Observations, mean, standard deviation, and range of each variable.
Period: 1964-2001.

The scores variable shows a mean of 46.08 and a positive slope of 0.017 along the period. This means that the companies show a slight improvement in performance for the researched period.

The return on assets ratio shows a mean of 8.53% and a negative slope of –0.087 along the period. This means that we can see a slight drop in profitability for the researched period. This indicator is mainly used to measure the firm profitability.

The cash flow to total assets ratio shows a mean of 13.43% and a negative slope of –0.091 along the period. It is the same drop as the previous measurement of profitability. This indicator is mainly used to measure the firm capabilities to generate cash and make new investments.

[242] White, G., Sondhi, A., and Fried, D., 1997, *The Analysis and Use of Financial Statements*, 2nd Ed., John Wiley & Sons, 18, 994.

The three-year sales growth rate shows a mean of 13.23% and a negative slope of –0.373 along the period. This means that there is a decrease in the three-year growth rate, as the companies become larger the three-year growth rates become smaller. This indicator measures the firm capabilities to generate sales growth.

The annual research and development expenditures to sales ratio shows a mean of 3.52% and a positive slope of 0.051 along the period. There is a slight increase in the annual R&D expenditures to sales for the analysed companies and the period. This indicator is a strategic index of firm investment.

The annual stock of R&D capital to sales ratio shows a mean of 14.24%. This is a ratio 4.05 times higher than the annual R&D to sales and consistent with Hall (1990)[243]. It shows a positive slope of 0.328 along the period and, in consequence, there is a slight increase of the stock of R&D capital to sales for the analysed period. This indicator is a strategic index of the cumulated firm investment.

The total investment to sales ratio shows a mean of 17.22% and a negative slope of -0.167. This means that the investments have been growing at a lower rate than the sales for the analysed period. This indicator reflects the positioning for future growth (working capital, new products introduction, mergers and acquisitions, plant and equipment, information technology, etc…). It is also a strategic index of firm investment as the previous ones.

The total assets to sales ratio shows a mean of 112.06% and a positive slope of 0.709 along the period and there is an increase of the total assets to sales ratio for the analysed period. This indicator measures the firm assets efficiency.

The market value to sales ratio shows a mean of 184.23% and a negative slope of –0.474 along the period, what means that the market value has been growing at a lower rate than the sales for the analysed period. This indicator measures the firm attractiveness to investors, and the capabilities to attract investors' capital.

The shareholder value added in logs shows a mean of 4.76 and a negative slope of –0.076 along the period. The shareholder value added without logs shows a slight positive slope along the period and, when taking logs, a negative one.

243 Hall, B., 1990, "The Manufacturing Sector Master File", NBER- *National Bureau of Economic Research*, Working paper No 3366, Appendix B, 40.

The created shareholder value in logs shows a mean of 3.23 and a negative slope of –0.097 along the period. The created shareholder value without logs shows a slight positive slope along the period and, when taking logs, a negative one. It is the same behaviour as the shareholder value added. This indicator measures the firm capability to create value for the shareholders.

The annual created shareholder value has been adjusted to constant 2001 US Dollars by the GDP deflator for fixed non-residential investment supplied by the Bureau of Economic Analysis and then transformed into a natural logarithm.

The total assets to total liabilities ratio shows a mean of 2.27% and a negative slope of -0.044 along the period. This ratio has been decreasing and this is an increase in corporate risk.

The total assets to total liabilities ratio in logs shows a mean of 0.74 and a negative slope of -0.018 along the period. The fact that this ratio has a negative slope means that the corporate risk has been increasing. The balance sheet structures have been worsening but far from the critical amounts. This indicator measures the firm risk.

The long-term debt to total assets ratio shows a mean of 14.93% and a positive slope of 0.102 along the period. This means that the firms have been slightly increasing the long-term debt to total assets ratio for the analysed period. This indicator measures the debt exposure in the long-term and the reliance and positioning for tough economic times.

The enclosed table summarizes the correlation matrix or covariance matrix for the group of variables to be considered in the econometric model:

	ROA	CFLATR	SLSG3Y	RDSLSR	RDSTSLSR	INVSLSR	ATSLSR	MKVSLSR	LNATLT	LTDATR	LNCSV
ROA	1.000										
CLFATR	0.889	1.000									
SLSG3Y	0.357	0.304	1.000								
RDSLSR	0.303	0.373	0.058	1.000							
RDSTSLSR	0.162	0.255	-0.120	0.930	1.000						
INVSLSR	0.106	0.071	0.293	0.130	0.011	1.000					
ATSLSR	-0.214	-0.305	-0.176	-0.096	-0.119	0.375	1.000				
MKVSLSR	0.581	0.544	0.218	0.432	0.273	0.277	0.132	1.000			
LNATLT	0.556	0.623	0.320	0.527	0.335	0.164	-0.159	0.504	1.000		
LTDATR	-0.467	-0.550	-0.010	-0.580	-0.570	0.007	0.352	-0.347	-0.563	1.000	
LNCSV	0.155	0.172	0.043	-0.017	-0.060	0.050	-0.098	0.122	0.048	-0.079	1.000

Table 6.4 Correlation or covariance matrix of the explanatory variables

The Cash flow to total assets ratio, the market value to sales ratio, and the total assets to total liabilities in logs show a high coefficient of correlation with the return on the total assets ratio and they will not be considered in the final model to avoid multicollinearity.

The long-term debt to total assets ratio correlates with the stock of R&D capital of –0.57 and it shows a lower significance in the regressions against the stock of R&D capital. It will not be considered in the final model to avoid multicollinearity.

Employment in logs as a measure of job creation correlates with the return on assets at a negative 0.568. Additionally, the number of employees variable is only available from 1982 till 2001 in the Standard and Poor's data. In the event that we were to use them, we would be loosing a large number of observations in the panel data.

We can build the first-order constructs of the financial performance as previously identified and the encountered issues at this stage of the research. These are:

Constructs	Determinants of Growth	Performance Variables	Issues
Return	Profitability	Return on Assets (Net Income to Total Assets ratio)	
Return	Cash Flow. Capabilities to generate cash and make new investments	Cash Flow to Assets ratio	It correlates with ROA of 0.889.
Growth	Growth Capabilities	Annual Sales Growth (three-year CAGR)	
Investment. Strategic Index	Annual Research & Development	Annual R&D to Sales ratio	It correlates with the stock of R&D to sales ratio of 0.932 and it shows a smaller t-Student than the stock of R&D to sales ratio.
Investment. Strategic Index	Cumulated Research & Development	Stock of R&D Capital to Sales ratio	It correlates with the long term debt to assets ratio of a negative 0.580
Investment. Strategic Index	Positioning for future growth (real investments done)	Investment to Sales ratio	
Efficiency	Assets Efficiency	Total Assets to Sales ratio	
Risk	Balance sheet strength and Bankruptcy forecast	Total Assets to Liabilities ratio in logs	It correlates with ROA of 0.555.
Risk	Debt exposure in the long term and reliance and positioning for tough economic times	Long Term Debt to Assets ratio	It correlates with the stock of R&D to sales of a negative 0.570.
Value Creation. Expectations	Company attractiveness to Investors. Capabilities to attract Investors Capital.	Market Value to Sales ratio	It correlates with ROA of 0.581.
Value Creation. Expectations	Capabilities to generate value for the Shareholders	Created Shareholder Value in logs	

Table 6.5 The independent variables

6.5 The Overall Performance Model specification

The proposed model takes the dependent variable based on Scoring, and the independent variables are the key processes leading to a sustainable and profitable growth after eliminating the variables due to multicollinearity.

The model will be as follows (See Appendix 8a for a fuller variables description):

$$Scoring_{it} = \alpha_i + \beta_1\, ROA_{it} + \beta_2\, SLSG3Y_{it} + \beta_3\, RDSTSLSR_{it} + \beta_4\, INVSLSR_{it} + \beta_5\, ATSLSR_{it} + \beta_6\, LNCSV_{it} + \varepsilon_{it} \qquad (6.5.1)$$

ROA_{it} = Return on assets (Net income to total assets ratio in percentage)

$SLSG3Y_{it}$ = Three-year sales growth (CAGR- compound annual growth rate)

$RDSTSLSR_{it}$ = Stock of R&D capital to sales ratio in percentage

$INVSLSR_{it}$ = Total investment to sales ratio in percentage

$ATSLSR_{it}$ = Total assets to sales ratio in percentage

$LNCSV_{it}$ = Created shareholder value in logs

α_i = Intercept

ε_{it} = Residuals

Due to the fact that the independent variables are expressed in ratios, growth rates, and levels in natural logarithms, the coefficients of the variables are not elasticities and the interpretation will not be so straightforward.

6.6 Description and discussion of results.

After conducting all the econometrics estimators for the specified model and selecting the most adequate one according to the different relevant tests, we can describe and discuss the following results:

Return on Assets. The econometric outcome shows a significant and positive contribution to the overall performance. This is consistent with the Carton and Hofer[244] findings. They

[244] Carton, R., and Hofer, C., 2006, *Measuring Organizational Performance. Metrics for Entrepreneurship and Strategic Management Research*, Edward Elgar, Cheltenham, 2, 35,

concluded that the return on assets was the most frequently used measure in the financial literature as a profitability measure, and Woo and Willard were showing that the profitability factor explained 17.7 percent of the variance, which was the highest value in their research. In our previous factor analysis the first factor was representing the return-profitability and risk and it explained 21.2% of the variance.

The return on sales may be used as an alternative measure of profitability. In this case the t-Student drops from the current 15.64 to 11.75 and the F-test of the overall significance of the regression drop from 137.07 to 108.34. This means that the return on assets is a much better indicator of profitability than the return on sales

Three-year Sales growth. The outcome shows a significant and positive contribution to the overall performance. This is consistent with the previous research by Dess and Robinson (1984), Venkatraman and Ramanujam (1987), Brush and Vanderwerf (1992), Robinson (1995), Murphy, Trailer and Hill (1996), and Carton and Hofer (2006).

Investment to Sales ratio. The outcome also shows a significant and positive contribution to the overall performance. Murphy et al. (1996) were considering the Ability to fund growth as one of the variables identifying Size and Liquidity. Carton and Hofer (2006) were considering the Growth rate of assets and this variable assumes that we have invested or retained earnings to grow the total assets of the firm.

The Investment variable is widely used in the Corporate Valuation and Shareholder Value literature, such as: Rappaport (1998), Black (1998), Madden (1999), Bennett Stewart III (2000), Copeland et al. (2000), Damodaran (2002), and Fernández (2002), but it is not in the Corporate Performance Management literature.

Created Shareholder value. The econometric outcome shows a significant and positive contribution to the overall performance. The Market value to sales ratio correlates with the Return on assets and is a poorer indicator of the shareholder value than the log of the created shareholder value, which is not correlating with any other variable.

6.7 Detailed discussion of the Econometric estimates

We started running the fixed and random effects estimators and the Hausman test with chi2(table)=11.07 < Statistic chi2(5)=37.53. This means that the null hypothesis of "Ho:

Individual effects are uncorrelated with other regressors" is rejected, and the consistent estimator is a fixed effects OLS-Ordinary least squares. Additionally, we can also confirm the high correlation between the individual effects and the regressors: corr(u_i, X)= -0.5937. This result clearly indicates that the estimator is a fixed effects one.

The proposed Overall Performance model will be estimated using the heteroskedasticity consistent covariance matrix [245] HCCME for the fixed effects OLS [246] in order to get consistent estimates for the parameters. This is the robust Huber-White [247] sandwich estimator of variance which produces consistent standard errors for the OLS regression coefficient estimates in the presence of heteroskedasticity. The command is named "areg - robust" in Stata.

The second estimator is the Newey-West[248] variance estimator which is an extension that produces the consistent estimates when there is autocorrelation in addition to possible heteroskedasticity.

Both estimators show the test of overall significance of the regression that the calculated F ratio exceeds the tabular value of F at the 5% level of significance. This indicates that the regression coefficients are not all equal to zero and the R-squared is significantly different from zero. The "areg" estimator shows an F equal to 137.07 larger than the tabular F(5, 428)=2.23 and the R-squared equal to 0.822. The "newey2" estimator shows an F equal to 286.48 larger than the tabular F(4, 454)=2.39. The final results are shown in Table 6.6.

After performing the HCC matrix for the fixed effects OLS estimator, the "areg" command in Stata, we have implemented the Wooldridge test[249] for autocorrelation in the panel data and the test shows the Statistic F(1, 25)=9.30 larger than the Critical F(1, 25)=4.24. This means that the null hypothesis of no first order autocorrelation in the residuals is rejected and there is autocorrelation of residuals. As previously mentioned in the Newey-West estimator, the error structure is assumed to be heteroskedastic and is possibly

---

[245] See Davidson, R. and MacKinnon, J., 1993, *Estimation and Inference in Econometrics*, Oxford University Press, 11.6, 401 and 552-556

[246] See Greene, W., 2000, *Econometric Analysis*, 4th Ed., Prentice Hall, 14, 579.

[247] See White, H., 1980, "Heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity", *Econometrica*, 48, 817-838.

[248] See Newey,W.K. and West, K.D., 1987, "A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica*, 55, 703-708.

[249] See Wooldridge, J.M., 2002, *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, 10, 274-276.

autocorrelated up to some lag. We will adopt a maximum of one lag in the error structure process.

The third estimator will be the Prais-Winsten model with panel-corrected standard errors. We assume that the disturbances are heteroskedastic (each panel has its own variance) and the disturbances are contemporaneously correlated across the panels (each pair of panels has its own covariance). We will assume that there is a first-order autocorrelation AR(1) within panels and that the coefficient of the AR(1) process is specific to each panel. The command is named "xtpcse – correlation(psar1) hetonly" in Stata.

The fourth will be a within estimator for fixed effects model when the disturbance term is a first-order autoregressive AR(1). The command is named "xtregar, fe lbi" in Stata.

The Return on assets, Three-year sales growth, Investment to sales ratio, and the Created Shareholder value in logs are the most significant variables with a positive contribution to the overall performance which affects the long-term success of the firm in all the considered estimators.

The stock of R&D capital to sales ratio has a significant and positive contribution to the overall performance in the Hubert-White HCC matrix for the fixed effects OLS estimator, but not significant in the Newey-West, Prais-Winsten and within Fixed Effects estimators. We will consider the outcome of the latter estimators more adequate than the Hubert-White HCCME due to the presence of first-order autocorrelation of residuals.

Our Panel Data is based on the 35 Companies of the Dow Jones Industrials which are the most important firms with less problems to get funding. The Long-term debt to total assets correlates with the stock of R&D capital to sales ratio and is not considered in the regressions. We may suspect that, for a larger panel data of companies, the financing through long-term debt will be more important and this is a variable to be carefully monitored in further studies.

After running the fixed effects OLS regression, we can implement the Breusch-Pagan LM test for cross-sectional correlation[250] in a fixed effects model. The Stata command is named "xttest2". The calculated statistic chi2(325)= 510.479 is larger than the critical chi2(325)= 368.04. This means that the null hypothesis of cross-sectional independence across firms is

[250] See Greene, W., 2000, *Econometric Analysis*, 4th Ed., Prentice Hall, 15, 599-603.

rejected and there is serial correlation across the cross-sections (firms).

We can also implement the modified Wald test for groupwise heteroskedasticity[251] in a fixed effects model. The Stata command is named "xttest3". The calculated statistic chi2(26)= 507.72 is larger than the critical chi2(26)= 38.88. This means that the null hypothesis of equality of disturbance variances or homoskedasticity is rejected and the disturbance variances differ substantially across firms.

Overall Performance Model	Scores	Fixed Effects OLS	Hubert-White Fixed Effects OLS-areg Robust	Newey-West OLS-newey2 Robust lag(0)	Newey-West OLS-newey2 std errors lag(1)	Prais-Winsten Het-corrected std errors AR(1)	Fixed Effects (within) AR(1)
Return on Assets ratio	roa	1.767 (21.47)	1.767 (15.64)	1.479 (19.36)	1.479 (16.87)	1.762 (21.55)	1.810 (20.84)
Three-year Sales growth	sls3yr	0.472 (9.75)	0.472 (9.16)	0.302 (4.76)	0.302 (4.17)	0.268 (4.33)	0.470 (8.68)
Stock of R&D Capital to Sales ratio	rdstslsr	0.154 (2.21)	0.154 (1.95)				
Investment to Sales ratio	invsls	0.065 (3.37)	0.065 (2.40)	0.083 (2.88)	0.083 (2.78)	0.058 (3.40)	0.057 (3.20)
Created Shareholder Value in logs	lncsv	0.381 (9.61)	0.381 (10.11)	0.405 (9.31)	0.405 (9.60)	0.322 (9.32)	0.321 (8.93)
Constant	cons	21.423 (12.12)	21.423 (9.74)	28.049 (37.82)	28.049 (34.90)	27.253 (34.82)	24.883 (41.25)
Nr Observations		459	459	459	459	459	433
F-Statistic		184.3	137.07	286.48	224.63		187.32
Wald chi2(4)						915.13	
R-squared		0.7158	0.8227			0.8274	0.7459
Adj R-squared			0.8103				

t-values in parentheses

Table 6.6 Overall Performance Model estimates

6.7.1 The Overall Performance Model. Stability tests

To test for the robustness and stability of the model we divide the panel in three periods and test the equality of the coefficients between the different linear regressions. The Chow test in Panel Data for the equality of the periods requires the definition of the related dummies by period, performing the linear regression including the dummies and running the "testparm" command[252] in Stata.

---

251 Baum, C., 2006, *An Introduction to Modern Econometrics using Stata*, Stata Press, Texas, 9, 222.

252 See the Chow's Breakpoint Test calculations in Appendix 8b.

The summary of the outcome can be seen in the following table:

Compared Periods		F-statistic	F-critical value at the 5% level	F-critical value at the 1% level	Outcome
1964-76	1977-88	F(4, 419)=2.07	F(4, 419)=2.39	F(4, 419)=3.36	Ho not rejected. Coeffs are equal at the 5% level
1964-76	1989-2001	F(5, 419)=3.66	F(5, 419)=2.23	F(5, 419)=3.06	Ho rejected. Coeffs are not equal
1977-88	1989-2001	F(7, 419)=2.55	F(7, 419)=2.03	F(7, 419)=2.58	Ho not rejected. Coeffs are equal at the 1% level

Table 6.7 The Chow Test in Panel Data for three periods.

As shown in the previous table, the null hypothesis of equality of coefficients is not rejected and there is not a significant difference in response between the first and second period. This means that the model is stable from 1964 till 1988 at the 5% level and from 1977 till 2001 at the 1% level, but not for the whole period.

If we investigate the evolution of the S&P 500 Industrials Composite for the period 1992-2001, we can find in the year 1998 a drop in the Net Sales and Operating Income after Depreciation[253] against the previous year. We can take as a breakpoint the year 1998 and take the two periods to investigate better the effect on the last period. The outcome of the separate Hubert-White HCCME regressions is the following:

Coefficients	1964-2001	1964-1997	1998-2001
Return on Assets ratio	1.751 (16.48)	1.760 (15.47)	2.072 (6.11)
Three-year Sales growth	0.417 (8.50)	0.416 (7.57)	0.492 (2.96)
Investment to Sales ratio	0.066 (2.42)	0.063 (1.85)	0.081 (1.75)
Created Shareholder Value in logs	0.378 (9.94)	0.378 (8.12)	0.310 (4.76)
Constant	24.918 (24.97)	25.024 (22.69)	20.769 (8.06)
Nr Observations	459	378	81
F-Statistic	170.42	146.74	33.11
R-squared	0.8207	0.8204	0.8871
Adj R-squared	0.8086	0.8054	0.8388
Residual sum of squares	17105.253	13929.133	1987.574

Table 6.8 The Chow Test with two periods: 1964-1997 & 1998-2001

253 Both items are expressed in Net Sales and Operating Income after Depreciation per share. Standard and Poor's, 2003, Analysts' Handbook..

Prior to perform the Chow Stability Test we need to implement the Goldfeld and Quandt test to validate the equality of the disturbance variances of the two periods. We suspect a breakpoint on 1998 and we may also doubt the constancy of the variance of the error terms in the two periods. The Goldfeld and Quandt[254] test is the appropriate one to verify this type of heteroskedasticity.

$$F-Statistic = \frac{RSS_2}{RSS_1}\frac{(T_1-k)}{(T_2-k)} = \frac{1987.57}{13929.13}\frac{(81-5)}{(378-5)} = 0.029 \quad (6.7.1.1)$$

The F-Critical Value: $F(T_2\text{-k}, T_1\text{-k}) = F(373, 76) = 1.364$

Since the F-Statistic =0.029 does not exceed the critical value at 1.364 at the 5% level of significance we do not reject the null hypothesis of homoskedasticity and we can conclude that the disturbance variances of the two considered periods are equal.

Additionally, we can implement the Chow's Breakpoint test, we have the following:

$$F-Statistic = \frac{RSS-(RSS_1+RSS_2)}{(RSS_1+RSS_2)}\frac{(T-2k)}{k} =$$
$$F-Statistic = \frac{17105.25-(1987.57+13929.13)}{(1987.57+13929.13)}\frac{(459-10)}{5} = 6.705 \quad (6.7.1.2)$$

The F-Critical Value: F(k, T-2k) = F(5, 449) = 2.234

Since the F-Statistic = 6.705 exceeds the critical value at 2.234 at the 5% level of significance we reject the null hypothesis of equality of coefficients and we can conclude that the coefficients are not the same.

This is due to the fact that there is a big difference between the two restricted models in the considered periods. The first period covers 34 years and the second 4 years of data. Based on the fact that the degrees of freedom of the short period model are lower than the coefficients to be estimated (dg=4 < k=5), we can implement the Chow's Forecast test and we have the following:

$$F-Statistic = \frac{RSS-RSS_1}{RSS_1}\frac{(T_1-k)}{T_2} = \frac{17105.25-13929.13}{13929.13}\frac{(378-5)}{81} = 1.050 \quad (6.7.1.3)$$

The F-Critical Value: $F(T_2, T_1\text{-k}) = F(81, 373) = 1.311$

254 See Otero, J.M., 1993, *Econometría. Series temporales y predicción*, Editorial AC, Madrid, 11, 369.

Since the F-Statistic = 1.05 does not exceed the critical value at the 5% level of significance, we do not reject the null hypothesis of equality of coefficients and we can conclude that the coefficients are the same. The model is stable for the whole period.

In this case, we find that the two Chow tests yield conflicting results. Based on the fact that the period 1998-2001 shows 1998 and 2000 as difficult years, we can conclude that the model is stable between 1964 till 1988 and from 1977 till 2001 according to the outcomes of the Chow's Breakpoint test. The existence of a breakpoint has also been tested by the Hansen stability test and discarding the Chow's Forecast test outcome.

The industrial sectors were impacted in a very different way by the economic events, and the main changes in the market conditions were the following: The financial crisis in the East and South-east Asian countries that began in July 1997, the financial collapse in Russia in September 1998, and the real GDP drop at a negative 2.5% in Japan in 1998 against the previous year. In the US, the high level of spending beyond its capacity, the stock prices drop of the Telecom sector in the year 2000 and the terrorist attacks on Sep, 11, 2001 were the main areas leading to a slowdown and mainly the areas affected by the global trade. In consequence, the year 1998 can be considered a breakpoint in the considered period.

The Hansen's test[255] of model stability has been implemented to provide an answer to the conflicting results of the Chow's test. The Hansen's test for parameter instability is performed after running a pooled estimator. Since the calculated Statistic_Lc = 1.651 does not exceed the critical value $L_c(6)=1.680$. The null hypothesis of model stability is not rejected at the 5% level and the model is stable for the period 1964 till 1982.

6.7.2a The Overall Performance Model. Panel unit root tests.

Based on a pooled data of the panel we have used the augmented Dickey-Fuller test with 4 lags, a constant and a trend. The outcome of the test shows the scores, the investment to sales ratio and the created shareholder value are non-stationary and they are integrated of order two, I(2). The three-year sales growth is non-stationary and it is integrated of order one, I(1). All the other variables are stationary, which are all I(0).

---

255 See the Hansen's Stability test calculations in Appendix 8b

THE OVERALL PERFORMANCE MODEL
AUGMENTED DICKEY FULLER TEST

	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
scores	-7.610	1.956	-17.823	1.970	-23.470	2.057
niat	-6.743	1.997				
slsg3y	-9.022	1.977	-15.300	1.996		
rdstslsr	-4.767	2.008				
invslsr	-7.237	1.953	-18.440	1.920	-24.914	1.956
lncsv	-8.509	1.933	-12.769	1.972	-15.356	2.196
1% Critical Value	-3.965					
5% Critical Value	-3.413					
10% Critical Value	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (scores, slsg3y, invslsr and lncsv)

Table 6.9 The Augmented Dickey-Fuller test.

Based on a panel data we have implemented the Im-Pesharan-Shin $W_{t\text{-bar}}$ test with a trend, 4 lags and demean. The outcome of the test shows a p-value of 0.029 and the null hypothesis that all series contain a unit root is rejected, in favour of the alternative that a nonzero fraction of the panels follow stationary processes.

Additionally, based on a panel data we have used the Fisher-type test with a trend, 4 lags and demean. The outcome of the test shows the four p-values in between 0.093 and 0.146, and the null hypothesis that all the panels contain unit roots cannot be rejected (see Appendix 8b). We can state that the panel is a non-stationary one and the model must be reestimated based on a first or second differenced variables model.

6.7.2b The Overall Performance Model. Cointegration tests

Based on a pooled data of the panel we have used the Johansen test[256]. The outcome of the test shows that the null hypothesis of at most 3 cointegrating vectors is rejected since the trace statistic of 16.06 is greater than the 5% critical value of 3.76. The trace test indicates 4 cointegrating equations, and the normalized outcome gives us three equations.

[256] Johansen, S., 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.
Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.213406	153.5115	47.21	54.46
At most 1 **	0.101618	78.13798	29.68	35.65
At most 2 **	0.086561	44.48981	15.41	20.04
At most 3 **	0.049862	16.06050	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels

Table 6.10 The Johansen Cointegration test (Trace)

Based on a pooled data of the panel we have used the Engle and Granger test[257]. This is the residual-based test where in the first stage the cointegrating OLS regression of the scores on the three-year sales growth, the investment to sales ratio, the created shareholder value and a constant has been performed and the residuals saved. In a second stage the OLS regression of the first differences on the 1st lag of the residuals is performed. The outcome shows that the t-statistic of -9.82 is more negative than the critical value of -4.18 at the 5% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986)[258] Table 2 for N=4 variables.

6.7.2c The Overall Performance Model. Vector error correction estimates.

The Vector error correction estimates provide us the short-run adjustment, and at the same time, it is led by the long-run theory. In this case, the long-run relationships are captured by the cointegrating equations. The cointegrating equations[259] are the following:

$$\text{CointEq1} = \text{scores\_1} - \underset{(-11.91)}{5.4761}\ \text{lncsv\_1} - 27.4715 \tag{6.7.2.1}$$

$$\text{CointEq2} = \text{slsg3y\_1} - \underset{(-10.81)}{11.1155}\ \text{lncsv\_1} + 29.2678 \tag{6.7.2.2}$$

$$\text{CointEq3} = \text{invslsr\_1} - \underset{(-10.14)}{11.8266}\ \text{lncsv\_1} + 25.7498 \tag{6.7.2.3}$$

257 Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometria*, 55, 2, 251-276.

258 Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157.

259 t-Statistics shown in parentheses

To perform the Vector error correction estimates we have selected the specification with intercept, no trend, lags interval 1 to 2 in the first differences and including two exogenous variables, the return on assets ratio and the stock of R&D capital to sales ratio. The outcome of the VECM shows that the convergence has been achieved after 40 iterations and the restrictions[260] identify all cointegrating vectors. The LR test for binding restrictions shows that the statistic chi-square(1)=0.0018 does not exceed the critical value of 3.84 at the 5% level. This means that the null hypothesis, that the restrictions are accepted, cannot be rejected. The error correction equation corresponding to the first differences of the scores shows the highest coefficient of multiple determination (R-squared) of 0.538 and the highest value of the test of the overall significance of the regression (F-statistic) of 31.76.

The final outcome of the error correction model of the scores (1^{st}-diff.) shows the coefficients of the cointegrating equations very significant. All the other coefficients are very significant, except the first differences of the three-year sales growth (1^{st}-lag), of the investment to sales ratio (1^{st} and 2^{nd}-lags), of the created shareholder value in logs (1^{st} and 2^{nd}-lags), and the stock of R&D capital to sales ratio. The created shareholder value in logs is not significant in the first differences, but it is very significant in levels in the cointegrating equations to the scores (1^{st}-diff.).

We can also estimate the error correction model based on the Engle-Granger 2-step method. First we estimate the cointegrating regression using the pooled OLS estimator and saving the residuals, secondly verify that the residuals are stationary and, thirdly, we estimate the error correction equation. The outcome is the following:

- The cointegrating regression (t-values in parentheses):

$$\text{Scores} = \underset{(13.71)}{0.560}\ \text{slsg3y} + \underset{(2.76)}{0.084}\ \text{invslsr} + \underset{(8.56)}{0.574}\ \text{lncsv} + \underset{(47.60)}{36.779} \qquad (6.7.2.4)$$

R-sq = 0.4223

F(3, 455) = 110.86

- Augmented Dickey Fuller test. Stationarity of residuals. Lags (4) and trend.
t-statistic = -5.177 is more negative than the critical value t = -3.427 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin Watson d-statistic (7, 314) = 1.032 does not exceed the critical value of 1.57 and there is evidence of autocorrelation of residuals.

[260] See cointegration restrictins in Appendix 8b.

- The error correction model (t-values in parentheses):

$$\Delta scores = \underset{(19.72)}{1.825\,\Delta niat} + \underset{(4.84)}{0.402\,\Delta slsg3y} - \underset{(-2.39)}{0.387\,\Delta rdstslsr} + \underset{(3.37)}{0.059\,\Delta invslsr} + \underset{(7.92)}{0.285\,\Delta lncsv} + \underset{(0.39)}{0.017\,ehat\_1} - \underset{(-0.18)}{0.366}$$

R-sq = 0.607
F(6, 418) = 107.62 (6.7.2.5)

The error correction model based on the Engle-Granger 2-step method in first differences is not reliable due to the autocorrelation of the residuals considered in the regression. In consequence, we estimate the cointegrating equation based on the first differences. The outcome is the following (t-values in parentheses):

$$\Delta Scores = \underset{(7.50)}{0.724\,\Delta slsg3y} + \underset{(1.49)}{0.037\,\Delta invslsr} + \underset{(5.96)}{0.286\,\Delta lncsv} + \underset{(0.65)}{0.328} \quad (6.7.2.6)$$

R-sq = 0.185
F(3, 421) = 32.04

- Augmented Dickey Fuller test. Stationarity of residuals. Lags (4) and trend.
t-statistic = -10.827 is more negative than the critical value t = -3.428 at the 5% level and the null hypothesis of non-stationarity of residuals and the existence of a unit root can be rejected.
The Durbin Watson d-statistic (7, 288) = 2.177, this is between 1.74 and 2.22 at the 5% level, there is evidence of no autocorrelation of residuals. The residuals are stationary.

- The error correction model (t-values in parentheses):

$$\Delta\Delta scores = \underset{(18.65)}{1.752\,\Delta\Delta niat} + \underset{(3.20)}{0.398\,\Delta\Delta slsg3y} - \underset{(-2.88)}{0.604\,\Delta\Delta rdstslsr} + \underset{(2.87)}{0.051\,\Delta\Delta invslsr} + \underset{(5.34)}{0.218\,\Delta\Delta lncsv} - \underset{(-1.21)}{0.212\,ehat\_1} - \underset{(-0.81)}{0.464}$$

R-sq = 0.576
F(6, 389) = 88.42 (6.7.2.7)

The coefficient of the residuals is negative and not significant. This means that the dependent variable scores (1^{st}-diff.) was above its equilibrium value in the period (t-1) and it will decrease in the next period to recover the equilibrium value. The coefficient of the residuals measures the speed of adjustment of the cointegrated model in the long term. In our case this amount is -0.212, which is a low amount and the speed of adjustment is low.

The residuals (1st-lag) are not significant, and this means that the short-run disequilibrium adjustment is not significant.

Error Correction:	D(SCORES)	D(SLSG3Y)	D(INVSLSR)	D(LNCSV)
CointEq1	-1.059 [-16.61]	-0.167 [-5.68]	-0.089 [-0.65]	-0.157 [-2.48]
CointEq2	0.397 [8.51]	0.000 [NA]	0.520 [5.07]	0.201 [4.01]
CointEq3	0.088 [2.40]	0.067 [5.34]	-0.473 [-5.92]	-0.023 [-0.61]
D(SCORES(-1))	0.220 [3.53]	0.249 [7.42]	0.241 [1.82]	0.113 [1.89]
D(SCORES(-2))	0.201 [3.84]	0.188 [6.67]	0.048 [0.43]	0.018 [0.36]
D(SLSG3Y(-1))	-0.144 [-1.40]	0.011 [0.20]	-0.369 [-1.70]	-0.108 [-1.10]
D(SLSG3Y(-2))	-0.178 [-1.95]	-0.085 [-1.73]	-0.056 [-0.28]	-0.110 [-1.25]
D(INVSLSR(-1))	-0.013 [-0.32]	-0.022 [-1.01]	-0.423 [-4.92]	0.000 [-0.008]
D(INVSLSR(-2))	-0.011 [-0.33]	0.005 [0.30]	-0.207 [-2.96]	-0.051 [-1.62]
D(LNCSV(-1))	-0.089 [-0.90]	-0.075 [-1.42]	-0.313 [-1.50]	0.050 [0.53]
D(LNCSV(-2))	0.012 [0.18]	-0.064 [-1.79]	-0.127 [-0.90]	0.029 [0.46]
C	-12.211 [-12.11]	-1.730 [-3.18]	-0.866 [-0.40]	-2.475 [-2.56]
NIAT	1.439 [14.78]	0.195 [3.71]	-0.064 [-0.30]	0.333 [3.56]
RDSTSLSR	-0.022 [-0.75]	-0.017 [-1.09]	0.027 [0.44]	-0.036 [-1.29]
R-squared	0.538	0.275	0.387	0.512
Adj. R-squared	0.521	0.248	0.365	0.494
F-statistic	31.764	10.335	17.221	28.572
Log likelihood	-1280.177	-1052.825	-1557.316	-1264.655

t-values in square brackets

Table 6.11 The Overall Performance Model. Vector error correction models.

6.7.2d The Overall Performance Model. Pairwise Granger causality test

Based on the Granger causality Wald test the null hypothesis that the three-year sales growth and the investment to sales ratio does not Granger cause the scores cannot be rejected, the F-statistics are lower than the critical F(5, 852)= 2.22 at the 5% level of confidence. This means that the performance "scores" cannot be predicted by the history of the three-year sales growth and the investment to sales ratio. Additionally, the null hypothesis that the return on assets, the stock of R&D capital to sales ratio and the created shareholder value does not Granger cause the performance "scores" is rejected. In consequence, the current performance can be predicted by the return on assets, the stock of R&D capital to sales ratio and the created shareholder value (see Appendix 8b). These results indicate that the previous variables help in the prediction of performance, but it does not indicate causality in the common use of the term[261].

6.7.2e The Overall Performance Model. Model re-estimation

Due to the fact that we were using non-stationary data of the outcome of the model may lead to spurious regressions. The existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the models (see Table 6.6). The fact is that the Engle-Granger 2-step method was showing evidence of the higher reliability of the vector error correction model in second differences, and we will proceed to re-estimate the model in second differences. We will also show the outcome in first differences for comparison purposes.

We have implemented the fixed and random effects OLS estimators in second differences and the Hausman test. It indicates that the random effects estimator has degenerated to a pooled OLS and the Wald test from "xthausman" may not be appropriate. The Newey-West variance estimator produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity, and it computes the pooled OLS estimates for panel data sets.

[261] EViews 5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.

The Breusch-Pagan Lagragian multiplier test[262] for the random effects in second differences yields a chi2(1)=10.46. This is higher than the critical value of chi2(1)=3.84 at the 5% level of confidence and the null hypothesis of homoskedasticity is rejected.

The Wooldridge test[263] for autocorrelation in the panel data indicates that the statistic F(1, 24) = 20.68. This is higher than the critical value of 4.24 at the 5% level of confidence and the null hypothesis of no first order autocorrelation is rejected. We need to perform regressions to correct the first order autocorrelation.

The return on assets, the three-year sales growth, the investment to sales ratio and the created shareholder value in logs show a positive and significant contribution to the performance "scores". All the variables estimated in second differences. The results are quite similar to the previous Newey-West HAC-Heteroskedasticity Autocorrelation Consistent covariance matrix estimator with a lag(1) and the variables in levels as shown in Table 6.6.

The second differences estimator with lag(1) shows the stock of R&D capital to sales ratio negative and not significant, against the negative and significant contribution provided by the first differences estimates with lag(1).

	First Differences	Newey-West Pooled OLS robust lag(0)	Newey-West Pooled OLS std errors lag(1)	Second Differences	Newey-West Pooled OLS robust lag(0)	Newey-West Pooled OLS std errors lag(1)	Newey-West Pooled OLS std errors lag(1)
Return on Assets	d.roa	1.824 [12.82]	1.824 [11.52]	d2.roa	1.756 [11.30]	1.756 [9.99]	1.814 [10.76]
Three-year Sales growth	d.slsg3y	0.391 [4.09]	0.391 [4.44]	d2.slsg3y	0.472 [3.87]	0.472 [3.51]	0.632 [5.80]
Stock of R&D capital to Sales ratio	d.rdstslsr	-0.401 [-1.88]	-0.401 [-2.02]	d2.rdstslsr	-0.583 [-1.76]	-0.583 [-1.67]	
Investment to Sales ratio	d.invslsr	0.059 [2.61]	0.059 [2.58]	d2.invslsr	0.056 [3.27]	0.056 [2.92]	0.054 [2.76]
Created Shareholder Value in logs	d.lncsv	0.280 [8.37]	0.280 [7.91]	d2.lncsv	0.249 [7.78]	0.249 [6.68]	0.248 [6.60]
Constant	cons	0.420 [1.19]	0.420 [1.36]	cons	-0.432 [-0.75]	-0.432 [-1.10]	-0.453 [-1.14]
Nr Observations F-Statistic		425 72.07	425 68.21		396 46.86	396 37.66	396 41.55

t-values in square brackets

Table 6.12 The Overall Performance Model in first and second differences estimates.

262 The Stata command is "xttest0" after the random effects regression

263 The Stata command is "xtserial (dep. variable and ind. Variables)"

6.8 Conclusion

The selection of the calculated scoring dependent variable based on the S&P methodology provides a more solid concept of overall corporate performance against the previous research, and the factor analysis has defined the adequate selection of the independent variables. Finally, the econometric regression provides us the right methodology to identify the significant processes that better contribute to the overall corporate performance.

We have been able to identify six constructs based on the factor analysis. These are: Return-Profitability, Growth, Strategic Investment, Assets Efficiency, Risk and Value Creation-Expectations and these results provide a sound link with the current literature in management.

The Return on assets, the three-year growth, the investment to sales ratio and the created shareholder value have been demonstrated to be the most significant variables to the overall corporate performance in the econometric outcome. Corporate risk has been additionally added due to the biased nature of our 35-Dow Jones Industrials companies. These are the largest companies and the ones with less problems to get financing. As mentioned in the research, there are very clear differences from the previous research related to the methodology and the variables selection. The model outcome performs in a stable manner for the periods 1964 to 1988 and 1977 to 2001, with a breakpoint in 1998 due to the different impact of the economic events in the industrial sectors.

The Augmented Dickey-Fuller test for a unit root of each variable and the Fisher-type test have been performed, and they show that the panel is non-stationary. The Im-Pesharan-Shin test shows that a nonzero fraction of the panels represent stationary processes. In consequence, the model needs to be re-estimated.

Additionally, the Johansen Cointegration test provided the number and the final cointegrating equations to be considered, the Engle-Granger 2-step method confirmed the details of the final estimation in second differences, and the VECM-Vector error correction models estimation provided the LR test of binding restrictions and all the error correction models estimates.

Finally, the model has been re-estimated with all the variables in second differences. The HAC-Heteroskedasticity autocorrelation consistent covariance matrix estimator with a lag(1) in second differences shows the return on assets ratio, the three-year sales growth, the investment to sales ratio and the created shareholder value in logs with a positive and significant contribution to the overall performance. See Section 7.1.10 for a fuller discussion of the conclusions and Appendix 8b for the details of the estimates.

Finally, the main processes for corporate management to succeed in the long-term have been listed (See Appendix 10). The research demonstrates that caring about the fundamental processes leads to success in the overall performance of the firms. Profitability, sales growth, strategic investments (R&D, M&A, etc...) and created shareholder value are the fundamental processes as mentioned above.

Chapter 7

Conclusions

7.1 Summary of findings

The first objective was to identify the main driving factors for corporate growth for the Sales, Profit-Cash, Risk, Created Shareholder Value, Market Value, and the Overall Performance Model. This objective has been widely achieved. The quality of the data, the discipline in performing the regressions, and the powerful econometric tools, like the dynamic panel data estimators have been key in getting the results. We have been able to identify and explain the most significant variables for the main business processes in a company and ensure that the interpretation of the long and short-term influence was tackled. The description of the driving factors of corporate growth, as mentioned in the introduction of the problems, is currently missing in the academic literature and we have been performing an empirical econometric approach, which is fully original, when compared with AT Kearney (1999), Canals (2000), Roberts (2004) and Slywotzky (2004).

The second objective of displaying the layout of actions to better understand the different measures has also been widely achieved, especially the one related to the Value Creation measures. The power of the econometric models, the graphs and examples being performed have made sure that the objective has been accomplished. It is shown that our Overall Performance Model was dropping the Cash Flow variable due to the multicollinearity with Net Income, with the last one as more significant in the regression. This is a very interesting finding because, in general, companies put more emphasis on Net Income, whereas Microsoft puts more on Cash Flow as described in section 8.3. The management of a portfolio of investments with a huge number of investments, with a shorter duration by Project, and some with huge amounts involved makes the Cash Flow more important than Net Income for the IT Management Industry.

The third objective of being very strict in the econometric work through the right methodology has also been achieved. The tables showing the estimates for each model are an excellent way to validate the work done, and to show the consistency of the different regressions being performed. The similarity of the coefficients and the levels of significance, as well as the statistics of the tests being performed, is a way to check the overall consistency.

The fourth objective of the Project Management approach has been achieved, but the cleaning of the S&P bankruptcy databases was very difficult and it caused a long delay in the work.

7.1.1 Introduction

First we adopt several driving factors to identify Corporate Growth. This is consistent with the current literature in Management, which embraces the constructs concept, but a very important difference is that we adopt the future expectations as an element, among others, to get Corporate Growth. The future expectations help us to understand better the investors behaviour and how to attract capitals. The current literature adopts the financial performance (TSR-Total shareholder return, CFROI-Cash flow return on investment, etc…) as the key variables to maximize, and this is only one variable of the overall performance in our research.

In the current literature we can find the elements of the strategy like: growth, risk and return with the objective to maximize shareholder value or value creation, but in our approach we have: volume growth, returns, risk and future expectations with the objective to maximize the overall corporate performance. This is represented by the scoring built based on the Standard and Poor's variables used in the annual Performance Ranking published in the *Business Week*. Our approach allows to study the impact of the different elements of the strategy to the overall corporate performance in a deeper way.

Penrose (1959) expressed that the managerial resources are the main limitation to grow the business and we fully agree with this concept, but a wider approach needed to be taken, and we studied the scarcity of resources and the limitation to grow. The analysis and adaptation of the Adbudg model to the specifications of the econometric models allows us to capture the short and long-term aspects and try to capture the different stages of the Adbudg function to every independent variable considered in our research. This means that we have been specifying every variable in first-lag and first-difference taking care of the above mentioned approach. This is not new in the economic literature, but it is in the corporate growth one.

A very important tool used has been the combined Methods and Directions matrix of Corporate Development described by Allen (1998). This strategic tool has allowed us to define the different variables related to the driving factors of corporate growth. Specifically, the sales models I and II, as well as the profit-cash flow model have taken advantage of this approach. The use of this matrix to define the variables for the econometric models is also new in the economic and management literature.

We wanted to justify that we cannot simplify growth to just regress a corporate rate growth. This has been widely achieved, first we have defined the key factors driving growth like the demand, sales, profit-cash flow, risk and value creation, second we have identified the underlying business processes for each factor. This required the help of the Allen's matrix and the study of the previous working papers in every factor. Once identified the underlying business processes we have been able to list the practical implications of the results for Corporate Management based on the outcome of the econometric models and the current literature. See Appendix 11.

7.1.2 The Sales Model

We have specified two econometric models: the first based on the different variables in levels and the second based on the different variables in first-lag and first-differences. Along the years the Cobb-Douglas production function has been the typical model to study this subject, but we have been focussed in the selection of the right variables and performing OLS and GMM estimators as Hall and Mairesse, etc…

It is very important to remark that the specification of the variables has been very important specially the stock of R&D capital and the Investment. We adopted the Zvi Griliches and Bronwyn Hall (1982) calculation of the stock of R&D capital with a depreciation rate 15%, as described in the NBER papers No 3366 App B. In the case of the Investment we have calculated it based on the book value of total assets. We consider that the intangible assets cannot be excluded at all from the calculation. This means that we are not in favour to use the net fixed assets in the calculation, like the Lewellen and Badrinath (1997)[264] approach. During the telecom bubble many companies were acquired with high corporate values based on the high value of the intangibles and huge future cash flow expectations, and after the burst of the bubble the high corporate values disappeared, but the agreed amounts, prior to the burst of the bubble in April 2000, needed to be paid with very difficult consequences for the acquiring companies. We cannot ignore the value of intangible assets, and one of the best ways to capture this item is to use the book value of total assets.

7.1.2a The Sales Model I

The sales model I econometric outcome based on the System GMM-1 estimator shows the research and development and the Investment with a positive and significant contribution to the sales, and the resources a negative and significant contribution to the sales. The outcome of the Augmented Dickey-Fuller unit root tests and the Fisher-type test shows that the panel is non-stationary and the model needs to be re-estimated.

The outcome of the Johansen Cointegration test shows the existence of three long-term cointegrating equations, in consequence the existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the regression in levels.

The vector error correction models have been estimated and the LR test for binding restrictions shows a chi-square(1)=0.0152 and the considered restrictions are accepted. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression are stationary and the Durbin-Watson statistic at 1.87. In consequence, the model has been re-estimated with all the variables in first differences. The fixed effects OLS is consistent and the outcome shows the market situation and the research and development with a positive and significant contribution to the sales, and resources and investment with a negative and significant contribution to the sales.

264 Lewellen, W.G. and Badrinath, S.G., 1997, "On the Measurement of Tobin's Q", *Journal of Financial Economics*, 44, 77-122, 91.

The fixed effects OLS in first differences shows the market situation with a positive and significant contribution, and the investment with a negative and significant contribution as the main difference against the System GMM-1 estimates with all the variables in levels.

We can confirm the positive and significant contribution of the research and development in the System GMM-1 and the fixed effects OLS in first differences like in the economic literature (Mairesse and Hall (1996)[265], etc…).

We were estimating the error correction model in first differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a low amount $\gamma = -0.043$, which means that the sales are not adjusted in a quick way to the short-term changes in the market situation, resources, research and development and investment. We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are not reflected in a quick way in the final sales.

The outcome of the Pairwise Granger causality test shows that the sales can be predicted by the history of the previous year sales, the market situation and the current investment, and not by the history of the resources and research and development. This last item is in accordance with the Geroski[266] findings that the innovative annual spending is erratic and the sales growth ratio unpredictable.

7.1.2b The Sales Model II

The sales model II econometric outcome based on the System GMM-2 estimator shows the sales (1st-lag), the market situation (1st-diff.), the research and development (1st-lag and 1st-diff.) and the investments (1st-lag) with a positive and significant contribution to the sales, and the market situation (1st-lag), the resources (1st-lag and 1st-diff.) with a negative and significant contribution to the sales. The outcome of the Augmented Dickey-Fuller tests and the Fisher-type test shows that the panel is non-stationary and the model needs to be re-estimated.

---

265 Mairesse, J. and Hall, B., 1996, "Estimating the Productivity of Research and Development: An Exploration of GMM Methods using data on French and United States Manufacturing Firms", *NBER-National Bureau of Economic Research*, Working Paper No 5501.

266 Geroski, P., 1998, "An Applied Econometrician's View of Large Company Performance", *CEPR Centre for Economic Policy Research*, Discussion Paper No 1862, 16.

The outcome of the Johansen Cointegration test shows near a singular matrix, and it does not provide any outcome. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression are stationary and the Durbin-Watson statistic at 1.91. In consequence, the model has been re-estimated with all the variables in first differences. The fixed effects OLS is consistent and the outcome shows the market situation (1^{st}-lag and 1^{st}-diff.), the research and development (1^{st}-lag and 1^{st}-diff.), and the investment (1^{st}-lag) with a positive and significant contribution to the sales, and resources (1^{st}-lag and 1^{st}-diff.) with a negative and significant contribution to the sales.

The fixed effects OLS in first differences shows the market situation (1^{st}-lag) with a positive and significant contribution as the main difference against the System GMM-2 estimates with all the variables in levels.

We can confirm the positive and significant contribution of the research and development in the System GMM-2 and the fixed effects OLS in first differences like in the economic literature (Mairesse and Hall (1996)[267], etc…).

We were estimating the error correction model in first differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a low amount $\gamma=0.007$, which means that the sales are not adjusted in a quick way to the short-term changes in the market situation (1^{st}-lag and 1^{st}-diff.), the resources (1^{st}-lag and 1^{st}-diff.), the research and development (1^{st}-lag and 1^{st}-diff.) and the investments (1^{st}-lag). We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are not reflected in a quick way in the final sales.

The outcome of the Pairwise Granger causality test shows that the sales can be predicted by the previous year sales, the market situation (1ts-lag and 1^{st}-diff.), the resources (1^{st}-diff.), the research and development (1^{st}-diff.), and the investment (1^{st}-lag), and not by the resources (1^{st}-lag) and the research and development (1^{st}-lag). This last item is in accordance with the Geroski[268] findings that the innovative annual spending is erratic and the sales growth ratio unpredictable.

---

[267] Mairesse, J. and Hall, B., 1996, "Estimating the Productivity of Research and Development: An Exploration of GMM Methods using data on French and United States Manufacturing Firms", *NBER-National Bureau of Economic Research*, Working Paper No 5501.

[268] Geroski, P., 1998, "An Applied Econometrician's View of Large Company Performance", *CEPR Centre for Economic Policy Research*, Discussion Paper No 1862, 16.

Additionally, we have performed the Industrial Sector Analysis, and the dummies allowed us to identify the industry groups and perform the econometric work. It was clear in the outcomes that the industry groups related to the consumer markets are also driven by the short-term advertising expenditures, and this variable was missing in our research.

Finally, we have covered the threshold analysis of the stock of R&D capital to identify the companies that the critical mass of the stock of R&D capital has been achieved. To perform this analysis we have splitted the panel in two sub-samples of companies: one with a r1>0.018 and the other with a r1<0.018 in the year 2002. The outcomes of the two regressions show differences in the coefficients and the t-statistic values, but the main conclusion is that the companies belonging to the sub-sample with the r1>0.018 show a higher probability to surpass the R&D critical mass, learning processes and increasing returns to scale of research and development than the sub-sample with r1<0.018. The companies belonging to the sub-sample with r1<0.018 show a lower probability to surpass the R&D critical mass, some of these companies belong to sectors with low annual R&D expenditures, in same cases erratic and without continuity in successive years.

In the economic literature we can find a coverage of the threshold analysis in Geroski (1998) and Gonzalez and Jaumandreu (1998), but the main difference with our research is the linear combination of the stock of R&D capital in logs (1^{st}-lag and 1^{st}-diff.) and the split of the panel in two sub-samples to solve the analysis of the threshold of the research and development.

7.1.3 The Profit-Cash Flow Model

The profit-cash flow model econometric outcome based on the System GMM-2 estimator shows the previous year profit-cash flow, the market situation (1^{st}-diff.), the sales (1^{st}-lag and 1^{st}-diff.), the research and development (1^{st}-lag), and the productivity (1^{st}-diff.) with a positive and significant contribution to the profit-cash flow, and the market situation (1^{st}-lag), the research and development (1^{st}-diff.), and the investments (1^{st}-diff.) with a negative and significant contribution to the profit-cash flow. The outcome of the Augmented Dickey-Fuller tests and the Fisher-type test shows that the panel is not stationary and the model needs to be re-estimated.

The outcome of the Johansen Cointegration test shows near a singular matrix, and it does not provide any outcome. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression in first differences are stationary and the Durbin-Watson statistic at 2.02. In consequence, the model has been re-estimated with all the variables in second differences. The MLE-maximum likelihood estimator in second differences is consistent and the outcome shows the profit-cash flow (1st-lag) not significant, all the other variables with a positive and significant contribution to the profit-cash flow, excepts the research and development (1st-diff.) and the investment (1st-diff.) with a negative and significant contribution to the profit-cash flow.

The MLE-maximum likelihood estimator in second differences show the market situation (1st-lag) with a positive and significant contribution to the profit-cash flow as the only difference against the System GMM-2 estimates with all the variables in levels.

We can confirm the positive and significant contribution of the research and development (linear combination of the 1st-lag and 1st-diff.) to the profit-cash flow in the System GMM-2 in levels and the MLE estimator in second differences like in the economic literature (Jaffe (1986)[269], etc…).

We were estimating the error correction model in second differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a low amount $\gamma=0.141$, which means that the profit-cash flow is not adjusted in a quick way to the short-term changes in the profit-cash flow (1st-lag), the market situation (1st-lag and 1st-diff.), the sales (1st-lag and 1st-diff.), the research and development (1st-lag and 1st-diff.), the productivity (1st-diff.) and the investment (1st-diff.). We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are not reflected in a quick way in the final profit-cash flow.

The outcome of the Pairwise Granger causality test shows that the profit-cash flow can be predicted by the history of the market situation (1st-lag and 1st-diff.), the sales (1st-lag and 1st-diff.), the research and development (1st-lag and 1st-diff.), and investment (1st-diff.), and not by the history of the apparent variable cost productivity (1st-diff.). This confirms the concept that variable cost productivity is erratic and very difficult to get.

[269] Jaffe, A.B., 1986, "Technological Opportunity and Spillovers of R&D: Evidence from Firm's Patents, Profits, and Market Value", *The American Economic Review,* Volume 76, Issue 5, 992.

We did not find the capability to generate sales, and the apparent variable cost productivity included in any profit model in the current economic literature.

Additionally, we have performed the Industrial Sector Analysis, and the dummies allowed us to identify the industry groups and perform the econometric work. It was clear in the outcomes that the industry groups related to the consumer markets are also driven by the short-term advertising expenditures, and this variable was missing in our research.

Finally, the dilemma between investing in R&D or selective investments have been analysed. The EBITDA to Total Assets ratio for the year 2002 table introduced and discriminated by the investment to sales ratio and the stock of R&D capital to sales ratio. The Table shows the saturation effect in each type of investment and the exact ratios involved for the related panel of companies.

7.1.4 The Net Income Variability Model

The net income variability model econometric outcome based on the fixed effects OLS estimator shows the standard deviation of the extraordinary items, special items, discontinued operations, non operating income/expense, sales and depreciation with a positive and significant contribution to the standard deviation of the adjusted net income, and the selling general and administrative expenditures, cost of goods sold, interest expenditures and savings due to common stock equivalents with a negative and significant contribution to the standard deviation of the adjusted net income.

The highest level of significance of the coefficients is shown by the extraordinary items, the special items, the discontinued operations and the non operating income/expense. The lowest level of significance of the coefficients is shown by the selling general and administrative expenditures, the sales and the cost of goods sold. The fact that all the operational variables show a lower level of significance means that the companies have been acting in the unusual items more than in the operational ones to get the net income for the analysed period.

7.1.5 The Default Probability Model.

Our main objective has been to analyse the significance of the industry variables and, secondly, identify alternative variables for the default probability.

The default probability econometric outcome based on the HCCME-Heteroskedasticity-consistent covariance matrix estimator for the fixed OLS shows the EBITDA interest coverage, pretax return on capital, and operating income before depreciation to sales ratio with a negative and significant contribution to the default probability, and the long-term debt to capitalization a positive and significant contribution to the default probability.

The capability to generate Cash, Profits and the level of Dbet are the key ingredients driving to the payment defaults if the financial situation is worsening.

The coefficients and t-statistics are very similar between the ln(DP) and the logistic function ln(DP/1-DP). The similarity of the econometric outcome allows us to recommend the use of the ln(DP) as a simplified version to get the same results as the logistic function.

7.1.6 The Bankruptcy Model.

Our main objective has been to analyse the significance of the industry variables and, secondly, identify alternative variables for the bankruptcy model.

The bankruptcy econometric outcome based on the HCCME-Heteroskedasticity-consistent covariance matrix estimator for the fixed OLS shows the EBITDA interest coverage, and the pretax return on capital with a positive and significant contribution to the log of the total assets to liabilities, and the free operating cash flow to total debt and the total debt to capitalization with a negative and significant contribution to the log of the total assets to liabilities.

In this section we have compared the default probability against the bankruptcy model. The main differences come from different dependent variables and the information data coming from different databases.

The EBITDA interest coverage and pretax return on capital are significant in both models. The default probability model emphasizes the operating income and long-term debt, whereas the bankruptcy one is more related to the generation of free operating cash flow and the level of total debt.

The benchmarking of variables was showing that the total assets to liabilities and the Altman's Z-score, due to the continuous nature of the variables, have more power of prediction of bankruptcy than the rating codes, and looking at the power of prediction through extrapolation the Altman's Z-score is more powerful than the total assets to liabilities variable.

7.1.7 The Created Shareholder Value Model

The created shareholder value econometric outcome based on the HCCME-Heteroskedasticity-consistent covariance matrix estimator for the fixed effects OLS shows the strategic index (1^{st}-lag), the cash dividends (1^{st}-lag) with a positive and significant contribution to the created shareholder value, and the net income (1^{st}-diff.), the over and undervalued shares gap, the potential growth path, the sale of common & preferred shares (1^{st}-lag), and the retirement of long-term debt (1^{st}-lag) with a negative and significant contribution to the created shareholder value. The outcome of the Augmented Dickey-Fuller unit root tests and the Fisher-type test shows that the panel is non-stationary and the model needs to be re-estimated.

The outcome of the Johansen test shows the existence of one long-term cointegrating equation, in consequence the existence of a cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the regression in levels.

The vector error correction model has been estimated and the LR test for binding restrictions shows a chi-square(1)=1.76 and the considered restrictions are accepted. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression are non-stationary and the D-W statistic at 1.77. In consequence, the model has been re-estimated with all the variables in 1st & 2nd differences. The outcome of the HAC-Heteroskedasticity autocorrelation consistent covariance estimator in first differences shows the strategic index (1^{st}-lag), the cash dividends (1^{st}-lag) with a positive and significant contribution to the created shareholder value, and the net income (1^{st}-diff.), the over and undervalued shares gap, the potential growth path, the sale of common & preferred shares (1^{st}-lag), and the retirement of long-term debt (1^{st}-lag) with a negative and significant contribution to the created shareholder value.

The outcomes of the HAC-Heteroskedasticity autocorrelation consistent covariance estimator in first differences and the HCCME-Heteroskedasticity consistent covariance matrix estimator for the fixed effects OLS in levels show the same signs and similar t-statistics of significance for each variable.

We were estimating the error correction model in first differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a high amount $\gamma = -0.417$, which means that the created shareholder value is adjusted in a quick way to the short-term changes in the net income (1^{st}-diff.), the strategic index (1^{st}-lag), the over and undervalued shares gap, the potential growth path, the cash dividends (1^{st}-lag), the sale of common & preferred shares (1^{st}-lag), and the retirement of long-term debt (1^{st}-lag). We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are reflected in a quick way in the final created shareholder value.

The outcome of the Pairwise Granger causality test shows that the created shareholder value can be predicted by the history of the strategic index (1^{st}-lag), the over and undervalued shares gap, the potential growth path, the cash dividends (1^{st}-lag), the sale of common & preferred shares (1^{st}-lag), and the retirement of long-term debt (1^{st}-lag), and not by the history of the net income (1^{st}-diff.).

7.1.8 The Market Value. Model I.

The market value model I econometric outcome based on the System GMM-2 estimator shows the market value (1^{st}-lag), the S&P500 (1^{st}-lag and 1^{st}-diff.), and the created shareholder value with a positive and significant contribution to the market value. The outcome of the Augmented Dickey-Fuller unit root tests and the Fisher-type test shows that the panel is non-stationary and the model needs to be re-estimated.

The outcome of the Johansen Cointegration test shows the existence of two long-term cointegrating equations, in consequence the existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the regression in levels.

The vector error correction models have been estimated and the LR test for binding restrictions shows a chi-square(2)=0.98 and the considered restrictions are accepted. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression in levels are stationary and the Durbin-Watson statistic at 2.18. In consequence, the model has been re-estimated with all the variables in first differences. The MLE-Maximum likelihood estimator is consistent and the outcome shows the market value (1^{st}-lag), the S&P500 (1^{st}-lag and 1^{st}-diff.), and the created shareholder value with a positive and significant contribution to the market value.

The MLE-Maximum likelihood estimator in first differences and the System GMM-2 in levels show the same signs and similar t-statistics of significance for each variable. We can state that the MLE estimator in first differences is showing the coefficient of the market value (1^{st}-lag) at ke=0.047 and higher reliability than the same coefficient in the System GMM-2 in levels.

We were estimating the error correction model in first differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a low amount γ=0.025, which means that the market value is not adjusted in a quick way to the short-term changes in the market value (1^{st}-lag), S&P500 (1^{st}-lag and 1^{st}-diff.), and the created shareholder value. We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are not reflected in a quick way in the final market value.

The outcome of the Pairwise Granger causality test shows that the market value can be predicted by the history of the S&P500 (1^{st}-lag and 1^{st}-diff.), but not by the history of the Market value (1^{st}-lag) and the created shareholder value. We can also find that the market value helps in the prediction of the created shareholder value. This is confirmed by the definition of the created shareholder value.

7.1.9 The Market Value. Model II.

The market value model II econometric outcome based on the System GMM-2 estimator shows the market value (1^{st}-lag), the S&P500 (1^{st}-diff.), the net income (1^{st}-diff.), the cash dividends (1^{st}-lag), and the sale of common & preferred shares (1^{st}-diff.) with a positive and significant contribution to the market value, and the over and undervalued shares gap, and the potential growth path with a negative and significant contribution to the market value. The outcome of the Augmented Dickey-Fuller unit root tests and the Fisher-type test shows that the panel is non-stationary and the model needs to be re-estimated.

The outcome of the Johansen Cointegration test shows the existence of one long-term cointegrating equation, in consequence the existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the regression in levels.

The vector error correction models have been estimated and the LR test for binding restrictions shows a chi-square(1)=0.023 and the considered restrictions are accepted. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression in levels are stationary and the Durbin-Watson statistic at 1.84. In consequence, the model has been re-estimated with all the variables in first differences. The MLE-Maximum likelihood estimator in first differences is consistent and the outcome shows the market value (1^{st}-lag), the S&P500 (1^{st}-diff.), the net income (1^{st}-diff.), the cash dividends (1^{st}-lag) with a positive and significant contribution to the market value, and the over and undervalued shares gap, the potential growth path, and the sale of common & preferred shares (1^{st}-diff.) with a negative and significant contribution to the market value.

The System GMM-2 in levels and the MLE estimator in first differences show the same signs and similar t-statistics of significance for each variable. We can state that the MLE estimator in first differences is showing the coefficient of the market value (1^{st}-lag) at ke=0.042 and a similar coefficient in the System GMM-2 in levels. The sale of common & preferred shares (1^{st}-diff.) is not significant in the MLE estimator in first differences, meanwhile it was significant in the System GMM-2 in levels, this is the only difference between the above mentioned estimates.

We were estimating the error correction model in first differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a high amount γ=0.563, which means that the market value is adjusted in a quick way to the short-term changes in the market value (1^{st}-lag), the S&P500 (1^{st}-diff.), the net income (1^{st}-diff.), the over and undervalued shares gap, the potential growth path, the cash dividends (1^{st}-lag) and the sale of common & preferred shares (1^{st}-diff.). We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are reflected in a quick way in the final market value.

The outcome of the Pairwise Granger causality test shows that the market value can be predicted by the history of the S&P500 (1^{st}-diff.), the potential growth path, the cash dividends (1^{st}-lag), and the sale of common & preferred shares (1^{st}-diff.), and not by the history of the market value (1^{st}-lag), the net income (1^{st}-diff.) and the over and undervalued shares gap.

7.1.10 The Overall Performance Model

The overall performance model econometric outcome based on the HAC-Heteroskedasticity autocorrelation consistent covariance matrix estimator with a lag(1) in levels shows the return on assets ratio, the three-year sales growth, the investment to sales ratio and the created shareholder value in logs with a positive and significant contribution to the overall performance. The outcome of the Dickey-Fuller unit root test and the Fisher type shows that the panel is non-stationary and the models needs to be re-estimated. The Im-Pesharan-Shin test shows that a nonzero fraction of the panels represent stationary processes.

The outcome of the Johansen Cointegration test shows the existence of three long-term cointegrating equations, in consequence the existence of cointegrating relationships in the estimated model may lead to non-reliable interpretations of the long-run coefficients in the outcome of the regression in levels.

The vector error correction models have been estimated and the LR test for binding restrictions shows a chi-square(1)=0.0018 and the considered restrictions are accepted. We were also estimating the error correction model based on the Engle-Granger 2-step method and the residuals of the cointegrating regression in first differences are stationary and the

Durbin-Watson statistic at 2.17. In consequence, the model has been re-estimated with all the variables in second differences. The HAC-Heteroskedasticity autocorrelation consistent covariance matrix estimator with a lag(1) in second differences shows the return on assets ratio, the three-year sales growth, the investment to sales ratio and the created shareholder value in logs with a positive and significant contribution to the overall performance.

We can confirm that there are no differences in the outcome of the regressions between the HAC covariance matrix with a lag(1) estimators in levels and second differences.

We were estimating the error correction model in second differences based on the Engle-Granger 2-step method as above mentioned, and we found that the coefficient of the residuals is a low amount $\gamma = -0.212$, which means that the overall performance is not adjusted in a quick way to the short-term changes in the return on assets ratio, the three-year sales growth, the investment to sales ratio and the created shareholder value in logs. We did not find this item covered in the current economic literature. This means that changes in the business processes strategy are not reflected in a quick way in the final overall performance.

The outcome of the Pairwise Granger causality test shows that the overall performance can be predicted by the history of the return on assets, the stock of R&D capital to sales ratio and the created shareholder value, but not by the history of the three-year sales growth and the investment to sales ratio.

7.2 Further work

The empirical research is finalised in terms of models. We could perform a further work with a larger sample of companies instead of the S&P 500. Another potential course of action is making a benchmarking work for a specific sector, instead of a global one, trying to display the results with specific coefficients by company.

The larger companies do not struggle with funding and the Long Term Debt has not been a very significant variable in our research. The positive aspect is that we better understand what the larger companies are doing. On the other side we missed the behaviour of Debt in a larger sample of companies. An approach like this will require the determination of certain company sizes and work with dummies.

We have been performing panel data with small and large N and T, and all the variables transformations have been academically correct, but we did not investigate the effects of a small number of observations, and how the variables/models struggle with that change. The GMM option with a small number of observations would not run correctly and it would be very interesting to see some work in this direction.

7.3 Strengths and weaknesses of the empirical research

The strengths have been: solving a gap in the academic literature in the corporate growth and in the econometric side: a high quality in the econometrics regressions and tests, high discipline in the Data & Variables Generating Processes and very friendly in presenting the cases. We guessed some of the results based on our professional experience but we had never seen them in a formalized way.

The weaknesses have been: the summary of results in every model requires a certain econometric background to understand dynamic panel data models, but we did not want to loose quality. The research is biased in terms of the analysed companies, the S&P 500 are the larger ones and we missed the effects of the Debt behaviour in small companies, which, in our case is not so relevant, and the fact of trying to solve the gap in the academic literature makes the research long when dealing with so many models.

Appendixes

Appendix 1a. The Sales Model Variables Description

1.1 Net Sales.

$$\text{Net Sales} = s = \ln\left[\frac{y1*100}{p2}\right]$$

$y1$ = Net Sales (thousand US Dollars) sourced by Standard & Poor's – Compustat.
$p2$ = PPI-Producer Price Index for each Sector to adjust Net Sales to constant 2002 US Dollars sourced by the Bureau of Labour Statistics.
www.bls.gov > Public Data Query.

1.2 Market Situation.

Market Situation = g = ln(real GDP)

Real GDP = Gross Domestic Product at constant 2002 US Dollars.

1.3 Core Resources.

$$\text{Core Resources} = e = \frac{SG\&A}{Sales} = \frac{x3*100}{p1} * \frac{p2}{y1*100} = \frac{x3*p2}{p1*y1}$$

x3 = Selling General and Administration expenditures (thousand US Dollars) sourced by Standard & Poor's – Compustat.
$p1$ = Annual GDP deflator for fixed non residential investment to adjust SG&A to constant 2002 US Dollars sourced by the Bureau of Economic Analysis.
www.bea.gov > Publications > National Income > NIPA Tables > Section 7.
e-mail: GDPNIWD@bea.gov

1.4 Research & Development.

Research & Development = r = ln(R&D Stock)

R&D Stock = Stock of R&D Capital. It has been built using a perpetual inventory with a depreciation rate of 15%, as described in B. Hall. 1990. *The Manufacturing Sector Manufacturing File*. NBER Working Paper No 3366. Amounts adjusted to constant 2002 US Dollars.

1.5 Investment.

Investment to Net Sales ratio = i = $\frac{Investment}{Sales} = \frac{x8*100}{p1} * \frac{p2}{y1*100} = \frac{x8*p2}{p1*y1}$

$Investment_{it} = x8 = AT_{it} + DP_{it} - AT_{i,t-1}$

AT = Assets Total.
DP = Annual Depreciation and Amortization.
Sourced by Standard & Poor's – Compustat.
Lewellen and Badrinath (1997)[270] use the Net Fixed Assets, instead of the book value of Total Assets to calculate the Investment. We consider that intangible assets cannot be excluded at all.

270 Lewellen, W.G. and Badrinath, S.G., 1997, "On the Measurement of Tobin's Q", *Journal of Financial Economics, 44, 77-122, 91.*

Appendix 1b. The Sales Model I. Arellano-Bond System GMM-1 estimator results. The Sargan, Augmented Dickey-Fuller, Fisher, Johansen, Engle and Granger tests. VECM estimates. Pairwise Granger causality test and Model re-estimation.

```
. xtabond2 s s_1 e r i, gmm(s_1 e r i)  iv(l.s_1 l.e l.r l.i, mz) small h(3)
Building GMM instruments.....
Estimating.
Performing specification tests.
```

1. Arellano-Bond dynamic panel-data estimation, one-step system GMM results

```
Group variable: id                          Number of obs      =     1608
Time variable : year                        Number of groups   =      223
Number of instruments = 145                  Obs per group: min =        1
F(4, 1603)    =   4288.60                              avg =     7.21
Prob > F      =     0.000                              max =        8
```

	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
s_1	.5744016	.0119882	47.91	0.000	.5508874	.5979158
e	-.1976077	.0109303	-18.08	0.000	-.2190469	-.1761686
r	.0253666	.0013935	18.20	0.000	.0226333	.0280999
i	.0040111	.0014957	2.68	0.007	.0010773	.0069449
_cons	.7931575	.0209685	37.83	0.000	.7520288	.8342861

2. Sargan test of overid. restrictions: chi2(140) = 721.78 Prob > chi2 = 0.000

Arellano-Bond test for AR(1) in first differences: z = -1.07 Pr > z = 0.287
Arellano-Bond test for AR(2) in first differences: z = -1.23 Pr > z = 0.217

3. The augmented Dickey-Fuller test

THE SALES MODEL I - AUGMENTED DICKEY FULLER TEST.						
	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
s	-16.249	1.974				
s_1	-18.334	2.018				
g	-75.542	2.658	-57.317	2.385	-47.391	2.092
e	-9.929	1.788	-19.774	1.756	-33.367	1.922
r	-9.018	2.152				
i	-23.019	1.170	-37.713	2.063		
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					
We assume 4 lags, a constant and a trend						
Ho: there is a unit root in the time series (non-stationary)						
We reject the null hypothesis for all the time series, excepts (g, e and i)						

4. Fisher-type test

Fisher-type unit-root test for s
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots   Number of panels   =   418
Ha: At least one panel is stationary   Avg. number of periods =   7.80

AR parameter: Panel-specific   Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included   Cross-sectional means removed
Drift term: Not included   ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(804)	P	0.0000	1.0000
Inverse normal	Z	.	.
Inverse logit t(4)	L*	.	.
Modified inv. chi-squared	Pm	-20.0499	1.0000

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.

The null hypothesis that all the panels contain unit roots cannot be rejected.

5. Johansen Cointegration test

Date: 02/20/10   Time: 12:53
Sample(adjusted): 6 3336
Included observations: 1980
Excluded observations: 1351 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: S G E I
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.575628	2322.865	47.21	54.46
At most 1 **	0.154161	625.7172	29.68	35.65
At most 2 **	0.098568	294.2133	15.41	20.04
At most 3 **	0.043833	88.74836	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels

3 Cointegrating Equation(s): Log likelihood 4847.790

Normalized cointegrating coefficients (std.err. in parentheses)

S	G	E	I
1.000000	0.000000	0.000000	-4.412677
			(0.24341)
0.000000	1.000000	0.000000	0.009874
			(0.00128)
0.000000	0.000000	1.000000	5.997225
			(0.32096)

Adjustment coefficients (std.err. in parentheses)

D(S)	-0.136713	-0.824642	-0.096755
	(0.01529)	(0.07666)	(0.01153)
D(G)	0.006399	-2.185568	0.008543
	(0.00850)	(0.04261)	(0.00641)
D(E)	-0.070274	-0.124157	-0.050494
	(0.01582)	(0.07928)	(0.01192)
D(I)	-0.742141	-0.728667	-0.691232
	(0.15226)	(0.76325)	(0.11475)

6. Engle and Granger test

. reg s g e i

Source	SS	df	MS
Model	20.8884754	3	6.96282513
Residual	64.6795753	2593	.024943916
Total	85.5680507	2596	.032961499

Number of obs = 2597
F(3, 2593) = 279.14
Prob > F = 0.0000
R-squared = 0.2441
Adj R-squared = 0.2432
Root MSE = .15794

s	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
g	.4928548	.0397772	12.39	0.000	.4148566	.570853
e	-.4821939	.0194232	-24.83	0.000	-.5202805	-.4441073
i	-.0420233	.0035601	-11.80	0.000	-.0490042	-.0350423
_cons	-2.284764	.3642236	-6.27	0.000	-2.998963	-1.570566

. dfuller ehat, regress lags(4) trend

Augmented Dickey-Fuller test for unit root Number of obs = 1980

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.004	-3.960	-3.410	-3.120

* MacKinnon approximate p-value for Z(t) = 0.0000

Durbin-Watson d-statistic(7, 1980) = 1.870118

reg dehat ehat_1

Source	SS	df	MS
Model	1.33074254	1	1.33074254
Residual	8.36673346	2468	.003390086
Total	9.697476	2469	.003927694

Number of obs	=	2470
F(1, 2468)	=	392.54
Prob > F	=	0.0000
R-squared	=	0.1372
Adj R-squared	=	0.1369
Root MSE	=	.05822

dehat	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ehat_1	-.2593938	.0130924	-19.81	0.000	-.2850669	-.2337206
_cons	.5499182	.0275834	19.94	0.000	.4958293	.6040072

. dwstat
Number of gaps in sample: 124
Durbin-Watson d-statistic(2, 2470) = 1.936193

7. VECM estimates

Vector Error Correction Estimates
Date: 02/20/10 Time: 13:02
Sample(adjusted): 4 3336
Included observations: 1374
Excluded observations: 1959 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:

B(1,1)=1,B(1,2)=0,B(1,3)=0,B(2,1)=0,B(2,2)=1,B(3,3)=1,B(2,3)=0,B(3,1)=0,B(3,2)=0,A(3,2)=0
Convergence achieved after 10 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 3):
Chi-square(1) 0.015232
Probability 0.901775

Cointegrating Eq:	CointEq1	CointEq2	CointEq3
S(-1)	1.000000	0.000000	0.000000
G(-1)	0.000000	1.000000	0.000000
E(-1)	0.000000	0.000000	1.000000
I(-1)	-0.063389 (0.00242) [-26.2070]	0.041820 (0.00411) [10.1791]	1.238734 (0.05351) [23.1495]
C	-2.084001	-9.177729	-0.551591

Error Correction:	D(S)	D(G)	D(E)	D(I)
CointEq1	-0.970640	-0.164856	0.359531	-0.902798
	(0.01007)	(0.01835)	(0.02917)	(0.30498)
	[-96.4112]	[-8.98209]	[12.3244]	[-2.96014]
CointEq2	-0.077571	-0.875678	0.000000	-0.599950
	(0.01476)	(0.02974)	(0.00000)	(0.45804)
	[-5.25452]	[-29.4481]	[NA]	[-1.30983]
CointEq3	-0.041819	0.024220	0.044076	-0.996940
	(0.00177)	(0.00327)	(0.00477)	(0.05369)
	[-23.6711]	[7.41349]	[9.23693]	[-18.5687]
D(S(-1))	0.007538	0.015209	0.037905	0.330071
	(0.01108)	(0.02008)	(0.03298)	(0.33523)
	[0.68030]	[0.75750]	[1.14925]	[0.98463]
D(S(-2))	0.017718	-0.025996	0.003023	1.261576
	(0.01047)	(0.01896)	(0.03115)	(0.31665)
	[1.69272]	[-1.37073]	[0.09705]	[3.98415]
D(G(-1))	0.045673	0.382448	-0.029510	0.942302
	(0.01442)	(0.02613)	(0.04293)	(0.43630)
	[3.16687]	[14.6356]	[-0.68743]	[2.15975]
D(G(-2))	0.020287	0.348622	-0.003600	0.203026
	(0.01382)	(0.02504)	(0.04113)	(0.41801)
	[1.46822]	[13.9251]	[-0.08753]	[0.48570]
D(E(-1))	-0.015866	0.005466	0.009020	-0.707037
	(0.01191)	(0.02158)	(0.03545)	(0.36035)
	[-1.33198]	[0.25327]	[0.25441]	[-1.96210]
D(E(-2))	0.027674	-0.056308	-0.091408	0.753354
	(0.01234)	(0.02236)	(0.03674)	(0.37340)
	[2.24214]	[-2.51781]	[-2.48810]	[2.01757]
D(I(-1))	0.003074	-0.001966	-0.009384	0.361874
	(0.00144)	(0.00261)	(0.00428)	(0.04350)
	[2.13758]	[-0.75474]	[-2.19260]	[8.31917]
D(I(-2))	-0.004097	0.006381	-0.004188	-0.086443
	(0.00126)	(0.00229)	(0.00376)	(0.03824)
	[-3.24117]	[2.78616]	[-1.11336]	[-2.26076]
C	-1.785443	-0.387085	0.707540	2.054828
	(0.01843)	(0.03339)	(0.05485)	(0.55746)
	[-96.8921]	[-11.5935]	[12.8999]	[3.68603]
S_1	0.844887	0.180477	-0.346165	-1.397035
	(0.00934)	(0.01692)	(0.02779)	(0.28246)
	[90.4896]	[10.6681]	[-12.4560]	[-4.94593]
R	0.003668	0.001645	0.003627	0.126702

	(0.00074)	(0.00134)	(0.00220)	(0.02239)
	[4.95539]	[1.22667]	[1.64619]	[5.65813]
R-squared	0.893528	0.472142	0.164064	0.448523
Adj. R-squared	0.892511	0.467096	0.156073	0.443252
Sum sq. resids	1.321348	4.337938	11.70653	1209.302
S.E. equation	0.031170	0.056477	0.092778	0.942970
F-statistic	877.9496	93.57314	20.53222	85.08500
Log likelihood	2822.850	2006.181	1324.164	-1861.904
Akaike AIC	-4.088574	-2.899827	-1.907080	2.730573
Schwarz SC	-4.035330	-2.846583	-1.853836	2.783816
Mean dependent	0.002558	0.006380	0.007752	-0.031739
S.D. dependent	0.095073	0.077366	0.100993	1.263771
Determinant Residual Covariance		1.39E-08		
Log Likelihood		4657.899		
Log Likelihood (d.f. adjusted)		4629.763		
Akaike Information Criteria		-6.640120		
Schwarz Criteria		-6.381508		

8. Engle-Granger 2-step method

reg ds ds_1 dg de dr di ehat_1

Source	SS	df	MS
Model	1.67666592	6	.27944432
Residual	1.30118463	1506	.000864
Total	2.97785055	1512	.001969478

Number of obs	=	1513
F(6, 1506)	=	323.43
Prob > F	=	0.0000
R-squared	=	0.5630
Adj R-squared	=	0.5613
Root MSE	=	.02939

ds	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ds_1	.0170928	.0070033	2.44	0.015	.0033555	.03083
dg	.2145018	.062872	3.41	0.001	.0911758	.3378279
de	-.2880665	.012945	-22.25	0.000	-.3134587	-.2626744
dr	.1294347	.0043309	29.89	0.000	.1209395	.1379299
di	-.0035927	.0007835	-4.59	0.000	-.0051295	-.0020559
ehat_1	-.0432681	.0093642	-4.62	0.000	-.0616364	-.0248997
_cons	.0824304	.020426	4.04	0.000	.042364	.1224968

9. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 02/20/10 Time: 18:36
Sample: 1 3344
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
S_1 does not Granger Cause S	3100	7.76261	0.00043
S does not Granger Cause S_1		122.384	0.00000
G does not Granger Cause S	3156	44.3460	0.00000
S does not Granger Cause G		1.48818	0.22594
E does not Granger Cause S	2425	1.27821	0.27872
S does not Granger Cause E		2.71946	0.06611
R does not Granger Cause S	1498	1.55791	0.21092
S does not Granger Cause R		4.38455	0.01263
I does not Granger Cause S	3057	6.73191	0.00121
S does not Granger Cause I		55.6842	0.00000

10. Model re-estimation

xtreg ds ds_1 dg de dr di, mle
Random-effects ML regression Number of obs = 1561
Group variable (i): id Number of groups = 219

Random effects u_i ~ Gaussian Obs per group: min = 1
avg = 7.1
max = 8

LR chi2(5) = 1049.10
Log likelihood = 3282.627 Prob > chi2 = 0.0000

ds	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
ds_1	.0082154	.0060863	1.35	0.177	-.0037135	.0201443
dg	.2762533	.0594522	4.65	0.000	.1597291	.3927775
de	-.2987213	.0127872	-23.36	0.000	-.3237838	-.2736588
dr	.1343697	.0044112	30.46	0.000	.1257239	.1430155
di	-.0044729	.0007429	-6.02	0.000	-.0059291	-.0030168
_cons	-.0098199	.0020889	-4.70	0.000	-.013914	-.0057258
/sigma_u	.0074862	.0013482	5.55	0.000	.0048438	.0101287
/sigma_e	.0287463	.0005688	50.54	0.000	.0276315	.0298612
rho	.0635129	.0223215			.0302426	.1200711

Likelihood-ratio test of sigma_u=0: chibar2(01)= 11.48 Prob>=chibar2 = 0.000

xtreg ds dg de dr di, fe

Fixed-effects (within) regression Number of obs = 1563
Group variable (i): id Number of groups = 219

R-sq: within = 0.3930 Obs per group: min = 1
between = 0.7653 avg = 7.1
overall = 0.5353 max = 8

F(4,1340) = 216.93
corr(u_i, Xb) = 0.3108 Prob > F = 0.0000

ds	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
dg	.3227211	.0656881	4.91	0.000	.1938583	.4515839
de	-.2873791	.0148339	-19.37	0.000	-.3164794	-.2582789
dr	.1173233	.0066673	17.60	0.000	.1042437	.1304029
di	-.0031846	.0008244	-3.86	0.000	-.004802	-.0015673
_cons	-.0085604	.0022445	-3.81	0.000	-.0129636	-.0041572

sigma_u .01889986
sigma_e .03117497
rho .26876017 (fraction of variance due to u_i)

F test that all u_i=0: F(218, 1340) = 1.63 Prob > F = 0.0000

Hausman specification test

	---- Coefficients ----		
	Fixed	Random	
ds	Effects	Effects	Difference
dg	.3227211	.2815348	.0411863
de	-.2873791	-.2900899	.0027108
dr	.1173233	.1491514	-.031828
di	-.0031846	-.0042138	.0010292

Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[S^(-1)](b-B), S = (S_fe - S_re) = 49.32
Prob>chi2 = 0.0000

Appendix 1c. The Sales Model II. Arellano-Bond System GMM-2 estimator results. The Hansen, Augmented Dickey-Fuller, Fisher, Johansen, Engle and Granger tests. VECM estimates. Pairwise Granger causality test and Model re-estimation.

xtabond2 s s_1 g_1 dg e_1 de r_1 dr i_1, gmm(s_1 g_1 dg e_1 de r_1 dr i_1) iv(l.s_1 l.g_1 l.e_1 l.r_1 l.i_1,mz) small twostep h(3)
Building GMM instruments.........
61 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id	Number of obs = 1566
Time variable : year	Number of groups = 219
Number of instruments = 225	Obs per group: min = 1
F(8, 218) = 9.19e+07	avg = 7.15
Prob > F = 0.000	max = 8

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
s_1	.8902191	.0004177	2131.32	0.000	.8893958	.8910423
g_1	-.037685	.000306	-123.15	0.000	-.0382881	-.0370819
dg	.0931525	.0010579	88.05	0.000	.0910674	.0952375
e_1	-.0461248	.0002394	-192.70	0.000	-.0465965	-.045653
de	-.2749167	.0000974	-2823.87	0.000	-.2751086	-.2747249
r_1	.0039368	.0000631	62.41	0.000	.0038125	.0040611
dr	.1016396	.0000828	1228.07	0.000	.1014764	.1018027
i_1	.0117914	.0000166	710.05	0.000	.0117587	.0118242
_cons	.5580243	.0025997	214.65	0.000	.5529004	.5631481

Warning: Uncorrected two-step standard errors are unreliable.

2. Hansen test of overid. restrictions: chi2(216) = 212.23 Prob > chi2 = 0.560

Arellano-Bond test for AR(1) in first differences: z = -3.63 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.66 Pr > z = 0.510

3. The augmented Dickey-Fuller test

THE SALES MODEL II - AUGMENTED DICKEY FULLER TEST						
	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
s	-16.249	1.974				
s_1	-18.335	2.018				
g_1	-78.170	2.766	-56.582	2.454	-44.827	2.112
dg	-71.863	2.582	-58.881	2.381	-47.957	2.145
e_1	-12.694	2.033				
de	-13.770	0.872	-34.678	1.889		
r_1	-9.033	2.169				
dr	-16.683	1.941				
i_1	-23.324	1.443	-42.620	1.822		
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					
We assume 4 lags, a constant and a trend						
Ho: there is a unit root in the time series (non-stationary)						
We reject the null hypothesis for all the time series, excepts (g_1, dg, de and i_1)						

4. Fisher-type test

Fisher-type unit-root test for s
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots   Number of panels = 418
Ha: At least one panel is stationary   Avg. number of periods = 7.80

AR parameter: Panel-specific   Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included   Cross-sectional means removed
Drift term: Not included   ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(804)	P	0.0000	1.0000
Inverse normal	Z	.	.
Inverse logit t(4)	L*	.	.
Modified inv. chi-squared	Pm	-20.0499	1.0000

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.

The null hypothesis that all the panels contain unit roots cannot be rejected.

5. Johansen Cointegration test

E-Views shows near a singular matrix, and it does not provide any outcome

6. Engle and Granger test

reg s g_1 dg de i_1

Source	SS	df	M
Model	5.39184576	4	1.34796144
Residual	69.5240204	2543	.027339371
Total	74.9158661	2547	.029413375

Number of obs	=	2548
F(4, 2543)	=	49.30
Prob > F	=	0.0000
R-squared	=	0.0720
Adj R-squared	=	0.0705
Root MSE	=	.16535

s	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
g_1	.3922052	.045049	8.71	0.000	.3038688	.4805416
dg	.1195889	.2996179	0.40	0.690	-.467931	.7071089
de	-.0255082	.0587455	-0.43	0.664	-.1407021	.0896856
i_1	-.0454476	.0044075	-10.31	0.000	-.0540903	-.036805
_cons	-1.463627	.4159665	-3.52	0.000	-2.279294	-.6479592

reg dehat ehat_1

Source	SS	df	MS
Model	1.37941748	1	1.37941748
Residual	4.05113252	2418	.001675406
Total	5.43055	2419	.002244957

Number of obs	=	2420
F(1, 2418)	=	823.33
Prob > F	=	0.0000
R-squared	=	0.2540
Adj R-squared	=	0.2537
Root MSE	=	.04093

dehat	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ehat_1	-.537887	.0187458	-28.69	0.000	-.5746464	-.5011275
_cons	1.137623	.0395278	28.78	0.000	1.060111	1.215135

7. VECM estimates

E-Views shows near a singular matrix and it does not provide any outcome

8. Engle-Granger 2-step method

reg D.s D.s_1 D.g_1 D.dg D.e_1 D.de D.r_1 D.dr D.i_1 ehat_1

Source	SS	df	MS
Model	7.09684686	9	.78853854
Residual	1.14290587	1424	.000802602
Total	8.23975274	1433	.005750002

Number of obs =	1434
F(9, 1424) =	982.48
Prob > F =	0.0000
R-squared =	0.8613
Adj R-squared =	0.8604
Root MSE =	.02833

D.s		Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
s_1							
	D1	.6294025	.0158116	39.81	0.000	.598386	.660419
g_1							
	D1	-.0356242	.0138204	-2.58	0.010	-.0627347	-.0085137
dg							
	D1	.1171314	.0639281	1.83	0.067	-.008272	.2425348
e_1							
	D1	-.1667977	.0134982	-12.36	0.000	-.1932762	-.1403191
de							
	D1	-.2563943	.0101491	-25.26	0.000	-.2763031	-.2364855
r_1							
	D1	.0287024	.0020882	13.75	0.000	.0246062	.0327986
dr							
	D1	.0532604	.0048781	10.92	0.000	.0436913	.0628294
i_1							
	D1	.0082384	.0009797	8.41	0.000	.0063167	.0101602
ehat_1		.0070954	.0218661	0.32	0.746	-.0357979	.0499887
_cons		-.0151088	.0462003	-0.33	0.744	-.1057367	.0755192

9. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 12/20/09 Time: 16:37
Sample: 1 3344
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
S_1 does not Granger Cause S	3100	7.76261	0.00043
S does not Granger Cause S_1		122.384	0.00000
G_1 does not Granger Cause S	3156	58.0917	0.00000
S does not Granger Cause G_1		0.48510	0.61568
DG does not Granger Cause S	3156	99.4372	0.00000
S does not Granger Cause DG		14.4835	5.5E-07
E_1 does not Granger Cause S	2370	1.78118	0.16866
S does not Granger Cause E_1		2.01149	0.13402
DE does not Granger Cause S	2359	2.52658	0.08015
S does not Granger Cause DE		2.33181	0.09734
R_1 does not Granger Cause S	1470	0.27915	0.75646
S does not Granger Cause R_1		2.41993	0.08928
DR does not Granger Cause S	1455	3.51206	0.03009
S does not Granger Cause DR		54.1756	0.00000
I_1 does not Granger Cause S	3012	2.64153	0.07142
S does not Granger Cause I_1		50.4055	0.00000

10. Model re-estimation

xtreg ds ds_1 dg_1 d2g de_1 d2e dr_1 d2r di_1, mle

```
Random-effects ML regression                Number of obs      =     1418
Group variable (i): id                      Number of groups   =      216

Random effects u_i ~ Gaussian               Obs per group: min =        1
                                                           avg =      6.6
                                                           max =        8
                                            LR chi2(8)         =  1087.71
Log likelihood  =  3160.4353                Prob > chi2        =   0.0000
------------------------------------------------------------------------------
          ds |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        ds_1 |  -.0030941   .0089811    -0.34   0.730    -.0206968    .0145086
        dg_1 |   .2599837   .0639707     4.06   0.000     .1346035    .3853638
         d2g |   .2984608   .0601273     4.96   0.000     .1806135     .416308
        de_1 |  -.3552729   .0180758   -19.65   0.000    -.3907009   -.3198449
         d2e |  -.2419864   .0101756   -23.78   0.000    -.2619303   -.2220425
        dr_1 |   .1258478   .0046921    26.82   0.000     .1166514    .1350441
         d2r |    .103745   .0051035    20.33   0.000     .0937422    .1137478
        di_1 |   .0076203   .0007688     9.91   0.000     .0061134    .0091271
       _cons |  -.0097429     .00223    -4.37   0.000    -.0141136   -.0053721
-------------+----------------------------------------------------------------
    /sigma_u |   .0070416   .0012239     5.75   0.000     .0046428    .0094404
    /sigma_e |   .0252539   .0005278    47.85   0.000     .0242195    .0262884
-------------+----------------------------------------------------------------
         rho |   .0721389   .0243599                      .0353413    .1329448
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01)=   12.44 Prob>=chibar2 = 0.000
```

```
xtreg ds dg_1 d2g de_1 d2e dr_1 d2r di_1, fe

Fixed-effects (within) regression           Number of obs      =      1418
Group variable (i): id                      Number of groups   =       216

R-sq:  within  = 0.4933                     Obs per group: min =         1
       between = 0.5803                                    avg =       6.6
       overall = 0.5481                                    max =         8
                                            F(7,1195)          =    166.18
corr(u_i, Xb)  = 0.2334                     Prob > F           =    0.0000
------------------------------------------------------------------------------
          ds |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dg_1 |    .329236   .0650275     5.06   0.000     .2016552    .4568168
         d2g |    .319944   .0597988     5.35   0.000     .2026216    .4372664
        de_1 |  -.3451138   .0192951   -17.89   0.000    -.3829698   -.3072578
         d2e |   -.249597   .0110266   -22.64   0.000    -.2712306   -.2279634
        dr_1 |   .0846358   .0077183    10.97   0.000     .0694929    .0997787
         d2r |   .0816844   .0059992    13.62   0.000     .0699144    .0934545
        di_1 |    .008174   .0007892    10.36   0.000     .0066258    .0097223
       _cons |  -.0061435   .0022137    -2.78   0.006    -.0104866   -.0018004
-------------+----------------------------------------------------------------
     sigma_u |  .01836766
     sigma_e |  .02472617
         rho |  .35559351   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(215, 1195) =     1.83          Prob > F = 0.0000

Hausman specification test

                 ---- Coefficients ----
             |      Fixed       Random
          ds |    Effects      Effects       Difference
-------------+-----------------------------------------
        dg_1 |    .329236     .2568693        .0723667
         d2g |    .319944     .2975571         .022387
        de_1 |  -.3451138    -.3545839        .0094701
         d2e |   -.249597    -.2415858       -.0080112
        dr_1 |   .0846358      .125873       -.0412372
         d2r |   .0816844     .1041754        -.022491
        di_1 |    .008174      .007629         .000545

    Test:  Ho:  difference in coefficients not systematic
                chi2(  7) = (b-B)'[S^(-1)](b-B), S = (S_fe - S_re) =   551.69
                Prob>chi2 =     0.0000
```

Appendix 1d. The Sales Model I and II estimates.

1. The Sales Model I estimates (t-values in parentheses)

	Fixed Effects OLS	Sys. GMM-1	Sys GMM-1 robust	Sys GMM-2	Sys GMM-2 robust	Diff GMM-1	Diff GMM-1 robust	Diff GMM-2
Sales (1st-Lag)	0.355 (29.38)	0.574 (47.91)	0.573 (7.98)	0.609 (316.91)	0.575 (7.98)	0.395 (24.21)	0.381 (3.32)	0.436 (10.87)
Market Situation				0.015 (5.10)		0.326 (7.58)	0.333 (6.42)	0.273 (7.56)
Resources	-0.186 (-13.84)	-0.197 (-18.08)	-0.192 (-6.64)	-0.173 (-141.99)	-0.192 (-6.73)	-0.186 (-13.07)	-0.218 (-5.48)	-0.181 (-9.97)
R& D	0.064 (22.68)	0.025 (18.20)	0.025 (4.46)	0.023 (57.67)	0.025 (4.48)	0.046 (8.83)	0.050 (2.55)	0.039 (4.53)
Investments	0.002 (2.57)	0.004 (2.68)		0.006 (79.31)		0.003 (3.63)		0.005 (4.36)
constant	0.993 (64.23)	0.793 (37.83)	0.793 (6.49)	0.587 (22.37)	0.792 (6.43)	-0.010 (-6.95)	-0.010 (-5.77)	-0.008 (-6.96)
Nr Observations		1608	1615	1608	1615	1202	1209	1202
F-Statistic	12.87	4288.6	820.35	229233.88	686.05	1140.52	169.12	712.33
R-squared	0.843							
Sargan		721.78	152.87	182.33	152.87	69.18		24.19
(d.f.)		140	105	153	105	20		20
Test for AR(1)		-1.07	-1.33	-1.47	-1.65	-2.27	-0.87	-2.24
Test for AR(2)		-1.23	-2.47	-2.75	-2.25	-4.09	-2.17	-2.86

Appendix 1d. The Sales Model I and II estimates.

2. The Sales Model II estimates (t-values in parentheses)

	Fixed Effects OLS	Sys. GMM-1	Sys GMM-1 robust	Sys GMM-2	Sys GMM-2 robust	Diff GMM-1	Diff GMM-1 robust	Diff GMM-2
Sales (1st-Lag)	0.586 (39.66)	0.891 (127.20)	0.891 (41.01)	0.890 (2131.32)	0.890 (40.70)	0.558 (20.22)	0.558 (6.25)	0.601 (17.33)
Market Situation (1st-Lag)		-0.044 (-5.07)	-0.044 (-5.90)	-0.037 (-123.15)	-0.044 (-5.83)	0.328 (6.42)	0.328 (5.86)	0.198 (4.60)
Market Situation (1st-Diff.)	0.146 (3.14)			0.093 (88.05)		0.211 (3.79)	0.211 (3.46)	0.210 (4.58)
Resources (1st-Lag)	-0.139 (-9.82)	-0.045 (-7.42)	-0.045 (-3.10)	-0.046 (-192.70)	-0.046 (-3.10)	-0.110 (-5.49)	-0.110 (-1.99)	-0.100 (-4.42)
Resources (1st-Diff.)	-0.224 (-24.49)	-0.276 (-25.87)	-0.276 (-7.69)	-0.274 (-2823.87)	-0.276 (-7.69)	-0.211 (-21.00)	-0.211 (-7.16)	-0.227 (-16.67)
R&D (1st-Lag)	0.030 (11.75)	0.003 (5.17)	0.003 (2.54)	0.003 (62.41)	0.003 (2.52)	0.023 (4.12)	0.023 (1.99)	0.017 (2.57)
R&D (1st-Diff.)	0.089 (18.33)	0.102 (23.90)	0.102 (6.73)	0.101 (1228.07)	0.102 (6.73)	0.073 (11.96)	0.073 (5.08)	0.060 (6.42)
Investments (1st-Lag)	0.013 (15.32)	0.011 (11.41)	0.011 (2.98)	0.011 (710.05)	0.011 (2.97)	0.008 (9.17)	0.008 (5.69)	0.009 (11.00)
constant	0.701 (34.79)	0.624 (7.89)	0.624 (10.30)	0.558 (214.65)	0.622 (10.28)	-0.010 (-5.22)	-0.010 (-4.83)	-0.006 (-3.65)
Nr Observations	1566	1566	1566	1566	1566	1171	1171	1171
F-Statistic	1751.49	9109.85	1899.41	9.19E+07	1928.23	673.55	93.43	1006.49
R-squared	0.9467							
Sargan chi2(..)=		864.22	211.23	212.23	211.23	172.45		29.95
(d.f.)		217	217	216	217	20		20
Test for AR(1)		-7.97	-3.75	-3.63	-3.55	-7.88	-2.91	-4.08
Test for AR(2)		-0.72	-0.56	-0.66	-0.58	-2.16	-1.4	-0.86

Appendix 1e. The Sales Model II. Arellano-Bond System GMM-2 estimator results. The Hansen and the augmented Dickey-Fuller tests. The threshold at r1>0.018

. xtabond2 s l.s l.g dg l.e de l.r dr l.i, gmm(l.s l.g dg l.e de l.r dr l.i) iv(l2.s l2.g l2.e l2.r l2.i,mz) twostep small h(3)
Building GMM instruments.........
54 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id		Number of obs =	1177
Time variable : year		Number of groups =	182
Number of instruments = 189		Obs per group: min =	1
F(8, 181) = 1.72e+07		avg =	6.47
Prob > F = 0.000		max =	7

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
s						
L1	.8725955	.000359	2430.59	0.000	.8718871	.8733038
g						
L1	-.0094146	.0006391	-14.73	0.000	-.0106757	-.0081535
dg	.168434	.0014187	118.73	0.000	.1656347	.1712333
e						
L1	-.0575161	.0002653	-216.76	0.000	-.0580396	-.0569925
de	-.3333939	.0002558	-1303.32	0.000	-.3338986	-.3328892
r						
L1	.0055922	.000045	124.31	0.000	.0055034	.005681
dr	.1088097	.0001759	618.60	0.000	.1084626	.1091568
i						
L1	.0090642	7.59e-06	1193.86	0.000	.0090492	.0090792
_cons	.3256894	.0055642	58.53	0.000	.3147104	.3366683

Warning: Uncorrected two-step standard errors are unreliable.

2. Hansen test of overid. restrictions: chi2(180) = 172.88 Prob > chi2 = 0.635

Arellano-Bond test for AR(1) in first differences: z = -3.04 Pr > z = 0.002
Arellano-Bond test for AR(2) in first differences: z = -0.57 Pr > z = 0.569

3. The augmented Dickey-Fuller test.

. dfuller uhat, regress

Dickey-Fuller test for unit root Number of obs = 995

	---------- Interpolated Dickey-Fuller ---------------------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-20.823	-3.430	-2.860	-2.570

- MacKinnon approximate p-value for Z(t) = 0.0000

We reject the null hypothesis that there is a unit root "no stationary residuals" (-20.823<-2.860) at the 5% interpolated DF critical value. In consequence we can state that the residuals are stationary.

Appendix 1f. The Sales Model II. Arellano-Bond System GMM-2 estimator results. The Hansen and the augmented Dickey-Fuller tests. The threshold at r1<0.018

. xtabond2 s l.s dg de l.r dr l.i, gmm(l.s dg de l.r dr l.i) iv(l2.s l2.r l2.i,mz) twostep small h(3)
Building GMM instruments.......
42 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id		Number of obs =	210
Time variable : year		Number of groups =	34
Number of instruments = 145		Obs per group: min =	1
F(6, 33) =	99701.86	avg =	6.18
Prob > F =	0.000	max =	7

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
s						
L1	.9482485	.0050648	187.22	0.000	.9379441	.9585528
dg	.4528397	.0526489	8.60	0.000	.3457247	.5599548
de	-.2862236	.0077016	-37.16	0.000	-.3018927	-.2705545
r						
L1	-.0029555	.0004905	-6.03	0.000	-.0039535	-.0019576
dr	.0339412	.0034805	9.75	0.000	.02686	.0410224
i						
L1	.0279887	.0013353	20.96	0.000	.0252719	.0307055
_cons	.1109849	.0100221	11.07	0.000	.0905948	.1313751

Warning: Uncorrected two-step standard errors are unreliable.

2. Hansen test of overid. restrictions: chi2(138) = 22.40 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -3.02 Pr > z = 0.003
Arellano-Bond test for AR(2) in first differences: z = -1.02 Pr > z = 0.309

3. The augmented Dickey-Fuller test.

. dfuller uhat, regress

Dickey-Fuller test for unit root Number of obs = 176

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
	---------- Interpolated Dickey-Fuller ---------			
Z(t)	-6.535	-3.485	-2.885	-2.575

- MacKinnon approximate p-value for Z(t) = 0.0000

We reject the null hypothesis that there is a unit root "no stationary residuals" (-6.535<-2.885) at the 5% interpolated DF critical value. In consequence we can state that the residuals are stationary.

Appendix 2. The Stock of R&D Capital.

Construction of the Stock of R&D Capital. The method was initially built by Zvi Griliches (1981), Zvi Griliches and Jacques Mairesse (1981), and Zvi Griliches and Bronwyn Hall (1982). It is a standard perpetual inventory with a depreciation rate of 15%. The equations are borrowed from Bronwyn Hall (1990), NBER Working paper. No 3366. App. B

It requires three assumptions/equations to build the series, these are:

- The initial stock for the first year is set at four times the related R&D expenditures for this year.

  $\mathbf{K_1 = 4\ R_1}$

- The first twelve years are calculated with the following equation:

  $\mathbf{K_t = (1 - \delta)\ K_{t-1} + R_t}$ Ex: : $K_2 = 0.85\ K_{2-1} + R_2$

  where:
  K_t = end of period stock of R&D Capital
  δ = depreciation rate is chosen to be 15 percent per year.
  R_t = constant R&D expenditures for the year.

- The 13th year is calculated with the following equation, with s=12 years:

  $\mathbf{K_t = \sum (1 - \delta)^s\ R_{t-s}}$

  Ex.: $K_{13} = 0.85^0\ R_{13-0} + 0.85^1\ R_{13-1} + 0.85^2\ R_{13-2} + 0.85^3\ R_{13-3} + ..$
  $K_{13} = R_{13} + 0.85\ R_{12} + 0.85^2\ R_{11} + 0.85^3\ R_{10} + ..$

- When missing one or two values of the R&D expenditures the problem is solved by setting the amounts by interpolation.

Appendix 3a. The Profit-Cash Flow Model Variables Description.

3.1 EBITDA to Total Assets ratio

EBITDA to Total Assets ratio = π = $\frac{y2*100}{x7}$

$y2$ = EBITDA – Earnings before Interest, Tax, Depreciation, and Amortization (millions US Dollars).
$x7$ = Assets Total (millions US Dollars)

3.2 Market Situation.

Market Situation = g = ln(real GDP)

Real GDP = Gross Domestic Product at constant 2002 US Dollars.

3.3 Net Sales.

Net Sales = s $= \ln\left[\frac{y1*100}{p2}\right]$

$y1$ = Net Sales (millions US Dollars) sourced by Standard & Poors – Compustat.
$p2$ = PPI-Producer Price Index for each Sector to adjust Net Sales to constant 2002 US Dollars
sourced by the Bureau of Labour Statistics.
www.bls.gov > Public Data Query.

3.4 Research & Development.

Stock of R&D to Sales ratio = r = $\frac{StockR\&D}{Sales} = \frac{x6*p2}{y1*100}$

Stock R&D = $x6$ = Stock of R&D Capital. It has been built using a perpetual inventory with a depreciation rate of 15%, as described in B. Hall. 1990. *The Manufacturing Sector Manufacturing File*. NBER Working Paper No 3366. Amounts adjusted to constant 2002 US Dollars.
See Annex 2.

3.5 Apparent Variable Cost Productivity.

$$\text{Apparent VCP} = v = \ln\left[\frac{x10 * 100}{p1}\right]$$

$$x10 = -\frac{cogs2}{ic} + \frac{sale2 * cogs1}{ics * sale1}$$

*x*10 = Variable Cost Productivity in millions US Dollars.

Cogs2 = current cost of goods sold (year 2)
Cogs1 = prior year cost of goods sold (year1)
Sale2 = current Sales (year 2)
Sale1 = prior year Sales (year 1)
Ic = Inflation index for direct material (year 2 vs 1)
Ics = Inflation index for Sales (year 2 vs 1)

The Apparent Variable Cost Productivity table is the following:

	Year 2	Year 1	V	Constant	Inflation Index	Price Realization	Volume
Sales	sls2	sls1	sls2 - sls1	sls2/ics	ics	sls2 - sls2/ics	sls1 - sls2/ics
Cost of Goods Sold	cogs2	cogs1	cogs2 - cogs1	cogs2/ic	ic	cogs2 - cogs2/ic	(sls1 - sls2/ics) (cogs1/sls1)
Contribution Margin	sls2 - cogs2	sls1 - cogs 1	V1			V2	V3

V1 = sls2 - sls1 - (cogs2 - cogs1) = sls2 - sls1 - cogs2 + cogs1

V2 = sls2 - sls2/ics - (cogs2 - cogs2/ic)

V3 = (sls1 - sls2/ics) - ((sls1 - sls2/ics) (cogs1/sls1)) = (sls1 - sls2/ics) (1 - (cogs1/sls1))

Apparent Variable Cost Productivity = V1 - V2 - V3

The adjustment to constant 2002 US Dollars must be done after making the above mentioned calculations.
Data sourced by Standard & Poors – Compustat.

*p*1 = Annual GDP deflator for fixed non residential investment to adjust SG&A to constant 2002 US Dollars sourced by the Bureau of Economic Analysis.
www.bea.gov > Publications > National Income > NIPA Tables > Section 7.
e-mail: GDPNIWD@bea.gov

3.6 Investment.

$$\text{Investment to Net Sales ratio} = i = \frac{Investment}{Sales} = \frac{x8*100}{p1} * \frac{p2}{y1*100} = \frac{x8*p2}{p1*y1}$$

$Investment_t = x8 = AT_t + DP_t - AT_{t-1}$

AT = Assets Total.
DP = Depreciation and Amortization.
Sourced by Standard & Poors – Compustat.
*p*1 = Annual GDP deflator for fixed non residential investment to adjust SG&A to constant 2002 US Dollars sourced by the Bureau of Economic Analysis.
www.bea.gov > Publications > National Income > NIPA Tables > Section 7.
e-mail: GDPNIWD@bea.gov

Lewellen and Badrinath (1997)[271] use the Net Fixed Assets, instead of the book value of Total Assets to calculate the Investment. We consider that intangible assets cannot be excluded at all.

271 Lewellen, W.G. and Badrinath, S.G., 1997, "On the Measurement of Tobin's Q", *Journal of Financial Economics, 44, 77-122, 91.*

Appendix 3b. The Profit-Cash Flow Model. Arellano-Bond System GMM-2 estimator results. The Hansen, Augmented Dickey-Fuller, Fisher, Johansen, Engle and Granger tests. VECM estimates. Pairwise Granger causality test and Model re-estimation.

```
. xtabond2 π π_1 g_1 dg s_1 ds r_1 dr dv di, gmm(π_1 g_1 dg s_1 ds r_1 dr dv di) iv(l.π_1 l.g_1 l.s_1 l.r_1, mz) small twostep h(3)
Building GMM instruments..........
68 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.
```

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id		Number of obs	= 1658
Time variable : year		Number of groups	= 229
Number of instruments = 252		Obs per group: min =	1
F(9, 228)	= 3.79e+06	avg =	7.24
Prob > F	= 0.000	max =	8

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
π_1	.8207415	.0010419	787.74	0.000	.8186886	.8227945
g_1	-7.078566	.1318047	-53.70	0.000	-7.338277	-6.818855
dg	30.5612	.5885978	51.92	0.000	29.40141	31.72098
s_1	.1627308	.0067142	24.24	0.000	.1495011	.1759606
ds	2.773431	.0181112	153.13	0.000	2.737744	2.809118
r_1	.1248746	.0282569	4.42	0.000	.0691965	.1805527
dr	-16.34498	.0414649	-394.19	0.000	-16.42668	-16.26327
dv	.197271	.0018479	106.76	0.000	.19363	.2009121
di	-.9018003	.0030245	-298.17	0.000	-.9077598	-.8958409
_cons	64.83561	1.190392	54.47	0.000	62.49004	67.18119

Warning: Uncorrected two-step standard errors are unreliable.

2. Hansen test of overid. restrictions: chi2(242) = 222.78 Prob > chi2 = 0.807

Arellano-Bond test for AR(1) in first differences: z = -6.83 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.93 Pr > z = 0.352

3. The augmented Dickey-Fuller test

THE PROFIT-CASH FLOW MODEL - AUGMENTED DICKEY FULLER TEST.

	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
π	-18.453	1.988				
π_1	-18.216	2.005				
g_1	-77.887	2.766	-56.377	2.454	-44.665	2.112
dg	-71.604	2.582	-58.669	2.381	-47.785	2.145
s_1	-17.725	2.018				
ds	-24.511	1.949				
r_1	-7.094	2.086				
dr	-10.047	1.375	-19.299	1.987		
dv	-31.291	2.004				
di	-31.643	2.053				
1% Critical Value	-3.961					
5% Critical Value	-3.411					
10% Critical Value	-3.127					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (g_1, dg and dr)

4. Fisher-type test

Fisher-type unit-root test for π
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots	Number of panels = 414
Ha: At least one panel is stationary	Avg. number of periods = 7.76
AR parameter: Panel-specific	Asymptotics: T -> Infinity
Panel means: Included	
Time trend: Included	Cross-sectional means removed
Drift term: Not included	ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(792)	P	0.0000	1.0000
Inverse normal	Z	.	.
Inverse logit t(4)	L*	.	.
Modified inv. chi-squared	Pm	-19.8997	1.0000

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.

The null hypothesis that all the panels contain unit roots cannot be rejected.

5. Johansen Cointegration test

E-Views shows near a singular matrix, and it does not provide any outcome

6. Engle and Granger test

reg π g_1 dg dr

Source	SS	df	MS
Model	12082.8788	3	4027.62626
Residual	123111.49	1682	73.1935138
Total	135194.369	1685	80.2340469

Number of obs	= 1686
F(3, 1682)	= 55.03
Prob > F	= 0.0000
R-squared	= 0.0894
Adj R-squared	= 0.0877
Root MSE	= 8.5553

π	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
g_1	-13.46599	2.877822	-4.68	0.000	-19.11048	-7.821504
dg	76.12245	18.78316	4.05	0.000	39.28163	112.9633
dr	-11.49055	1.490921	-7.71	0.000	-14.4148	-8.566294
_cons	138.0373	26.55746	5.20	0.000	85.94812	190.1264

reg dehat ehat_1

Source	SS	df	MS
Model	1572.76288	1	1572.76288
Residual	8464.15505	1564	5.41186384
Total	10036.9179	1565	6.41336609

Number of obs	= 1566
F(1, 1564)	= 290.61
Prob > F	= 0.0000
R-squared	= 0.1567
Adj R-squared	= 0.1562
Root MSE	= 2.3263

dehat	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ehat_1	-.42739	.0250707	-17.05	0.000	-.4765657	-.3782143
_cons	7.081376	.4436695	15.96	0.000	6.211127	7.951626

The t-statistic –17.05 is more negative than the critical value t=-4.70 at the 1% level and it rejects the null hypothesis of non-cointegration. It means that the variables are cointegrated. The t-critical value is taken from Engle and Yoo (1986) Table 2 for N=4 variables.

7. VECM estimates

E-Views shows near a singular matrix and it does not provide any outcome

8. Engle-Granger 2-step method

reg D.π D.g_1 D.dg D.dr

Source	SS	df	MS
Model	12393.3564	3	4131.1188
Residual	60734.3971	1552	39.1329878
Total	73127.7535	1555	47.0274942

Number of obs = 1556
F(3, 1552) = 105.57
Prob > F = 0.0000
R-squared = 0.1695
Adj R-squared = 0.1679
Root MSE = 6.2556

D.π	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
g_1						
D1	-18.33067	2.500141	-7.33	0.000	-23.23468	-13.42666
dg						
D1	45.07361	12.4704	3.61	0.000	20.61301	69.53421
dr						
D1	-13.77862	1.021047	-13.49	0.000	-15.7814	-11.77584
_cons	.007943	.1635636	0.05	0.961	-.3128859	.3287719

dwstat
Number of gaps in sample: 126
Durbin-Watson d-statistic(4, 1556) = 2.011635

. dfuller ehat, regress lags(4) trend

Augmented Dickey-Fuller test for unit root Number of obs = 973

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller	---------	
Z(t)	-20.010	-3.960	-3.410	-3.120

* MacKinnon approximate p-value for Z(t) = 0.0000

reg D2.π D2.π_1 D2.g_1 D2.dg D2.s_1 D2.ds D2.r_1 D2.dr D2.dv D2.di ehat_1

Source	SS	df	MS
Model	50643.8418	10	5064.38418
Residual	95472.1842	1385	68.932985
Total	146116.026	1395	104.742671

- Number of obs = 1396
- F(10, 1385) = 73.47
- Prob > F = 0.0000
- R-squared = 0.3466
- Adj R-squared = 0.3419
- Root MSE = 8.3026

D2.π		Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
π_1							
	D2	.0027898	.0265522	0.11	0.916	-.0492971	.0548767
g_1							
	D2	-17.88079	3.147036	-5.68	0.000	-24.05427	-11.70732
dg							
	D2	27.6067	12.53578	2.20	0.028	3.015521	52.19787
s_1							
	D2	-.0618873	.3020142	-0.20	0.838	-.6543419	.5305674
ds							
	D2	5.932472	.6943592	8.54	0.000	4.570362	7.294581
r_1							
	D2	-14.61164	1.502024	-9.73	0.000	-17.55812	-11.66515
dr							
	D2	-14.6834	1.50657	-9.75	0.000	-17.63881	-11.728
dv							
	D2	.1025321	.0140685	7.29	0.000	.0749343	.13013
di							
	D2	-.7842893	.0983426	-7.98	0.000	-.9772058	-.5913729
ehat_1		.1415881	.1280329	1.11	0.269	-.1095711	.3927474
_cons		.0006055	.2293961	0.00	0.998	-.4493958	.4506069

9. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 12/20/09 Time: 16:52
Sample: 1 3320
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
π_1 does not Granger Cause π	3024	12.1062	5.8E-06
π does not Granger Cause π_1		1290.89	0.00000
G_1 does not Granger Cause π	3083	1.89180	0.15098
π does not Granger Cause G_1		9.75692	6.0E-05
DG does not Granger Cause π	3083	90.5921	0.00000
π does not Granger Cause DG		4.05541	0.01742
S_1 does not Granger Cause π	3030	3.12296	0.04417
π does not Granger Cause S_1		4.14969	0.01586
DS does not Granger Cause π	3030	30.5857	7.1E-14
π does not Granger Cause DS		4.07128	0.01715
R_1 does not Granger Cause π	1441	6.04557	0.00243
π does not Granger Cause R_1		38.9838	0.00000
DR does not Granger Cause π	1429	7.92987	0.00038
π does not Granger Cause DR		1.61650	0.19896
DV does not Granger Cause π	2968	1.78935	0.16725
π does not Granger Cause DV		16.3827	8.4E-08
DI does not Granger Cause π	2970	14.8938	3.7E-07
π does not Granger Cause DI		18.9100	6.9E-09

10. Model re-estimation

Newey-West "newey2" computes pooled OLS estimates. HAC- Heteroskedasticity autocorrelation consistent covariance estimator. All variables in first differences.

newey2 dπ dπ_1 dg_1 d2g ds_1 d2s dr_1 d2r d2v d2i, lag(0)

Regression with robust standard errors Number of obs = 1504
maximum lag : 0 F(9, 1494) = 18.07
Prob > F = 0.0000

Robust

dπ	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
dπ_1	-.0373783	.0235787	-1.59	0.113	-.0836291	.0088726
dg_1	41.61191	11.05433	3.76	0.000	19.92827	63.29556
d2g	67.93177	12.17713	5.58	0.000	44.04569	91.81784
ds_1	-.9537358	.8322651	-1.15	0.252	-2.586268	.6787964
d2s	.2230582	.1840407	1.21	0.226	-.1379475	.5840639
dr_1	-15.64351	3.043675	-5.14	0.000	-21.61384	-9.673183
d2r	-18.1547	2.361813	-7.69	0.000	-22.78752	-13.52188
d2v	.0837592	.0151416	5.53	0.000	.0540581	.1134603
d2i	-.5692774	.2009556	-2.83	0.005	-.9634625	-.1750924
_cons	-1.719293	.3804089	-4.52	0.000	-2.465485	-.9731008

The MLE estimator with all variables in first differences.

xtreg de4 dg_1 d2g ds_1 d2s dr_1 d2r d2v d2i, mle

Fitting constant-only model:
Iteration 0: log likelihood = -4807.1103
Iteration 1: log likelihood = -4776.3128
Iteration 2: log likelihood = -4774.2019
Iteration 3: log likelihood = -4774.1869

Fitting full model:
Iteration 0: log likelihood = -4557.3222
Iteration 1: log likelihood = -4557.3087

Random-effects ML regression Number of obs = 1508
Group variable (i): id Number of groups = 226

Random effects u_i ~ Gaussian Obs per group: min = 1
avg = 6.7
max = 8

LR chi2(8) = 433.76
Log likelihood = -4557.3087 Prob > chi2 = 0.0000

dπ	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
dg_1	41.33049	12.15128	3.40	0.001	17.51442	65.14656
d2g	65.70369	11.4632	5.73	0.000	43.23623	88.17114
ds_1	-1.059035	.5692612	-1.86	0.063	-2.174767	.0566964
d2s	.2755157	.130641	2.11	0.035	.0194641	.5315673
dr_1	-15.13502	1.490677	-10.15	0.000	-18.05669	-12.21334
d2r	-18.15639	1.00801	-18.01	0.000	-20.13205	-16.18073
d2v	.0902013	.0140122	6.44	0.000	.0627379	.1176646
d2i	-.5935805	.0841729	-7.05	0.000	-.7585563	-.4286047
_cons	-1.717589	.4140053	-4.15	0.000	-2.529025	-.9061538
/sigma_u	0	.1889855	0.00	1.000	-.3704048	.3704048
/sigma_e	4.968657	.0904688	54.92	0.000	4.791341	5.145972
rho	0	.			.	.

Likelihood-ratio test of sigma_u=0: chibar2(01)= 0.00 Prob>=chibar2 = 1.000

The MLE estimator with all variables in second differences

xtreg d2π d2g_1 d2dg d2s_1 d2ds d2r_1 d2dr d2dv d2di, mle

Fitting constant-only model:
Iteration 0: log likelihood = -4860.1743
Iteration 1: log likelihood = -4842.0606
Iteration 2: log likelihood = -4841.1414
Iteration 3: log likelihood = -4841.138

Fitting full model:
Iteration 0: log likelihood = -4685.0008
Iteration 1: log likelihood = -4684.9853

Random-effects ML regression — Number of obs = 1307
Group variable (i): id — Number of groups = 221

Random effects u_i ~ Gaussian — Obs per group: min = 1
avg = 5.9
max = 8

LR chi2(8) = 312.31
Log likelihood = -4684.9853 — Prob > chi2 = 0.0000

d2 π	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
d2g_1	4.812584	2.338843	2.06	0.040	.2285354	9.396633
d2dg	31.68298	13.1675	2.41	0.016	5.875153	57.4908
d2s_1	.5084375	.2592555	1.96	0.050	.0003061	1.016569
d2ds	4.478612	.7005743	6.39	0.000	3.105511	5.851712
d2r_1	8.958012	1.126708	7.95	0.000	6.749705	11.16632
d2dr	-4.441911	1.449721	-3.06	0.002	-7.283313	-1.60051
d2dv	.0980194	.014931	6.56	0.000	.0687553	.1272836
d2di	-.6322476	.1018941	-6.20	0.000	-.8319564	-.4325389
_cons	-.8640131	.2452255	-3.52	0.000	-1.344646	-.3833798
/sigma_u	0	.4326877	0.00	1.000	-.8480523	.8480523
/sigma_e	8.719788	.1705377	51.13	0.000	8.38554	9.054036
rho	0	.			.	.

Likelihood-ratio test of sigma u=0: chibar2(01)= 0.00 Prob>=chibar2 = 1.000

Appendix 3c. The Profit-Cash Flow Model estimates

The Profit-Cash Flow Model estimates (t-values in parentheses)

	Fixed Effects OLS	Sys. GMM-1	Sys.GMM-1 robust	Sys GMM-2	Sys GMM-2 robust	Diff GMM-1	Diff GMM-1 robust	Diff GMM-2
Profit (1st-Lag)	0.518 (21.890)	0.818 (61.540)	0.818 (43.430)	0.821 (787.74)	0.824 (40.860)	0.756 (14.770)	0.712 (13.050)	0.733 (18.160)
Market Situation (1st-Lag)	-6.538 (-4.290)	-6.643 (-4.260)	-6.643 (-4.210)	-7.078 (-53.700)	-6.341 (-2.880)			
Market Situation (1st-Diff.)	38.003 (3.810)	26.943 (2.570)	26.943 (2.650)	30.561 (51.920)	28.094 (2.890)	41.758 (3.100)	42.704 (2.830)	38.099 (3.300)
Sales (1st-Lag)				0.162 (24.240)				
Sales (1st-Diff.)	4.702 (7.270)	3.555 (5.480)	3.555 (2.630)	2.773 (153.130)	3.538 (2.470)	6.058 (6.720)	6.040 (3.640)	6.079 (4.640)
R&D (1st-Lag)	-7.330 (-6.400)			0.125 (4.420)		4.716 (2.150)		
R&D (1st-Diff.)	-14.370 (-12.490)	-15.979 (-14.810)	-15.979 (-5.660)	-16.345 (-394.190)	-16.225 (-5.660)	-11.655 (-7.450)	-12.496 (-3.660)	-18.339 (-8.320)
Productivity (1st-Diff.)	0.157 (7.860)	0.195 (9.320)	0.195 (8.040)	0.197 (106.76)	0.190 (6.760)	0.209 (8.630)	0.204 (7.210)	0.191 (7.630)
Investments (1st-Diff.)	-0.809 (-7.970)	-0.903 (-8.540)	-0.903 (-3.460)	-0.902 (-298.17)	-0.920 (-3.350)	-1.125 (-9.320)	-1.118 (-3.780)	-1.492 (-7.330)
constant	68.084 (4.840)	62.279 (4.320)	62.279 (4.260)	64.835 (54.470)	59.459 (2.940)	-0.197 (-2.120)	-0.166 (-1.560)	-0.141 (-1.470)
Nr Observations F-Statistic R-squared	1658 204.00 0.638	1658 635	1658 390.46	1658 3.79E+06	1658 349.75	1237 89.37	1237 40.78	1237 79.42
Sargan (d.f.) Test for AR(1) Test for AR(2)		411.10 183 -14.65 -1.08	192.08 183 -7.04 -0.92	222.78 242 -6.83 -0.93	192.08 183 -6.53 -0.88	57.05 20 -10.62 -1.69	 -5.56 -1.41	32.08 20 -5.91 -1.71
Sargan (table) Ho: Overidentified restrictions are valid		215.56 Rejected	215.56 Not rejec.	279.29 Not rejec.	215.56 Not rejec.	31.41 Rejected		31.41 Rejected

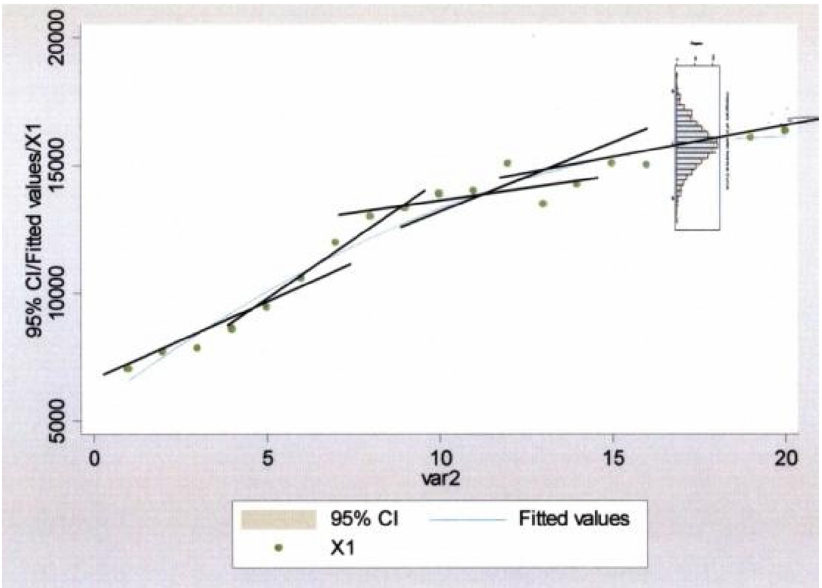
Appendix 4a. The Trailing Standard Deviation.
Market Risk - The Net Income Variability Model

4.1 Background.

The Standard Deviation is measured over a subsample which moves through time, in order to estimate the standard deviation at each point in time. Officer (1993) developed this method for the first time using a rolling standard deviation to estimate volatility at each point in time, without de-trend. Garman and Klass (1980) and Parkinson (1980) used the difference between high and low prices to estimate volatility for that day. Both methods are quite accurate if the objective is to measure volatility in a given time, as quoted by Merton (1980).

This introduction has been borrowed from Campbell, J., Lo, A. and MacKinlay A., 1997, *The Econometrics of Financial Markets*, 12.2, 481, Princeton.

A graph of the underlying concept is enclosed:



As you can see the related standard deviation in a given point is calculated by the previous four and the current observations data, in this way we eliminate the systematic growth for the y-axis variable.

4.2 Calculations.

In our case we have taken at each point additionally the four previous lags of observations to build the linear relationship identifying the trend and getting the standard deviation against the estimated linear regression, the formulae to be used will be:

X	Y	X^2
0	y_4	0
1	y_3	1
2	y_2	4
3	Y_1	9
4	y_0	16
10		30

The straight line relationship will be:

$y = a + b\,x$

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2} = \frac{1}{50}\left(5\sum xy - 10\sum y\right)$$

$$a = \frac{1}{n}(\sum y - b\sum x) = \frac{1}{5}(\sum y - 10b)$$

The variance of the errors against the linear estimation will be:

$$s^2 = \frac{1}{n-2}(\sum y^2 - a\sum y - b\sum xy) = \frac{1}{3}(\sum y^2 - a\sum y - b\sum xy)$$

The standard deviation is the square root of the variance.

$$\sigma = \sqrt{s^2}$$

Appendix 4b. The Trailing Standard Deviation.

Market Risk – The Net Income Variability model. Fixed effects OLS estimator.

. xtreg σ20 σ1 σ2 σ3 σ5 σ8 σ9 σ10 σ17 σ18 σ19, fe

Fixed-effects (within) regression Number of obs = 3003
Group variable (i): id Number of groups = 330

R-sq: within = 0.9591 Obs per group: min = 1
between = 0.9444 avg = 9.1
overall = 0.9441 max = 16

F(10,2663) = 6243.88
corr(u_i, Xb) = -0.2658 Prob > F = 0.0000

σt20	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
σ1	.2566272	.016131	15.91	0.000	.2249967	.2882578
σ2	-.2404946	.0179795	-13.38	0.000	-.2757497	-.2052394
σ3	-.4268027	.0262413	-16.26	0.000	-.478258	-.3753473
σ5	.1248349	.0379185	3.29	0.001	.0504821	.1991877
σ8	-.6003638	.1171186	-5.13	0.000	-.8300164	-.3707112
σ9	.8204658	.0443727	18.49	0.000	.7334572	.9074743
σ10	.8900771	.0110884	80.27	0.000	.8683343	.9118199
σ17	-.6620196	.0996374	-6.64	0.000	-.8573941	-.4666451
σ18	.8753704	.0099788	87.72	0.000	.8558035	.8949373
σ19	.3574995	.0170116	21.02	0.000	.3241422	.3908567
cons	-6.707346	3.248775	-2.06	0.039	-13.07772	-.3369686

sigma_u 158.76678
sigma_e 128.87228
rho .60281996 (fraction of variance due to u_i)

Appendix 4c. The Trailing Variance.

Market Risk – The Net Income Variability model. Fixed effects OLS estimator.

```
. xtreg var20 var1 var2 var3 var5 var8 var9 var10 var13 var14 var16 var17 var18 var19, fe

Fixed-effects (within) regression          Number of obs     =    1752
Group variable (i): id                     Number of groups  =     263

R-sq:  within  = 0.9995                    Obs per group: min =      1
between = 0.9684                                          avg =    6.7
overall = 0.9911                                          max =     16

F(13,1476)        = 250154.53
corr(u_i, Xb)  = -0.1279                   Prob > F          =  0.0000


s20        Coef.   Std. Err.      t        P>t     [95% Conf. Interval]
-------------------------------------------------------------------------------
var1     .1398441  .0120037    11.65   0.000    .1162979    .1633903
var2     -.125782  .0145533    -8.64   0.000   -.1543293   -.0972347
var3   -.5191816   .0443395   -11.71   0.000   -.6061566   -.4322065
var5   -.4065364   .0778906    -5.22   0.000   -.5593245   -.2537483
var8   -18.11415   2.235914    -8.10   0.000   -22.50006   -13.72825
var9    8.386689   .3974351    21.10   0.000    7.607092    9.166287
var10   3.062451   .0206335   148.42   0.000    3.021977    3.102925
var13  -1.913132   .0447436    42.76   0.000     -2.0009   -1.825364
var14  -5.139179   1.859973    -2.76   0.006   -8.787651   -1.490706
var16  -625.6459   70.02389    -8.93   0.000   -763.0028    -488.289
var17   7.652307   2.318588     3.30   0.001    3.104229    12.20039
var18    .876653   .0144622    60.62   0.000    .8482842    .9050217
var19   .7816747   .0738184    10.59   0.000    .6368745    .9264749
_cons  -282052.9    15925.8   -17.71   0.000   -313292.5   -250813.3
-------------------------------------------------------------------------------
sigma_u   3409907.1
sigma_e   572789.51
rho   .97255771   (fraction of variance due to u_i)

F test that all u_i=0:    F(262, 1476) =    23.03          Prob > F = 0.0000
```

Appendix 5a. Credit Risk. The Default Probability Models Variables Description.

5.1 Default Probability. Two Dependent variables:

p4 = Ln(DP/100) = Log of the Default Probability

p5 = $\text{Ln}\left(\dfrac{DP/100}{1-(DP/100)}\right)$ = Log of the Default Probability based on the Logistic Function.

DP = Default Probability in percentage

p3 = DP/100

5.2 EBIT Interest Coverage.

$$x38 = \frac{EBIT}{Interest\ Expenditures} = \frac{EBIT}{XINT} = \frac{x6*100}{x8}$$

5.3 EBITDA Interest Coverage.

$$x39 = \frac{EBITDA}{Interest\ Expenditures} = \frac{EBITDA}{XINT} = \frac{x24*100}{x8}$$

5.4 Funds from Operations to Total Debt.

$$x40 = \frac{Funds\ from\ Operations}{Total\ Debt} = \frac{FOPT}{DT} = \frac{x25*100}{x26}$$

Funds from Operations = FOPT = x25 = x15 + x5 + x18 + x19

x15 = Income before Extraordinary Items = IB
x5 = Depreciation = DP
x18 = Extraordinary Items = XI
x19 = Discontinued Operations = DO

5.5 Free Operating Cash Flow to Total Debt.

$$x41 = \frac{Free\,Operating\,Cash\,Flow}{Total\,Debt} = \frac{OANCF - CAPX}{DT} = \frac{(x27 - x28)*100}{x26}$$

Operating Activities (Net Cash Flow) = OANCF
Capital Expenditures = CAPX

5.6 Pretax Return on Capital (%).

$$x42 = \frac{\Pr etax\,Income\,after\,Depreciation}{Average\,Total\,Assets} = \frac{PI}{AT} = \frac{x12*100}{x30}$$

5.7 Operating Income before depreciation to Sales (%).

$$x43 = \frac{EBITDA}{Sales} = \frac{OIBDP}{SALE} = \frac{x4*100}{x1}$$

5.8 Long Term Debt to Capitalization.

$$x44 = \frac{Long\,Term\,Debt}{Market\,Value\,Fiscal\,Year\,End} = \frac{DLTT}{MKVALF} = \frac{x29*100}{x23}$$

5.9 Total Debt to Capitalization.

$$x45 = \frac{Total\,Debt}{Market\,Value\,Fiscal\,Year\,End} = \frac{DT}{MKVALF} = \frac{x26*100}{x23}$$

Appendix 5b. Credit Risk. The Default Probability Model. "areg" HCCM Heteroscedasticity-consistent Covariance Matrix for the fixed effects OLS estimator results.

$$\mathbf{Ln(DP/100)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}}$$

areg p4 x39 x42 x43 x44, absorb(id) robust

Regression with robust standard errors

Number of obs = 4559
F(4, 4158) = 54.65
Prob > F = 0.0000
R-squared = 0.7866
Adj R-squared = 0.7660
Root MSE = .72604

Robust p4	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]
x39	-5.67e-06	2.68e-06	-2.11	0.035	-.0000109	-4.05e-07
x42	-.0207056	.0027163	-7.62	0.000	-.0260309	-.0153803
x43	-.0072263	.0020371	-3.55	0.000	-.01122	-.0032325
x44	.0038497	.0005862	6.57	0.000	.0027005	.004999
_cons	-6.891339	.0498673	-138.19	0.000	-6.989106	-6.793573

id absorbed (397 categories)

NOTE: In the case of heteroscedasticity in a fixed effects model, the easiest thing to do is just use a heteroscedasticity-consistent covariance matrix, if you suspect heteroscedasticity in the panel. Fortunately, although "xtreg,fe" doesn't support the robust option, "areg" does. The Newey2 estimator with lag(0) also supports the robust option.

<u>Internal Definitions:</u>

p4 = log of the Default Probability divided by 100
x39 = EBITDA Interest Coverage
x42 = Pretax Return on Capital
x43 = Operating Income before Depreciation to Sales
x44 = Long Term Debt to Capitalization

Appendix 5c. Credit Risk. The Default Probability Model. "areg" HCCM Heteroscedasticity-consistent Covariance Matrix for the fixed effects OLS estimator results.

$$Ln(DP/1\text{-}DP)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$$

areg p5 x39 x42 x43 x44, absorb(id) robust

Regression with robust standard errors

Number of obs = 4559
F(4, 4158) = 51.62
Prob > F = 0.0000
R-squared = 0.7857
Adj R-squared = 0.7650
Root MSE = .73182

p5	Coef.	Robust Std. Err.	T	P>t	[95% Conf. Interval]	
x39	-5.66e-06	2.68e-06	-2.11	0.035	-.0000109	-4.01e-07
x42	-.0210653	.0028548	-7.38	0.000	-.0266622	-.0154683
x43	-.0073594	.0021106	-3.49	0.000	-.0114973	-.0032215
x44	.0038912	.0005886	6.61	0.000	.0027373	.0050451
_cons	-6.88351	.0512577	-134.29	0.000	-6.984003	-6.783018

id absorbed (397 categories)

Internal Definitions:

p5 = log(DP/1-DP) with the Default Probability divided by 100
x39 = EBITDA Interest Coverage
x42 = Pretax Return on Capital
x43 = Operating Income before Depreciation to Sales
x44 = Long Term Debt to Capitalization

Appendix 6a. Credit Risk. The Bankruptcy Model Variables Description.

6.1 Total Assets to Total Liabilities.

$$Ly6 = \mathrm{Ln}\left(\frac{Assets\,Total}{Liabilities\,Total}\right) = \mathrm{Ln}\left(\frac{AT}{LT}\right) = \mathrm{Ln}\left(\frac{y2*100}{y3}\right)$$

6.2 EBIT Interest Coverage.

$$x2 = \frac{EBIT}{Interest\ Expenditures} = \frac{EBIT}{XINT} = \frac{x1*100}{x3}$$

6.3 EBITDA Interest Coverage.

$$x4 = \frac{EBITDA}{Interest\ Expenditures} = \frac{EBITDA}{XINT} = \frac{x5*100}{x3}$$

6.4 Funds from Operations to Total Debt.

$$x10 = \frac{Funds\ from\ Operations}{Total\ Debt} = \frac{FOPT}{DT} = \frac{(x6 + x7 + x8 + x9)*100}{y1}$$

Funds from Operations = FOPT = x6 + x7 + x8 + x9

x6 = Income before Extraordinary Items = IB
x7 = Depreciation = DP
x8 = Extraordinary Items = XI
x9 = Discontinued Operations = DO

6.5 Free Operating Cash Flow to Total Debt.

$$x13 = \frac{Free\ Operating\ Cash\ Flow}{Total\ Debt} = \frac{OANCF - CAPX}{DT} = \frac{(x11 - x12)*100}{y1}$$

Operating Activities (Net Cash Flow) = OANCF
Capital Expenditures = CAPX

6.6 Pretax Return on Capital (%).

$$x15 = \frac{Pretax\ Income\ after\ Depreciation}{Average\ Total\ Assets} = \frac{PI}{AT} = \frac{x14 * 100}{(y2 + y2_{-1}) * 0.5}$$

6.7 Operating Income before depreciation to Sales (%).

$$x17 = \frac{EBITDA}{Sales} = \frac{OIBDP}{SALE} = \frac{x16 * 100}{x18}$$

6.8 Long Term Debt to Capitalization.

$$x20 = \frac{Long\ Term\ Debt}{Market\ Value\ Fiscal\ Year\ End} = \frac{DLTT}{MKVALF} = \frac{x19 * 100}{x21}$$

6.9 Total Debt to Capitalization.

$$x23 = \frac{Total\ Debt}{Market\ Value\ Fiscal\ Year\ End} = \frac{DT}{MKVALF} = \frac{y1 * 100}{x21}$$

6.10 Altman's Z-Score.

Altman's Z-Score = *ZSCORE*

Appendix 6b. Credit Risk. The Bankruptcy Model. "areg" HCCM Heteroscedasticity-consistent Covariance Matrix for the fixed effects OLS estimator results.

$$\mathbf{Ln(AT/LT)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}}$$

. areg ly6 x4 x13 x15 x23, absorb(c1) robust

Regression with robust standard errors

Number of obs =	2171
F(4, 1875) =	22.65
Prob > F =	0.0000
R-squared =	0.5889
Adj R-squared =	0.5242
Root MSE =	.50107

ly6	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
x4	.0000123	5.62e-06	2.18	0.029	1.24e-06	.0000233
x13	-.000067	.0000295	-2.27	0.023	-.0001248	-9.13e-06
x15	.0015787	.000198	7.97	0.000	.0011904	.0019669
x23	-7.45e-06	2.14e-06	-3.49	0.000	-.0000116	-3.26e-06
_cons	4.957821	.0123462	401.57	0.000	4.933607	4.982034

c1 absorbed (292 categories)

Internal Definitions:

Ly6 = log of total Assets to total Liabilities
x4 = EBITDA Interest Coverage
x13 = Free Operating Cash Flow to Total Debt
x15 = Pretax Return on Capital
x23 = Total Debt to Capitalization

Appendix 6c. The Bankruptcy Model. Benchmarking of Variables.

The covariance matrix or correlation coefficients among the different variables is the following:

. corr ln(AT/LT) Z-Score ln(DP)
(obs=975)

	ln(AT/LT)	Z-Score	ln(DP)
ln(AT/LT)	**1.0000**		
Z-Score	**0.7227**	**1.0000**	
Ln(DP)	**-0.4939**	**-0.4844**	**1.0000**

Appendix 7a. The Created Shareholder and Market Value Models Variables Description.

7.1 The Shareholder Value Added – Quarterly.

Y1 = Shareholder Value Added Qtly = $(x1 - x1_{-1}) + x2 + x3 - x4$

x1 = Market Value = MKVALQ
x2 = Cash Dividends = DVQ
x3 = Purchase of Common & Preferred Shares = PRSTKQ
x4 = Sale of Common & Preferred Shares = SSTKQ

7.2 The Created Shareholder Value – Quarterly.

Lcsv = Log of the Created Shareholder Value Qtly

csv = Shareholder Value Added – (Market Value$_{-1}$ * $\frac{Ke_{-1}}{100}$) = y1-($x1_{-1}$*$\frac{Ke_{-1}}{100}$)

Ke_{-1} = Lag of the required return to Equity

Ke = Risk Free Rate + (β_L *Market Risk Premium) = x57 + (β_L*8.04)

Market Risk Premium = 8.04%

x57 = Risk Free Rate = 3 Month Treasury Bill Rate = TBILL3M

bl = Levered Beta = β_L

b1 = $((x13*(x1+x27*(1-t)))-(bd*x27*(1-t)))/x1$

x13 = Beta = BETA
x1 = Market Value of Equity = MKVALQ
bd = Beta of the Debt
x27 = Total Debt = DTQ

bd = Beta of the Debt = $\frac{Kd - Risk\ Free\ Rate}{Market\ Risk\ Premium} = \frac{Kd - x57}{8.04}$

Kd = Required return to Debt

Kd = $\frac{Interest\ Expenditures}{Total\ Debt} = \frac{XINTQ}{DTQ} = \frac{x31*100}{x27}$

7.3 Standard & Poor's - Quarterly Index.

x16 = S&P500 Comp Ltd, I0003, Price Close Monthly = PRCCM

sp = ln(x16) = log of the S&P500 Quarterly Index
dsp = first differences of the "sp"

7.4 Free Cash Flow - Quarterly.

x7 = Free Cash Flow Qtly = FREECFLQ

f = ln(x7) = log of the Free Cash Flow Qtly
df = first differences of the "f".

7.5 Net Income – Quarterly.

x23 = Net Income Qtly = NIQ

ni = ln(x23) = log of the Net Income Qtly
dni = first differences of the "ni"

7.6 Assets Efficiency – Quarterly.

x51 = ef = $\frac{Average\ Assets\ Total\ Qtly}{Sales\ Qtly} = \frac{Ave.\ ATQ}{SALEQ} = \frac{x44}{x25}$

dx51 = def = first differences of "x51"

7.7 Strategic Index – Stock of R&D Capital to Sales ratio – Quarterly.

x55 = si = $\frac{R\ \&\ D\ Stock\ Qtly}{Sales\ Qtly} = \frac{Stock\ XRDQ}{SALEQ} = \frac{x52 * 100}{x25}$

dx55 = first differences of "x55"

7.8 Total Debt - Quarterly.

x27 = Total Debt Qtly = DTQ

td = ln(x27) = log of the Total Debt Qtly.

7.9 Over and Undervalued Shares Gap.

The Net Present Value of the Free Cash Flows Qtly is:

NPV(FCFQ) = $\sum \frac{FREECFLQ(1+g)^{i-1}}{(1+wacc)^{i}} = \frac{FREECFLQ}{wacc-g} = \frac{x7}{(wacc-\frac{x42}{100})}$

The difference between the projected share price from the FCF and the current share price will be:

x53 = $\left(\frac{FREECFLQ}{wacc-g} - DTQ\right)\frac{1}{CSHOQ} - \frac{MKVALQ}{CSHOQ}$

x53 = $\left(\frac{X7}{wacc-\frac{x42}{100}} - x27\right)\frac{1}{x17} - \frac{x1}{x17}$

The weigthed average cost of capital is:

wacc = $\frac{(MKVALQ*Ke)+(DTQ*Kd*(1-T))}{MKVALQ+DTQ} = \frac{(x1*Ke)+(x27*Kd*(1-T))}{x1+x27}$

T = $\frac{Total\ Income Taxes}{\Pr ofit\ before Taxes} = \frac{TXTQ}{PIQ} = \frac{x29}{x30}$

Kd = Required return to Debt

Kd = $\frac{Interest\ Expenditures}{Total\ Debt} = \frac{XINTQ}{DTQ} = \frac{x31*100}{x27}$

g = x42 = Free Cash Flow Qtly growth rate against same period of the previous year.

g = x42 = FCFQ growth rate = $\frac{(FREECFLQ - FREECFLQ_{-4})*100}{FRRECFLQ_{-4}} = \frac{(x7-x7_{-4})*100}{x7_{-4}}$

v = Over and Undervalued Shares Gap = ln(x53)

7.10 Potential Growth Path.

x54 = (PRCHM12 – PRCCM)*CSHOQ = (x37 – x36)*x17

x37 = Price Monthly High 12 Months
x36 = Price Monthly Close
x17 = Common Shares Outstanding Quarterly

p = Potential Growth Path = ln(x54)

7.11 Look Forward EPS diluted to current – Analysts forecast.

x45 = LF EPS F1MN – EPSFXQ = x9 – x10

x9 = Look Forward EPS diluted excluding extraordinary items for the current year
x10 = EPS diluted excluding extraordinary items Qtly
L = Look forward EPS diluted to current = ln(x45)

7.12 Free Cash Flow to Total Assets ratio – Quarterly.

$$x43 = \frac{FREECFLQ}{Average\ ATQ} = \frac{x7*100}{x44}$$

fa = Free Cash Flow to Total Assets ratio Qtly = ln(x43)
dfa = first differences of "fa"

7.13 Payment of Cash Dividends – Quarterly.

x2 = DVQ

di = Payment of Cash Dividends Qtly = ln(x2)
ddi = first differences of "di"

7.14 Repurchase of Shares – Quarterly.

x3 = PRSTKQ

r = Purchase of common and preferred shares Qtly = ln(x3)
dr = first differences of "r"

7.15 Sale of Common and Preferred Shares – Quarterly.

x4 = SSTKQ

s = Sale of Common and Preferred Shares Qtly = ln(x4)
ds = first differences of "s"

7.16 Retirement of Debt – Total Debt Reduction – Quarterly.

x5 = DLTRQ

rd = Retirement of long term Debt Qtly = ln(x5)
drd = first differences of "rd"

7.17 Investing Activities – Net Cash Flow – Quarterly.

x22 = IVNCFQ

ia = Investment Activities Qtly = ln(x22)
dia = first differences of "ia"

7.18 Retained Earnings – Quarterly.

x20 = REQ

re = Retained Earnings Qtly = ln(x20)
dre = first differences of "re"

7.19 Invested Capital – Quarterly.

x21 = ICAPTQ

ic = Invested Capital Qtly = ln(x21)
dic = first differences of "ic"

7.20 Investments – Capex – Quarterly.

x19 = CAPXQ

px = Capital Expenditures Qtly = ln(x19)
dpx = first differences of "px".

Appendix 7b. The Created Shareholder Value Model. "areg" HCCM Heteroscedasticity-consistent Covariance Matrix for the fixed effects OLS estimator results. Augmented Dickey-Fuller, Fisher, Johansen, and Engle and Granger tests. VECM estimates. Engle-Granger 2-step method. Pairwise Granger causality test and Model re-estimation.

1. HCCM for the fixed effects OLS estimator results

$$Ln(csv)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$$

. areg lcsv dni si_1 v p di_1 s_1 rd_1, absorb(id) robust

Regression with robust standard errors

Number of obs = 233
F(7, 203) = 17.36
Prob > F = 0.0000
R-squared = 0.3269
Adj R-squared = 0.2307
Root MSE = 6.5419

Robust lcsv	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
dni	-.2453895	.0927242	-2.65	0.009	-.4282156	-.0625635
si_1	.1117027	.0419593	2.66	0.008	.0289707	.1944347
v	-3.918479	1.624025	-2.41	0.017	-7.120598	-.7163589
p	-3.291215	.3983628	-8.26	0.000	-4.076675	-2.505756
di_1	3.352645	1.033158	3.25	0.001	1.315547	5.389743
s_1	-1.286703	.6134397	-2.10	0.037	-2.496233	-.0771723
rd_1	-.9798857	.3329191	-2.94	0.004	-1.636309	-.3234628
_cons	-1.475076	10.00587	-0.15	0.883	-21.20384	18.25369

id absorbed (23 categories)

2. The Augmented Dicker-Fuller test

THE CREATED SHAREHOLDER VALUE MODEL - AUGMENTED DICKEY FULLER TEST

Variables	Levels t-Statistic	Levels D-W Statistic	1st- Differences t-Statistic	1st- Differences D-W Statistic
lcsv	-11.167	1.975		
dni	-39.472	2.006		
si_1	0.961	1.818	-12.795	1.994
v	-0.988	1.955	-15.980	1.959
p	-10.036	2.022		
di_1	-0.567	1.889	-20.317	1.996
s_1	-10.700	1.887		
rd_1	-5.521	1.914		
1% Critical Value	-3.961			
5% Critical Value	-3.411			
10% Critical Value	-3.127			

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (si_1, v and di_1)

3. Fisher-type test

Fisher-type unit-root test for lcsv
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots   Number of panels = 74
Ha: At least one panel is stationary   Avg. number of periods = 15.18

AR parameter: Panel-specific   Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included   Cross-sectional means removed
Drift term: Not included   ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(120)	P	108.5220	0.7650
Inverse normal	Z	1.0201	0.8462
Inverse logit t(259)	L*	0.8634	0.8057
Modified inv. chi-squared	Pm	-0.7409	0.7706

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.

All four of the tests cannot reject the null hypothesis that all the panels contain unit roots

4. Johansen Cointegration test

Date: 01/06/10 Time: 19:58
Sample(adjusted): 35 4487
Included observations: 190
Excluded observations: 4263 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: LCSV SI_1 V DI_1
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.210256	63.37805	47.21	54.46
At most 1	0.078561	18.52925	29.68	35.65
At most 2	0.014290	2.983750	15.41	20.04
At most 3	0.001310	0.249004	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels

The normalized cointegrating equation is:

1 Cointegrating Equation(s): Log likelihood -1155.882

Normalized cointegrating coefficients (std.err. in parentheses)

LCSV	SI_1	V	DI_1
1.000000	-0.001766	0.728846	0.054730
	(0.01385)	(1.13187)	(0.45104)

Adjustment coefficients (std.err. in parentheses)

D(LCSV)	-1.285750
	(0.21936)
D(SI_1)	-0.252779
	(0.20124)
D(V)	-0.003420
	(0.00693)
D(DI_1)	-0.004946
	(0.00689)

5. Engle and Granger test

reg lcsv si_1 v di_1

Source	SS	df	MS			
				Number of obs	=	323
				F(3, 319)	=	3.01
Model	493.258351	3	164.41945	Prob > F	=	0.0305
Residual	17444.8153	319	54.6859414	R-squared	=	0.0275
				Adj R-squared	=	0.0184
Total	17938.0737	322	55.7083033	Root MSE	=	7.395

lcsv	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
si_1	.0034369	.0146454	0.23	0.815	-.025377	.0322507
v	-2.486261	.9177071	-2.71	0.007	-4.291784	-.6807386
di_1	-.3903783	.411437	-0.95	0.343	-1.199851	.4190944
_cons	-11.70444	3.996429	-2.93	0.004	-19.56712	-3.841748

reg dehat ehat_1

Source	SS	df	MS
Model	11.4561778	1	11.4561778
Residual	158.934831	363	.437837
Total	170.391009	364	.468107167

Number of obs =	365
F(1, 363) =	26.17
Prob > F =	0.0000
R-squared =	0.0672
Adj R-squared =	0.0647
Root MSE =	.66169

dehat	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ehat_1	-.1497605	.0292775	-5.12	0.000	-.2073352	-.0921857
_cons	-.6285963	.1204696	-5.22	0.000	-.8655023	-.3916903

6. VECM estimates

Vector Error Correction Estimates
Date: 01/06/10 Time: 21:27
Sample(adjusted): 33 4487
Included observations: 176
Excluded observations: 4279 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1,B(1,2)=0
Convergence achieved after 3 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 1):

Chi-square(1)	1.765860
Probability	0.183895

Cointegrating Eq:	CointEq1
LCSV(-1)	1.000000
SI_1(-1)	0.000000
V(-1)	0.549535 (0.85583) [0.64211]
DI_1(-1)	-0.800489 (0.38890) [-2.05837]
C	10.37766

Error Correction:	D(LCSV)	D(SI_1)	D(V)	D(DI_1)
CointEq1	-1.497085	-0.186852	0.002294	0.001720
	(0.14325)	(0.20634)	(0.00441)	(0.01281)
	[-10.4508]	[-0.90556]	[0.52069]	[0.13420]
D(LCSV(-1))	0.245729	0.111531	-0.005656	0.006138
	(0.11229)	(0.16174)	(0.00345)	(0.01004)
	[2.18841]	[0.68958]	[-1.63749]	[0.61104]
D(LCSV(-2))	0.137302	0.092525	-0.002864	0.000248
	(0.06545)	(0.09428)	(0.00201)	(0.00585)
	[2.09774]	[0.98141]	[-1.42235]	[0.04235]
D(SI_1(-1))	0.005553	-0.323185	0.000507	-0.000364
	(0.06935)	(0.09989)	(0.00213)	(0.00620)
	[0.08007]	[-3.23555]	[0.23746]	[-0.05860]
D(SI_1(-2))	-0.029037	-0.143115	-0.000255	0.002895
	(0.05353)	(0.07710)	(0.00165)	(0.00479)
	[-0.54249]	[-1.85628]	[-0.15459]	[0.60474]
D(V(-1))	1.861593	3.234359	-0.346535	0.651643
	(3.01824)	(4.34747)	(0.09285)	(0.26999)
	[0.61678]	[0.74396]	[-3.73236]	[2.41359]
D(V(-2))	1.017810	-3.024942	0.021545	0.693261
	(3.24063)	(4.66781)	(0.09969)	(0.28988)
	[0.31408]	[-0.64804]	[0.21612]	[2.39152]
D(DI_1(-1))	0.179184	0.249002	-0.044738	-0.548795
	(0.67167)	(0.96747)	(0.02066)	(0.06008)
	[0.26677]	[0.25737]	[-2.16528]	[-9.13403]
D(DI_1(-2))	-0.873977	0.753259	0.010453	-0.408846
	(0.68972)	(0.99347)	(0.02122)	(0.06170)
	[-1.26715]	[0.75821]	[0.49270]	[-6.62670]
C	23.27411	-0.332317	-0.635958	-0.977237
	(4.30936)	(6.20720)	(0.13256)	(0.38548)
	[5.40083]	[-0.05354]	[-4.79740]	[-2.53510]
DNI	-0.159821	0.059195	0.000307	0.012450
	(0.10702)	(0.15415)	(0.00329)	(0.00957)
	[-1.49335]	[0.38399]	[0.09318]	[1.30048]
P	-2.988785	0.135412	0.078947	-0.027123
	(0.43400)	(0.62513)	(0.01335)	(0.03882)
	[-6.88667]	[0.21662]	[5.91344]	[-0.69865]
S_1	0.965894	0.059942	-0.023884	0.199862
	(0.40204)	(0.57910)	(0.01237)	(0.03596)
	[2.40245]	[0.10351]	[-1.93120]	[5.55729]
RD_1	-0.222619	-0.057513	0.011572	0.065261
	(0.29422)	(0.42380)	(0.00905)	(0.02632)
	[-0.75663]	[-0.13571]	[1.27856]	[2.47961]

R-squared	0.724356	0.104272	0.277342	0.486693
Adj. R-squared	0.702237	0.032393	0.219351	0.445501
Sum sq. resids	6413.138	13305.66	6.068620	51.31623
S.E. equation	6.291842	9.062765	0.193547	0.562820
F-statistic	32.74730	1.450654	4.782496	11.81541
Log likelihood	-566.1477	-630.3737	46.59386	-141.2752
Akaike AIC	6.592588	7.322429	-0.370385	1.764491
Schwarz SC	6.844785	7.574626	-0.118187	2.016689
Mean dependent	-0.464934	0.731735	0.027859	0.076750
S.D. dependent	11.53034	9.213214	0.219058	0.755822

Determinant Residual Covariance	30.67844
Log Likelihood	-1271.030
Log Likelihood (d.f. adjusted)	-1300.206
Akaike Information Criteria	15.45689
Schwarz Criteria	16.53773

7. Engle-Granger 2-step method

reg D.lcsv D.si_1 D.v D.di_1

Source	SS	df	MS
Model	5196.32105	3	1732.10702
Residual	34065.1065	289	117.872341
Total	39261.4275	292	134.456944

Number of obs = 293
F(3, 289) = 14.69
Prob > F = 0.0000
R-squared = 0.1324
Adj R-squared = 0.1233
Root MSE = 10.857

D.lcsv	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
si_1						
D1	.164633	.0713006	2.31	0.022	.0242987	.3049673
v						
D1	-16.01516	2.693846	-5.95	0.000	-21.3172	-10.71311
di_1						
D1	-.3599659	.8313735	-0.43	0.665	-1.996281	1.276349
_cons	.1121976	.638349	0.18	0.861	-1.144205	1.3686

dfuller ehat, regress lags(4) trend
Augmented Dickey-Fuller test for unit root Number of obs = 228

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-8.290	-3.997	-3.433	-3.133

* MacKinnon approximate p-value for Z(t) = 0.0000

reg D2.lcsv D2.dni D2.si_1 D2.v D2.p D2.di_1 D2.s_1 D2.rd_1 ehat_1

Source	SS	df	MS		
Model	33428.2565	8	4178.53206	Number of obs =	159
Residual	37635.6253	150	250.904168	F(8, 150) =	16.65
Total	71063.8818	158	449.771404	Prob > F =	0.0000
				R-squared =	0.4704
				Adj R-squared =	0.4422
				Root MSE =	15.84

D2.lcsv	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
dni						
D2	-.2079953	.1066092	-1.95	0.053	-.4186449	.0026543
si_1						
D2	.0864729	.1068735	0.81	0.420	-.124699	.2976447
v						
D2	-8.687383	6.056237	-1.43	0.154	-20.65393	3.279167
p						
D2	-6.133423	.8693023	-7.06	0.000	-7.851082	-4.415764
di_1						
D2	2.343632	1.787006	1.31	0.192	-1.187322	5.874586
s_1						
D2	.4262831	1.239623	0.34	0.731	-2.023095	2.875661
rd_1						
D2	-2.026352	.7185798	-2.82	0.005	-3.446198	-.6065064
ehat_1	-.9368144	.5497634	-1.70	0.090	-2.023095	.1494661
_cons	.1496713	1.267229	0.12	0.906	-2.354253	2.653596

8. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 12/20/09 Time: 16:56
Sample: 1 4491
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
DNI does not Granger Cause LCSV	938	1.43009	0.23981
LCSV does not Granger Cause DNI		2.95090	0.05278
SI_1 does not Granger Cause LCSV	339	2.45407	0.08749
LCSV does not Granger Cause SI_1		1.72019	0.18061
V does not Granger Cause LCSV	904	17.6409	3.1E-08
LCSV does not Granger Cause V		0.20142	0.81761
P does not Granger Cause LCSV	925	2.43472	0.08819
LCSV does not Granger Cause P		2.70163	0.06763
DI_1 does not Granger Cause LCSV	792	7.07407	0.00090
LCSV does not Granger Cause DI_1		14.6187	5.8E-07
S_1 does not Granger Cause LCSV	763	5.47478	0.00436
LCSV does not Granger Cause S_1		2.79347	0.06184
RD_1 does not Granger Cause LCSV	770	13.6194	1.5E-06
LCSV does not Granger Cause RD_1		7.96727	0.00038

9. Model re-estimation

The HAC regression in first differences:

newey2 dlcsv ddni dsi_1 dv dp ddi_1 ds_1 drd_1, lag(0)

Regression with robust standard errors — Number of obs = 190
maximum lag : 0 — F(7, 182) = 22.92
Prob > F = 0.0000

Robust dlcsv	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ddni	-.2437589	.0810228	-3.01	0.003	-.4036236	-.0838942
dsi_1	.1086461	.055062	1.97	0.050	4.08e-06	.2172881
dv	-9.896871	3.667674	-2.70	0.008	-17.1335	-2.660243
dp	-5.374612	.6468924	-8.31	0.000	-6.650985	-4.098239
ddi_1	3.86314	1.688749	2.29	0.023	.5310958	7.195185
ds_1	-1.041715	1.042261	-1.00	0.319	-3.098185	1.014754
drd_1	-1.820603	.6827772	-2.67	0.008	-3.16778	-.4734267
_cons	-.0427294	.7146114	-0.06	0.952	-1.452718	1.367259

The HAC regression in second differences:

newey2 d2lcsv d2dni d2si_1 d2v d2p d2di_1 d2s_1 d2rd_1, lag(0)

Regression with robust standard errors — Number of obs = 159
maximum lag : 0 — F(7, 151) = 36.50
Prob > F = 0.0000

Robust d2lcsv	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
d2dni	-.2218408	.1022421	-2.17	0.032	-.4238507	-.0198309
d2si_1	.1543938	.0513067	3.01	0.003	.0530221	.2557656
d2v	-15.30553	5.612535	-2.73	0.007	-26.39477	-4.216289
d2p	-6.435933	.7349576	-8.76	0.000	-7.888062	-4.983805
d2di_1	2.722505	1.967339	1.38	0.168	-1.164561	6.609571
d2s_1	.2505409	1.183853	0.21	0.833	-2.088515	2.589597
d2rd_1	-2.067475	.6929727	-2.98	0.003	-3.43665	-.6983004
_cons	-.0266445	1.247317	-0.02	0.983	-2.491092	2.437803

Appendix 7c. The Created Shareholder Value Model. "Newey2" HAC-Heteroscedasticity and Autocorrelation Consistent Covariance matrix estimator results.

$$\mathbf{Ln(csv)_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}}$$

```
. newey2 lcsv  dsp dni  si_1 p di_1 dic, lag(0)

Regression with robust standard errors          Number of obs  =  326
maximum lag : 0                                   F( 6,   319)  =   25.93
                                                  Prob > F      = 0.0000
```

Robust lcsv	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
dsp	9.522196	3.174988	3.00	0.003	3.275635	15.76876
dni	-.1714986	.0679629	-2.52	0.012	-.3052107	-.0377866
si_1	.0387997	.0128323	3.02	0.003	.0135531	.0640464
p	-2.686897	.2724519	-9.86	0.000	-3.222927	-2.150868
di_1	.89703	.3865931	2.32	0.021	.1364358	1.657624
dic	6.813698	2.321476	2.94	0.004	2.24636	11.38104
_cons	13.57377	2.591709	5.24	0.000	8.474764	18.67277

Appendix 7d. The quarterly Market Value Model. Arellano Bond System GMM-2 estimator results. The Hansen, Augmented Dickey-Fuller, Fisher, Johansen, and Engle and Granger tests. VECM estimates. Engle-Granger 2-step method. Pairwise Granger causality test and Model re-estimation.

$$m_{it} = \alpha_i\, m_{i,t-1} + \beta_i \ln(csv)_{it} + \eta_i + \varepsilon_{it}$$

```
. xtabond2 m m_1 lcsv, gmm(m_1 lcsv) iv(l.m_1, mz) small twostep h(3)
Building GMM instruments...
31 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.
```

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

```
Group variable: id                      Number of obs      =    1067
Time variable : quarter                 Number of groups   =      74
Number of instruments = 349             Obs per group: min =       2
F(2, 73)     = 252082.21                               avg =   14.42
Prob > F     =     0.000                               max =      19
------------------------------------------------------------------------------
             Coef.      Std. Err.     t      P>t     [95% Conf. Interval]
------------------------------------------------------------------------------
m_1      1.008063     .00147     685.77  0.000     1.005134   1.010993
lcsv      .023341    .0001444    161.61  0.000     .0230531   .0236288
_cons   -.0016397    .0145161     -0.11  0.910    -.0305703   .0272909
------------------------------------------------------------------------------
Warning: Uncorrected two-step standard errors are unreliable.
```

2. Hansen test of overid. restrictions: chi2(346) = 71.27 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -4.92 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.86 Pr > z = 0.392

xtabond2 m m_1 sp_1 dsp lcsv, gmm(m_1 sp_1 dsp lcsv) iv(l.m_1 l.sp_1 l.lcsv, mz) small twostep h(3)
Building GMM instruments.....
254 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.

Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id		Number of obs =	1061
Time variable : quarter		Number of groups =	74
Number of instruments = 430		Obs per group: min =	2
F(4, 73) = 2.79e+07		avg =	14.34
Prob > F = 0.000		max =	18

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
m_1	1.008451	.0007364	1369.49	0.000	1.006984	1.009919
sp_1	.1230156	.0124505	9.88	0.000	.0982018	.1478293
dsp	.4768549	.0139012	34.30	0.000	.4491499	.50456
lcsv	.0203647	.0002992	68.05	0.000	.0197683	.020961
_cons	-.8851913	.0866522	-10.22	0.000	-1.057889	-.7124937

Warning: Uncorrected two-step standard errors are unreliable.
Hansen test of overid. restrictions: chi2(425) = 70.61 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -4.83 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.32 Pr > z = 0.745

---

2. Augmented Dickey-Fuller test

THE MARKET VALUE MODEL I.
AUGMENTED DICKEY FULLER TEST

	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
m	-7.352	2.009				
m_1	-7.372	2.004				
sp_1	-19.121	2.100	-18.671	2.007	-38.016	1.827
dsp	-22.609	1.886	-42.107	1.776	-53.936	2.314
lcsv	-11.197	2.006				
1% Critical Value	-3.963					
5% Critical Value	-3.412					
10% Critical Value	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (sp_1 and dsp)

3. Fisher-type test

Fisher-type unit-root test for m
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots   Number of panels   =   92
Ha: At least one panel is stationary   Avg. number of periods = 17.73

AR parameter: Panel-specific   Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included   Cross-sectional means removed
Drift term: Not included   ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(184)	P	154.7881	0.9425
Inverse normal	Z	4.2954	1.0000
Inverse logit t(419)	L*	3.9942	1.0000
Modified inv. chi-squared	Pm	-1.5228	0.9361

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.

All four of the tests show that the null hypothesis that all the panels contain unit roots cannot be rejected.

4. Johansen Cointegration test

Date: 01/08/10   Time: 21:16
Sample(adjusted): 6 1640
Included observations: 1596
Excluded observations: 39 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: M SP_1 DSP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.403649	1144.467	29.68	35.65
At most 1 **	0.154446	319.4524	15.41	20.04
At most 2 **	0.031876	51.70190	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 3 cointegrating equation(s) at both 5% and 1% levels

The normalized cointegrating equation is:

2 Cointegrating Equation(s):	Log likelihood	4289.846
Normalized cointegrating coefficients (std.err. in parentheses)		
M	SP_1	DSP
1.000000	0.000000	-22409.64
		(752.180)
0.000000	1.000000	-58.81514
		(1.64067)
Adjustment coefficients (std.err. in parentheses)		
D(M)	0.000235	-0.064237
	(0.00030)	(0.12903)
D(SP_1)	0.000323	-0.152032
	(1.9E-05)	(0.00820)
D(DSP)	0.000685	-0.205914
	(5.9E-05)	(0.02488)

5. Engle and Granger test

reg m sp_1 dsp

```
Source          SS          df       MS              Number of obs    =   1631
---------------------------------------------------      F(  2,  1628)   =   9.36
Model     28.5766446       2   14.2883223             Prob > F        =  0.0001
Residual  2484.59863    1628   1.52616624             R-squared       =  0.0114
---------------------------------------------------      Adj R-squared=  0.0102
Total     2513.17528    1630   1.54182532             Root MSE        =  1.2354
```

```
m         Coef.        Std. Err.      t     P>t        [95% Conf.     Interval]
------------------------------------------------------------------------------------
sp_1    .7543358      .1815415     4.16   0.000       .3982563       1.110415
dsp     .5546479      .2963854     1.87   0.061       -.026689       1.135985
_cons   4.866119      1.286251     3.78   0.000       2.343237       7.389001
------------------------------------------------------------------------------------
```

reg dehat ehat_1

Source	SS	df	MS
Model	.873926031	1	.873926031
Residual	9.24906844	1637	.005650011
Total	10.1229945	1638	.006180094

Number of obs	= 1639
F(1, 1637)	= 154.68
Prob > F	= 0.0000
R-squared	= 0.0863
Adj R-squared	= 0.0858
Root MSE	= .07517

dehat	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ehat_1	-.1738135	.0139756	-12.44	0.000	-.2012255	-.1464016
_cons	1.773551	.1426281	12.43	0.000	1.493798	2.053304

6. VECM estimates

Vector Error Correction Estimates
Date: 01/08/10 Time: 21:13
Sample(adjusted): 4 1640
Included observations: 1050
Excluded observations: 587 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1,B(1,2)=0,B(2,1)=0,B(2,2)=1,A(2,1)=0,A(3,1)=0
Convergence achieved after 24 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 2):

Chi-square(2)	0.980878
Probability	0.612358

Cointegrating Eq:	CointEq1	CointEq2
M(-1)	1.000000	0.000000
SP_1(-1)	0.000000	1.000000
DSP(-1)	-2.188131 (0.29184) [-7.49782]	-15.85038 (0.35159) [-45.0820]
C	-10.13677	-7.307354

Error Correction:	D(M)	D(SP_1)	D(DSP)
CointEq1	-0.984466	0.000000	0.000000
	(0.01270)	(0.00000)	(0.00000)
	[-77.5233]	[NA]	[NA]
CointEq2	0.208686	-0.109035	0.111667
	(0.02099)	(0.00361)	(0.01220)
	[9.94289]	[-30.1881]	[9.15117]
D(M(-1))	0.013112	-1.11E-05	-0.004823
	(0.01185)	(0.00205)	(0.00691)
	[1.10668]	[-0.00545]	[-0.69759]
D(M(-2))	-0.000332	-0.001150	-0.005670
	(0.01171)	(0.00202)	(0.00683)
	[-0.02839]	[-0.56871]	[-0.83007]
D(SP_1(-1))	0.563205	-0.206258	0.417568
	(0.15770)	(0.02723)	(0.09202)
	[3.57144]	[-7.57485]	[4.53801]
D(SP_1(-2))	0.336907	-0.347422	0.149842
	(0.15269)	(0.02636)	(0.08909)
	[2.20649]	[-13.1776]	[1.68185]
D(DSP(-1))	1.222207	-0.683317	0.690005
	(0.30605)	(0.05285)	(0.17858)
	[3.99345]	[-12.9304]	[3.86382]
D(DSP(-2))	0.507664	-0.276484	0.332914
	(0.17293)	(0.02986)	(0.10090)
	[2.93567]	[-9.25949]	[3.29931]
C	-9.924000	0.017280	0.039202
	(0.13620)	(0.02352)	(0.07947)
	[-72.8642]	[0.73477]	[0.49328]
M_1	0.989662	-0.002092	-0.002152
	(0.01346)	(0.00232)	(0.00785)
	[73.5443]	[-0.90056]	[-0.27402]
LCSV	0.021814	0.000677	0.003109
	(0.00077)	(0.00013)	(0.00045)
	[28.4683]	[5.11410]	[6.95348]

R-squared	0.864109	0.924952	0.562795
Adj. R-squared	0.862801	0.924230	0.558588
Sum sq. resids	32.37604	0.965272	11.02303
S.E. equation	0.176524	0.030480	0.103001
F-statistic	660.6817	1280.550	133.7462
Log likelihood	336.6561	2180.857	902.3078
Akaike AIC	-0.620297	-4.133062	-1.697729
Schwarz SC	-0.568372	-4.081136	-1.645803
Mean dependent	-0.017483	-0.004001	0.001777
S.D. dependent	0.476572	0.110731	0.155032
Determinant Residual Covariance		2.23E-07	
Log Likelihood		3587.561	
Log Likelihood (d.f. adjusted)		3571.454	
Akaike Information Criteria		-6.728484	
Schwarz Criteria		-6.544384	

7. Engle-Granger 2-step method

reg D.m D.sp_1 D.dsp

Source	SS	df	MS		
				Number of obs =	1624
				F(2, 1621) =	35.46
Model	13.9144583	2	6.95722916	Prob > F =	0.0000
Residual	318.050206	1621	.196206173	R-squared =	0.0419
				Adj R-squared =	0.0407
Total	331.964665	1623	.204537686	Root MSE =	.44295

D.m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
sp_1						
D1	.832538	.1222071	6.81	0.000	.5928375	1.072238
dsp						
D1	.6954553	.0873049	7.97	0.000	.5242131	.8666975
_cons	-.0023384	.0109927	-0.21	0.832	-.0238998	.0192231

. dfuller ehat, regress lags(4) trend
Augmented Dickey-Fuller test for unit root Number of obs = 1634

	---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-18.177	-3.960	-3.410	-3.120

* MacKinnon approximate p-value for Z(t) = 0.0000

reg D2.m D2.m_1 D2.sp_1 D2.dsp D2.lcsv ehat_1

Source	SS	df	MS		
				Number of obs =	927
				F(5, 921) =	232.74
Model	142.702387	5	28.5404775	Prob > F =	0.0000
Residual	112.939172	921	.12262668	R-squared =	0.5582
				Adj R-squared =	0.5558
Total	255.641559	926	.276070798	Root MSE =	.35018

D2.m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
m_1						
D2	.7076755	.024635	28.73	0.000	.6593282	.7560228
sp_1						
D2	.2573522	.1501944	1.71	0.087	-.0374108	.5521152
dsp						
D2	.3806102	.0992654	3.83	0.000	.1857975	.5754228
lcsv						
D2	.0188779	.0006997	26.98	0.000	.0175048	.020251
ehat_1	-.0219428	.2039855	-0.11	0.914	-.4222732	.3783876
_cons	-.0049203	.0117929	-0.42	0.677	-.0280644	.0182238

8. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 01/09/10 Time: 20:01
Sample: 1 1640
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
M_1 does not Granger Cause M	1616	1.51946	0.21914
M does not Granger Cause M_1		293.213	0.00000
SP_1 does not Granger Cause M	1617	5.02252	0.00669
M does not Granger Cause SP_1		25.7714	9.6E-12
DSP does not Granger Cause M	1617	2.58842	0.07545
M does not Granger Cause DSP		1.59308	0.20362
LCSV does not Granger Cause M	927	1.23356	0.29173
M does not Granger Cause LCSV		8.94131	0.00014

The MLE-Maximum likelihood estimator in first differences:

xtreg dm dm_1 dsp_1 ddsp dlcsv, mle

Fitting constant-only model:
Iteration 0: log likelihood = -1.4806503
Iteration 1: log likelihood = 38.838383
Iteration 2: log likelihood = 43.440023
Iteration 3: log likelihood = 43.535705
Iteration 4: log likelihood = 43.53576

Fitting full model:
Iteration 0: log likelihood = 242.08111
Iteration 1: log likelihood = 242.08751

Random-effects ML regression Number of obs = 980
Group variable (i): id Number of groups = 72

Random effects u_i ~ Gaussian Obs per group: min = 1
avg = 13.6
max = 18

LR chi2(4) = 397.10
Log likelihood = 242.08751 Prob > chi2 = 0.0000

dm	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
dm_1	.0475107	.0112455	4.22	0.000	.0254699	.0695515
dsp_1	.7939848	.0736825	10.78	0.000	.6495697	.9383998
ddsp	.5410767	.0607187	8.91	0.000	.4220701	.6600832
dlcsv	.0110073	.0006102	18.04	0.000	.0098113	.0122034
_cons	-.007277	.0061389	-1.19	0.236	-.0193091	.0047551
/sigma_u	0	.0277606	0.00	1.000	-.0544097	.0544097
/sigma_e	.1890079	.0042691	44.27	0.000	.1806406	.1973751
rho	0	.			.	.

Likelihood-ratio test of sigma_u=0: chibar2(01)= 0.00 Prob>=chibar2 = 1.000

The MLE-Maximum likelihood estimator in second differences:

```
xtreg d2m d2sp_1 d2dsp d2lcsv, mle

Fitting constant-only model:
Iteration 0:   log likelihood = -722.49437
Iteration 1:   log likelihood = -712.96674
Iteration 2:   log likelihood = -712.57223
Iteration 3:   log likelihood = -712.57113
Iteration 4:   log likelihood = -712.57113

Fitting full model:
Iteration 0:   log likelihood = -619.78423
Iteration 1:   log likelihood = -619.76574
Iteration 2:   log likelihood = -619.76573

Random-effects ML regression                Number of obs      =      926
Group variable (i): id                      Number of groups   =       69

Random effects u_i ~ Gaussian               Obs per group: min =        1
                                                           avg =     13.4
                                                           max =       18

LR chi2(3)        =    185.61
Log likelihood  = -619.76573                Prob > chi2        =   0.0000


d2m          Coef.      Std. Err.      z     P>z     [95% Conf. Interval]
------------------------------------------------------------------------------
d2sp_1     .7849767   .1769608     4.44   0.000     .4381399    1.131814
d2dsp      .4533555   .1092147     4.15   0.000     .2392988    .6674123
d2lcsv     .0111736   .0008576    13.03   0.000     .0094928    .0128544
_cons      .0160668   .0184948     0.87   0.385    -.0201824     .052316
------------------------------------------------------------------------------
/sigma_u   .0764853   .0229377     3.33   0.001     .0315283    .1214423
/sigma_e   .4672543   .0111916    41.75   0.000     .4453191    .4891895
------------------------------------------------------------------------------
rho        .0260955   .0154929                       .0072872    .0748875
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01)=    4.33 Prob>=chibar2 = 0.019
```

Appendix 7e. The quarterly Market Value Model. Arellano Bond System GMM-2 estimator results. The Hansen, Augmented Dickey-Fuller, Fisher, Johansen, and Engle and Granger tests. VECM estimates. Engle-Granger 2-step method. Pairwise Granger causality test and Model re-estimation.

```
xtabond2 m m_1 dsp dni v p di_1 ds, gmm(m_1 dsp dni v p di_1 ds) iv(l.m_1 l.v l.p l.di_1,mz)
small twostep h(3)
Building GMM instruments........
226 instruments dropped because of collinearity.
Warning: Number of instruments may be large relative to number of observations.
Estimating.
Warning: Two-step estimated covariance matrix of moment conditions is singular.
Number of instruments may be large relative to number of groups.
Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
Performing specification tests.
```

1. Arellano-Bond dynamic panel-data estimation, two-step system GMM results

Group variable: id		Number of obs =	601
Time variable : quarter		Number of groups =	61
Number of instruments = 507		Obs per group: min =	1
F(7, 60) = 91074.50		avg =	9.85
Prob > F = 0.000		max =	14

	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
m_1	1.048282	.0054113	193.72	0.000	1.037458	1.059106
dsp	.5644142	.0210868	26.77	0.000	.5222343	.6065941
dni	.0010505	.0004012	2.62	0.011	.000248	.001853
v	-.0320404	.008359	-3.83	0.000	-.0487609	-.0153199
p	-.0749604	.0034377	-21.81	0.000	-.0818369	-.0680839
di_1	.0159811	.003189	5.01	0.000	.0096021	.02236
ds	.0099435	.0018618	5.34	0.000	.0062194	.0136676
_cons	-.0634313	.0844071	-0.75	0.455	-.2322706	.1054079

Warning: Uncorrected two-step standard errors are unreliable.

2. Hansen test of overid. restrictions: chi2(499) = 56.30 Prob > chi2 = 1.000

Arellano-Bond test for AR(1) in first differences: z = -3.96 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = 0.68 Pr > z = 0.494

3. The Augmented Dickey-Fuller test

THE MARKET VALUE MODEL II.
AUGMENTED DICKEY FULLER TEST

Variables	Levels t-Statistic	Levels D-W Statistic	1st- Differences t-Statistic	1st- Differences D-W Statistic	2nd- Differences t-Statistic	2nd- Differences D-W Statistic
m	-7.551	2.006				
m_1	-7.710	2.009				
dsp	-31.820	1.848	-43.037	1.944	-45.913	2.070
dni	-22.013	1.985				
v	-4.550	1.930				
p	-8.362	2.004				
di_1	-5.274	1.921				
ds	-13.006	1.917				
1% Critical Value	-3.965					
5% Critical Value	-3.413					
10% Critical Value	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (dsp)

4. Fisher-type test

xtunitroot fisher m,dfuller trend lags(4) demean

Fisher-type unit-root test for m
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots Number of panels = 92
Ha: At least one panel is stationary Avg. number of periods = 13.77

AR parameter: Panel-specific Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included Cross-sectional means removed
Drift term: Not included ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(184)	P	281.6651	0.0000
Inverse normal	Z	6.5022	1.0000
Inverse logit t(384)	L*	3.4245	0.9997
Modified inv. chi-squared	Pm	5.0911	0.0000

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.
The tests P and Pm reject the null hypothesis, and Z and L* cannot reject the null hypothesis that all the panels contain unit roots.

5. Johansen Cointegration test

Date: 01/09/10 Time: 21:01
Sample(adjusted): 6 1274
Included observations: 1237
Excluded observations: 32 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: M DSP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.446551	788.3787	15.41	20.04
At most 1 **	0.044715	56.58775	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 2 cointegrating equation(s) at both 5% and 1% levels

The normalized cointegrating equation is:

1 Cointegrating Equation(s): Log likelihood 348.9800

Normalized cointegrating coefficients (std.err. in parentheses)

M	DSP
1.000000	-4491.356
	(142.746)

Adjustment coefficients (std.err. in parentheses)

D(M)	0.000134
	(0.00011)
D(DSP)	0.000562
	(1.8E-05)

6. Engle and Granger test

reg m dsp

Source	SS	df	MS
Model	2.71251632	1	2.71251632
Residual	2029.23995	1265	1.60414226
Total	2031.95247	1266	1.60501775

Number of obs	= 1267
F(1, 1265)	= 1.69
Prob > F	= 0.1937
R-squared	= 0.0013
Adj R-squared	= 0.0005
Root MSE	= 1.2665

m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
dsp	.4638052	.3566735	1.30	0.194	-.2359315	1.163542
_cons	10.20297	.0371602	274.57	0.000	10.13007	10.27587

reg dehat ehat_1

Source	SS	df	MS
Model	3.73751948	1	3.73751948
Residual	2.63017906	1271	.002069378
Total	6.36769854	1272	.005006052

Number of obs	= 1273
F(1, 1271)	= 1806.11
Prob > F	= 0.0000
R-squared	= 0.5869
Adj R-squared	= 0.5866
Root MSE	= .04549

dehat	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ehat_1	-1.173002	.0276011	-42.50	0.000	-1.227151	-1.118853
_cons	11.95177	.2812329	42.50	0.000	11.40004	12.5035

7. VECM estimates

Vector Error Correction Estimates
Date: 01/09/10 Time: 21:06
Sample(adjusted): 4 1271
Included observations: 588
Excluded observations: 680 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1,A(2,1)=0
Convergence achieved after 5 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 1):

Chi-square(1)	0.023344
Probability	0.878567

Cointegrating Eq:	CointEq1
M(-1)	1.000000
DSP(-1)	-0.623022 (0.15089) [-4.12887]
C	-10.31393

Error Correction:	D(M)	D(DSP)
CointEq1	-1.029703	0.000000
	(0.01676)	(0.00000)
	[-61.4322]	[NA]
D(M(-1))	-0.025470	-0.012323
	(0.01624)	(0.00998)
	[-1.56788]	[-1.23505]
D(M(-2))	0.000547	-0.012179
	(0.01472)	(0.00904)
	[0.03716]	[-1.34691]
D(DSP(-1))	-0.441933	-0.757776
	(0.07662)	(0.04707)
	[-5.76749]	[-16.1003]
D(DSP(-2))	-0.293179	-0.252994
	(0.06572)	(0.04037)
	[-4.46100]	[-6.26716]
C	-10.53124	0.068324
	(0.19501)	(0.11978)
	[-54.0042]	[0.57040]
M_1	1.067399	-0.014335
	(0.02092)	(0.01285)
	[51.0270]	[-1.11563]
DNI	-0.000128	-0.002580
	(0.00188)	(0.00115)
	[-0.06808]	[-2.23749]
V	-0.022647	0.002202
	(0.00959)	(0.00589)
	[-2.36172]	[0.37384]
P	-0.081112	-0.001082
	(0.00826)	(0.00507)
	[-9.82447]	[-0.21336]
DI_1	0.025417	0.016902
	(0.00808)	(0.00496)
	[3.14549]	[3.40526]
DS	0.013693	-0.001016
	(0.00772)	(0.00474)
	[1.77399]	[-0.21428]
R-squared	0.856098	0.401258
Adj. R-squared	0.853350	0.389824
Sum sq. resids	21.83264	8.237234
S.E. equation	0.194689	0.119586
F-statistic	311.5202	35.09249
Log likelihood	133.9005	420.4745
Akaike AIC	-0.414628	-1.389369
Schwarz SC	-0.325307	-1.300048
Mean dependent	-0.019655	0.001984
S.D. dependent	0.508394	0.153092
Determinant Residual Covariance		0.000472
Log Likelihood		595.3455
Log Likelihood (d.f. adjusted)		583.2321
Akaike Information Criteria		-1.895347
Schwarz Criteria		-1.701819

8. Engle-Granger 2-step method

reg D.m D.dsp

Source	SS	df	MS
Model	6.90152175	1	6.90152175
Residual	332.8285	1259	.264359412
Total	339.730022	1260	.269627001

Number of obs = 1261
F(1, 1259) = 26.11
Prob > F = 0.0000
R-squared = 0.0203
Adj R-squared = 0.0195
Root MSE = .51416

D.m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
dsp						
D1	.4858182	.0950821	5.11	0.000	.2992814	.6723549
_cons	-.004545	.0144792	-0.31	0.754	-.0329511	.023861

dfuller ehat, regress lags(4) trend

Augmented Dickey-Fuller test for unit root Number of obs = 1268

	---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-43.144	-3.960	-3.410	-3.120

* MacKinnon approximate p-value for Z(t) = 0.0000

reg D2.m D2.m_1 D2.dsp D2.dni D2.v D2.p D2.di_1 D2.ds ehat_1

Source	SS	df	MS		
Model	41.035681	8	5.12946013	Number of obs =	488
Residual	55.3502368	479	.11555373	F(8, 479) =	44.39
				Prob > F =	0.0000
				R-squared =	0.4257
				Adj R-squared =	0.4162
Total	96.3859178	487	.197917696	Root MSE =	.33993

D2.m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
m_1						
D2	.5156796	.0380912	13.54	0.000	.4408331	.5905262
dsp						
D2	.6026662	.1241905	4.85	0.000	.3586407	.8466916
dni						
D2	-.0003268	.0012002	-0.27	0.786	-.0026852	.0020316
v						
D2	-.056341	.0146767	-3.84	0.000	-.0851796	-.0275024
p						
D2	-.137396	.0115188	-11.93	0.000	-.1600296	-.1147625
di_1						
D2	.0802404	.0154008	5.21	0.000	.0499789	.1105019
ds						
D2	.0250408	.006079	4.12	0.000	.0130959	.0369856
ehat_1	1.126075	.4660162	2.42	0.016	.2103859	2.041763
_cons	.0002036	.0157389	0.01	0.990	-.0307221	.0311294

9. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 12/20/09 Time: 17:02
Sample: 1 1274
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
M_1 does not Granger Cause M	1255	0.85592	0.42514
M does not Granger Cause M_1		167.697	0.00000
DSP does not Granger Cause M	1255	2.23275	0.10766
M does not Granger Cause DSP		1.34675	0.26046
DNI does not Granger Cause M	1220	0.05716	0.94444
M does not Granger Cause DNI		2.52962	0.08011
V does not Granger Cause M	837	0.05527	0.94623
M does not Granger Cause V		4.18555	0.01554
P does not Granger Cause M	1229	2.15890	0.11589
M does not Granger Cause P		74.1147	0.00000
DI_1 does not Granger Cause M	923	8.21718	0.00029
M does not Granger Cause DI_1		16.8529	6.5E-08
DS does not Granger Cause M	708	5.08085	0.00644
M does not Granger Cause DS		0.74126	0.47689

10. Model re-estimation

The MLE estimator in first differences:

```
xtreg dm dm_1 ddsp ddni dv dp ddi_1 dds, mle

Fitting constant-only model:
Iteration 0:   log likelihood =  56.509251
Iteration 1:   log likelihood =  92.169372
Iteration 2:   log likelihood =   97.09764
Iteration 3:   log likelihood =  97.276811
Iteration 4:   log likelihood =  97.277089
Iteration 5:   log likelihood =  97.277089
Fitting full model:
Iteration 0:   log likelihood =  227.26828
Iteration 1:   log likelihood =  227.92268
Iteration 2:   log likelihood =  227.97743
Iteration 3:   log likelihood =  227.98645
Iteration 4:   log likelihood =  227.98821
Iteration 5:   log likelihood =  227.98859
Iteration 6:   log likelihood =  227.98867
Iteration 7:   log likelihood =  227.98869
Iteration 8:   log likelihood =   227.9887
Iteration 9:   log likelihood =   227.9887
Iteration 10:  log likelihood =   227.9887

Random-effects ML regression              Number of obs      =      537
Group variable (i): id                    Number of groups   =       57

Random effects u_i ~ Gaussian             Obs per group: min =        1
                                                         avg =      9.4
                                                         max =       14
LR chi2(7)        =   261.42
Log likelihood  =   227.9887                 Prob > chi2       =   0.0000

dm          Coef.      Std. Err.      z     P>z       [95% Conf. Interval]
------------------------------------------------------------------------------
dm_1      .0427247   .0126246     3.38   0.001      .017981    .0674685
ddsp       .1460571   .0471818     3.10   0.002      .0535825    .2385317
ddni      .0010886   .0009519     1.14   0.253    -.0007771    .0029544
dv        -.0473273   .0112824    -4.19   0.000    -.0694403   -.0252143
dp        -.12509      .0076257   -16.40   0.000    -.1400361    -.110144
ddi_1      .0076002   .0100212     0.76   0.448    -.012041     .0272414
dds       -.000035     .0043029    -0.01   0.994    -.0084685    .0083986
_cons     -.0325365   .0068358    -4.76   0.000    -.0459346   -.0191385
------------------------------------------------------------------------------
/sigma_u    5.04e-17   .2192977     0.00   1.000    -.4298156    .4298156
/sigma_e    .1582628   .0048292    32.77   0.000     .1487977    .1677279
------------------------------------------------------------------------------
rho          1.02e-31   8.83e-16                               0          1
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01)=    0.00 Prob>=chibar2 = 1.000
```

The HAC regression in second differences:

newey2 d2m d2dsp d2dni d2v d2p d2di_1 d2ds, lag(0)

Regression with robust standard errors Number of obs = 488
maximum lag : 0 F(6, 481) = 21.82
Prob > F = 0.0000

Robust d2m	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
d2dsp	.1720674	.0620411	2.77	0.006	.0501624	.2939725
d2dni	.0019899	.0013222	1.51	0.133	-.000608	.0045879
d2v	-.0443729	.0220617	-2.01	0.045	-.0877222	-.0010236
d2p	-.1365968	.0148772	-9.18	0.000	-.1658291	-.1073646
d2di_1	.0014909	.0270971	0.06	0.956	-.0517523	.0547342
d2ds	.002579	.010538	0.24	0.807	-.0181271	.0232852
_cons	-.0233064	.0181401	-1.28	0.199	-.0589501	.0123374

Appendix 7f. Estimation of the Market Risk Premium.

The Market Risk Premium has been calculated based on the Standard & Poor's estimation[272], where the expected rate of return for an asset is:

Ke = Required return to equity = CAPAPM = Risk Free Rate + Company's Risk Premium

Ke = CAPAPM = Risk Free Rate + β_L*Market Risk Premium

Ke = CAPAPM = $R_F + \beta_L * P_M$

Market Risk Premium = $P_M = R_M - R_F$

Expected Return on the Market = $R_M = ((Price/Price_{-1})^4 - 1) * 100$

Risk Free Rate = R_F = 3 Month Treasury Bill rate

Quarters	Price-Close Monthly	TY-Return	T-Bill-3 Month	Market Risk Premium
Jun-91	371.16		5.54	
Sep-91	387.86	19.25	5.11	14.14
Dec-91	417.09	33.73	3.88	29.85
Mar-92	403.69	-12.24	4.05	-16.29
Jun-92	408.14	4.48	3.57	0.91
Sep-92	417.8	9.81	2.69	7.12
Dec-92	435.71	18.28	3.08	15.20
Mar-93	451.67	15.48	2.89	12.59
Jun-93	450.53	-1.01	3.03	-4.04
Sep-93	458.93	7.67	2.92	4.75
Dec-93	466.45	6.72	3.01	3.71
Mar-94	445.77	-16.59	3.48	-20.07
Jun-94	444.27	-1.34	4.15	-5.49
Sep-94	462.69	17.64	4.67	12.97
Dec-94	459.27	-2.92	5.53	-8.45
Mar-95	500.71	41.28	5.70	35.58
Jun-95	544.75	40.10	5.44	34.66
Sep-95	584.41	32.46	5.24	27.22
Dec-95	615.93	23.38	4.96	18.42
Mar-96	645.5	20.63	5.00	15.63
Jun-96	670.63	16.51	5.04	11.47
Sep-96	687.31	10.33	4.91	5.42
Dec-96	740.74	34.91	5.07	29.84
Mar-97	757.12	9.14	5.21	3.93
Jun-97	885.14	86.81	5.06	81.75
Sep-97	947.28	31.18	4.93	26.25
Dec-97	970.43	10.14	5.22	4.92
Mar-98	1,101.75	66.14	5.02	61.12
Jun-98	1,133.84	12.17	4.97	7.20
Sep-98	1,017.01	-35.27	4.26	-39.53
Dec-98	1,229.23	113.42	4.37	109.05
Mar-99	1,286.37	19.93	4.37	15.56
Jun-99	1,372.71	29.67	4.65	25.02
Sep-99	1,282.71	-23.76	4.74	-28.50
Dec-99	1,469.25	72.13	5.17	66.96
Mar-00	1,498.58	8.23	5.72	2.51
Jun-00	1,454.60	-11.23	5.71	-16.94
Sep-00	1,436.51	-4.88	6.05	-10.93
Dec-00	1,320.28	-28.64	5.73	-34.37
Mar-01	1,160.33	-40.34	4.20	-44.54
Jun-01	1,224.42	23.99	3.57	20.42
Sep-01	1,040.94	-47.76	2.35	-50.11
Dec-01	1,148.08	47.97	1.71	46.26
Mar-02	1,147.39	-0.24	1.76	-2.00
Jun-02	989.82	-44.62	1.67	-46.29
Sep-02	815.28	-53.97	1.54	-55.51
Dec-02	879.82	35.63	1.20	34.43
Mar-03	848.18	-13.63	1.12	-14.75
Jun-03	848.18	0.00	1.12	-1.12
			Total	385.92
			Observations	48
			Mean	8.04

272 Standard & Poor's Compustat, 1998, *Compustat (North America) Data Guide*, McGraw Hill, 26, 3.

Expected Return on the Market = R_M = Return on the S&P 500 Composite Ltd Index as a proxy for the market portfolio of all the risky assets, as quoted on Reilly, F. and Brown, K., 1997, *Investment Analysis and Portfolio Management*, fifth edition, page 293.

The Market Risk Premium estimated for the analysed period is 8.04, there are many recommendations: R. Brealey and S. Myers in their fifth edition-1996 Page 181 recommend an 8.4 based on past evidence. As quoted by T. Copeland, T. Koller and J. Murrin in their third edition, page 216, they were recommending between 4.5 and 5 percent. The market risk premium can vary between 3 to 8 percent depending on the analysed period and the method of calculation.

Appendix 8a. The Overall Performance Model Variables Description.

8.1 Return on Assets. Net Income to Total Assets ratio.

$$\text{Niat} = \frac{Net\ Income}{Assets\ Total} = \frac{NI}{AT} = \frac{x1*100}{x2}$$

8.2 Three-year Sales Growth.

$$\text{Compound Average Growth Rate (\%)} = \left[\left(\frac{Sales_t}{Sales_{t-3}}\right)^{1/3} - 1\right]*100$$

8.3 Cash Flow to Total Assets ratio.

$$\text{Cfat} = \frac{Cash\ Flow}{Assets\ Total} = \frac{CFL}{AT} = \frac{x4*100}{x2}$$

8.4 Total Assets to Sales ratio.

$$\text{Atsls} = \frac{Total\ Assets}{Sales} = \frac{AT}{SALE} = \frac{x2*100}{x3}$$

8.5 Long Term Debt to Total Assets ratio.

$$\text{Ltd} = \frac{Long\ Term\ Debt}{Total\ Assets} = \frac{DLTT}{AT} = \frac{x5*100}{x2}$$

8.6 Investment to Sales ratio.

$$\text{Invsls} = \frac{Investment}{Sales} = \frac{AT + DP - AT_{-1}}{SALE} = \frac{(x2 + x9 - x2_{-1})*100}{x3}$$

AT = Total Assets
DP = Depreciation and Amortization

The Total Invested Capital ICAPT or the addition of the Investment & Advances Equity Method-IVAEQ and Others-IVAO can be used as alternative variables. The problem is that we encounter many missing data, especially in the IVAEQ. In this case we miss 624 observations out of 988 in the panel data, this is missing 63% of the observations of the total, due to this issue we prefer to use the above mentioned variable. The main advantage is that the total assets include tangible and intangible assets.

8.7 Strategic Index. Stock of R&D Capital to Sales ratio.

Rd = $\frac{Stock\ of\ R\,\&\,D\ Capital}{Sales} = \frac{x15*100}{x3}$

The Stock of R&D Capital calculated as described in the Appendix nr 2.

8.8 Market Value to Sales ratio.

mkvas = $\frac{Market\,Value}{Sales} = \frac{MKVAL}{SALE} = \frac{x10*100}{x3}$

8.9 Created Shareholder Value

lcsv = log of the Created Shareholder Value adjusted by the GDP Implicit Price Deflator

Created Shareholder Value = $\ln\left(\frac{csv*100}{p}\right)$

Based on Fernandez (2002)[273] the Created shareholder value is equal to the excess of the shareholder value added over the equity market value adjusted by the required return to equity:

$CSV_t = SVA_t - (MV_{t-1}\ Ke_{t-1})$

where:

SVA_t = Shareholder Value Added

MV_t = Equity Market Value

CSV_t = Created Shareholder Value

Ke = Required return to equity

Shareholder Value Added = Change of the Market Value +Dividends paid +Other Payments to Shareholders (Buybacks,..) – Outlays by Shareholders – Convertible Debentures converted.

[273] Fernández, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academic Press, Elsevier Science, 1, 5-9.

8.10 Number of Employees.

We found 47% of the observations missing in the original database, and, due to this, we dropped this variable from the regressions. Finally, we adopted a long term panel data with 26 Companies and 38 years of data to make sure we profit of the scoring system in depth. We cannot accept the loss of 464 observations because of the number of employees variable.

If the main objective were more qualitative, then we would keep this variable, but in our case we could not loose so much information.

Appendix 8b. The Overall Performance Model. "areg" HCCM Heteroscedasticity-consistent Covariance Matrix for the fixed effects OLS estimator results. The augmented Dickey-Fuller test for a unit root. The Chow's Breakpoint and Forecast tests. The Hansen's test for parameter instability, and the Wooldridge's test for serial correlation.

$$\text{Scoring}_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$$

1. The "areg" HCCM estimator for the fixed effects OLS estimator.

. areg scores niat slsg3y rdstslsr invslsr lncsv, absorb(id) robust

Regression with robust standard errors Number of obs = 459
F(5, 428) = 137.07
Prob > F = 0.0000
R-squared = 0.8227
Adj R-squared = 0.8103
Root MSE = 6.286

Robust scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.767202	.1130118	15.64	0.000	1.545075	1.98933
slsg3y	.4722781	.0515745	9.16	0.000	.3709073	.573649
rdstslsr	.1542095	.0789855	1.95	0.052	-.0010382	.3094571
invslsr	.0657097	.0274302	2.40	0.017	.0117951	.1196244
lncsv	.3810775	.0376976	10.11	0.000	.3069822	.4551729
_cons	21.4232	2.199168	9.74	0.000	17.10069	25.74571

id absorbed (26 categories)

2. The augmented Dickey-Fuller test for a unit root

. dfuller uhat

Dickey-Fuller test for unit root Number of obs = 425

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-6.823	-3.446	-2.873	-2.570

* MacKinnon approximate p-value for Z(t) = 0.0000

3. The Chow's Breakpoint Test in Panel Data. Three periods: 1964-76, 1977-88 and 1989-2001.

. areg scores niat slsg3y invslsr lncsv pre* mid* post* C1 C2 c3, absorb(id) robust

Regression with robust standard errors

Number of obs =	459
F(14, 419) =	60.05
Prob > F =	0.0000
R-squared =	0.8303
Adj R-squared =	0.8145
Root MSE =	6.2155

scores	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.270629	.9209711	1.38	0.168	-.5396702	3.080928
slsg3y	-.2757472	.6963127	-0.40	0.692	-1.644448	1.092954
invslsr	.7346413	.4292291	1.71	0.088	-.1090694	1.578352
lncsv	.319078	.0739678	4.31	0.000	.1736837	.4644723
pre_niat	(dropped)					
pre_slsg3y	(dropped)					
pre_invslsr	(dropped)					
pre_lncsv	-.2215242	.2409076	-0.92	0.358	-.6950622	.2520138
mid_niat	.6494539	.9363413	0.69	0.488	-1.191058	2.489965
mid_slsg3y	.6749626	.699324	0.97	0.335	-.6996579	2.049583
mid_invslsr	-.603202	.430076	-1.40	0.161	-1.448577	.2421732
mid_lncsv	(dropped)					
post_niat	.4271893	.9278527	0.46	0.645	-1.396637	2.251015
post_slsg3y	.7316916	.699236	1.05	0.296	-.6427559	2.106139
post_invslsr	-.7002335	.430304	-1.63	0.104	-1.546057	.1455901
post_lncsv	.0925167	.0863273	1.07	0.284	-.0771719	.2622053
C1	3.249627	15.55607	0.21	0.835	-27.32803	33.82728
C2	(dropped)					
c3	4.150673	1.896484	2.19	0.029	.4228649	7.878481
_cons	21.93939	1.689635	12.98	0.000	18.61817	25.26061

id absorbed (26 categories)

. testparm pre* mid*

(1) pre_niat = 0
(2) pre_slsg3y = 0
(3) pre_invslsr = 0
(4) pre_lncsv = 0
(5) mid_niat = 0
(6) mid_slsg3y = 0
(7) mid_invslsr = 0
(8) mid_lncsv = 0
Constraint 1 dropped
Constraint 2 dropped
Constraint 3 dropped
Constraint 8 dropped

F(4, 419) = 2.07 < Critical F(0.05, 4, 419) = 2.39. The null hypothesis is not rejected at the 5% level. It is concluded that there is not a significant difference in response between the analysed first and second period.
Prob > F = 0.0845

. testparm pre* post*

(1) pre_niat = 0
(2) pre_slsg3y = 0
(3) pre_invslsr = 0
(4) pre_lncsv = 0
(5) post_niat = 0
(6) post_slsg3y = 0
(7) post_invslsr = 0
(8) post_lncsv = 0
Constraint 1 dropped
Constraint 2 dropped
Constraint 3 dropped

F(5, 419) = 3.66 > Critical F(0.05, 5, 419) = 2.23. The null hypothesis is rejected at the 5% level. It is concluded that there is a significant difference in response between the analysed first and third period.
Prob > F = 0.0030

. testparm mid* post*

(1) mid_niat = 0
(2) mid_slsg3y = 0
(3) mid_invslsr = 0
(4) mid_lncsv = 0
(5) post_niat = 0
(6) post_slsg3y = 0
(7) post_invslsr = 0
(8) post_lncsv = 0
Constraint 4 dropped

F(7,   419) =   2.55 > Critical F(0.05, 7, 419) = 2.03. The null hypothesis is rejected at the 5% level. It is concluded that there is a significant difference in response between the analysed second and third period.
Prob > F =   0.0140

. testparm pre* mid* post*

(1) pre_niat = 0
(2) pre_slsg3y = 0
(3) pre_invslsr = 0
(4) pre_lncsv = 0
(5) mid_niat = 0
(6) mid_slsg3y = 0
(7) mid_invslsr = 0
(8) mid_lncsv = 0
(9) post_niat = 0
(10) post_slsg3y = 0
(11) post_invslsr = 0
(12) post_lncsv = 0
Constraint 1 dropped
Constraint 2 dropped
Constraint 3 dropped
Constraint 8 dropped

F(8,   419) =   2.87 > Critical F(0.05, 8, 419) = 1.96. The null hypothesis is rejected at the 5% level. It is concluded that there is a significant difference in response among the analysed periods.
Prob > F =   0.0041

4. The Chow's Forecast test.

We estimate two models one using the complete set of data (1964-2001) and the other using the first and longer sample (1964-97). Prior to perform the Chow's forecast test, we need to implement the Goldfeld & Quandt test to validate that the panel data is homoskedastic. We suspect a breakpoint on 1998 and we may also suspect the constancy of the variance of the error terms in the two periods. The Goldfeld & Quandt test is the appropriate one to verify this type of heteroskedasticity. This is as follows:

RSS2 = 1987.57
RSS1 = 13929.13
T1 = 81
T2 = 378
K = 5

$$F1 = \frac{RSS_2}{RSS_1}\frac{(T_1 - k)}{(T_2 - k)} = 0.029 < \text{Critical F}(0.05, 373, 76) = 1.364$$

The null hypothesis of homoskedasticity is not rejected at the 5% level. We can conclude that the panel data is homoskedastic and we can apply the Chow's forecast test.

RSS = 17105.25
RSS_1 = 13929.13
T_1 = 378
T_2 = 81
K = 5

$$F2 = \frac{(RSS - RSS_1)}{RSS_1}\frac{(T_1 - k)}{T_2} = 1.05 < \text{Critical F}(0.5, 81, 373) = 1.311$$

The null hypothesis is not rejected at the 5% level. It is concluded that there is not a significant difference in response among the two analysed periods and there is no structural change for the analysed period and the coefficients are the same.

5. The Hansen's test for parameter instability in linear models

. drop if year>1982
(26 observations deleted)

. hansen scores niat slsg3y invslsr lncsv, regress
Annual data: 4 to 494 (37 obs)
Warning: sample has 21 gaps with 454 missing observations

Source	SS	df	MS
Model	3331.77008	4	832.942519
Residual	1163.11683	32	36.347401
Total	4494.88691	36	124.85797

Number of obs	= 37
F(4, 32)	= 22.92
Prob > F	= 0.0000
R-squared	= 0.7412
Adj R-squared	= 0.7089
Root MSE	= 6.0289

scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.167143	.2530442	4.61	0.000	.6517093	1.682578
slsg3y	.7197155	.1237159	5.82	0.000	.4677144	.9717166
invslsr	.0499455	.112563	0.44	0.660	-.1793378	.2792288
lncsv	.5676059	.1451281	3.91	0.000	.2719896	.8632222
_cons	20.69674	3.199384	6.47	0.000	14.17981	27.21368

Individual Statistics

niat = .61448673
slsg3y = .54116866
invslsr = .41770345
lncsv = .90906779
_cons = .535426
sigma = .10880056

Joint test statistic with 6 degrees of freedom:

Statistic_Lc = 1.6518634 < Critical value $L_c(6)$=1.68. The null hypothesis of model stability is not rejected at the 5% level and the model is stable for the period 1964 till 1982

.

6. The Wooldridge's test for serial correlation

. xtserial scores niat slsg3y rdstslsr invslsr lncsv, output

Regression with robust standard errors	Number of obs = 425
	F(5, 25) = 56.09
	Prob > F = 0.0000
	R-squared = 0.6058
Number of clusters (id) = 26	Root MSE = 7.2265

Robust D.scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
niat						
D1	1.827726	.2044847	8.94	0.000	1.406581	2.24887
slsg3y						
D1	.3881533	.0870109	4.46	0.000	.2089511	.5673555
rdstslsr						
D1	-.3778714	.2062651	-1.83	0.079	-.8026824	.0469396
invslsr						
D1	.0588861	.0167382	3.52	0.002	.0244131	.0933591
lncsv						
D1	.2778507	.0412334	6.74	0.000	.192929	.3627724

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
F(1, 25) = 9.301
Prob > F = 0.0054

Critical F(1, 25) = 4.24 < F(1, 25) = 9.301 the null hypothesis of no first order autocorrelation is rejected and the idiosyncratic errors show first order autocorrelation in the panel data.

6. The Augmented Dickey-Fuller test

THE OVERALL PERFORMANCE MODEL
AUGMENTED DICKEY FULLER TEST

	Levels		1st- Differences		2nd- Differences	
Variables	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic	t-Statistic	D-W Statistic
scores	-7.610	1.956	-17.823	1.970	-23.470	2.057
niat	-6.743	1.997				
slsg3y	-9.022	1.977	-15.300	1.996		
rdstslsr	-4.767	2.008				
invslsr	-7.237	1.953	-18.440	1.920	-24.914	1.956
lncsv	-8.509	1.933	-12.769	1.972	-15.356	2.196
1% Critical Va	-3.965					
5% Critical Va	-3.413					
10% Critical V	-3.128					

We assume 4 lags, a constant and a trend
Ho: there is a unit root in the time series (non-stationary)
We reject the null hypothesis for all the time series, excepts (scores, slsg3y, invslsr and lncsv)

7. Panel data unit-root test. Im-Pesaran-Shin type

xtunitroot ips scores, trend lags(4) demean
Im-Pesaran-Shin unit-root test for scores

Ho: All panels contain unit roots   Number of panels = 26
Ha: Some panels are stationary   Avg. number of periods = 35.04

AR parameter: Panel-specific   Asymptotics: T,N -> Infinity
Panel means: Included   sequentially
Time trend: Included   Cross-sectional means removed

ADF regressions: 4 lags

	Statistic	p-value
W-t-bar	-1.8873	0.0296

The p-value=0.0296 < 0.050, we reject the null hypothesis that all series contain a unit root in favour of the alternative that a nonzero fraction of the panels represent stationary processes.

8. Panel data unit-root test. Fisher-type test.

xtunitroot fisher scores, dfuller trend lags(4) demean
Fisher-type unit-root test for scores
Based on augmented Dickey-Fuller tests

Ho: All panels contain unit roots   Number of panels = 26
Ha: At least one panel is stationary   Avg. number of periods = 35.04

AR parameter: Panel-specific   Asymptotics: T -> Infinity
Panel means: Included
Time trend: Included   Cross-sectional means removed
Drift term: Not included   ADF regressions: 4 lags

		Statistic	p-value
Inverse chi-squared(52)	P	62.7096	0.1469
Inverse normal	Z	-1.1805	0.1189
Inverse logit t(134)	L*	-1.3260	0.0935
Modified inv. chi-squared	Pm	1.0502	0.1468

P statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels.
The p-value=0.1469 > 0.050. The null hypothesis that all the panels contain unit roots cannot be rejected

9. Johansen Cointegration test

Date: 01/10/10 Time: 13:22
Sample(adjusted): 9 988
Included observations: 314
Excluded observations: 666 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: SCORES SLSG3Y INVSLSR LNCSV
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.213406	153.5115	47.21	54.46
At most 1 **	0.101618	78.13798	29.68	35.65
At most 2 **	0.086561	44.48981	15.41	20.04
At most 3 **	0.049862	16.06050	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at both 5% and 1% levels

The normalized cointegration equation is:

3 Cointegrating Equation(s):	Log likelihood		-4324.871
Normalized cointegrating coefficients (std.err. in parentheses)			
SCORES	SLSG3Y	INVSLSR	LNCSV
1.000000	0.000000	0.000000	-8.541285
			(0.81624)
0.000000	1.000000	0.000000	-3.098802
			(0.47674)
0.000000	0.000000	1.000000	-17.99801
			(2.44521)
Adjustment coefficients (std.err. in parentheses)			
D(SCORES)	-0.270822	-0.000864	0.110040
	(0.09293)	(0.09602)	(0.02895)
D(SLSG3Y)	0.039693	-0.172185	0.009589
	(0.03572)	(0.03691)	(0.01113)
D(INVSLSR)	0.537167	-0.387110	-0.165596
	(0.16058)	(0.16592)	(0.05003)
D(LNCSV)	0.080554	0.039300	0.028138
	(0.07427)	(0.07673)	(0.02314)

10. Engle and Granger test

reg scores slsg3y invslsr lncsv

Source	SS	df	MS
Model	40289.502	3	13429.834
Residual	55120.0125	455	121.142885
Total	95409.5145	458	208.317717

Number of obs	= 459
F(3, 455)	= 110.86
Prob > F	= 0.0000
R-squared	= 0.4223
Adj R-squared	= 0.4185
Root MSE	= 11.006

scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
slsg3y	.5601817	.0408675	13.71	0.000	.4798692	.6404942
invslsr	.0844684	.0306448	2.76	0.006	.0242454	.1446913
lncsv	.5745076	.0671531	8.56	0.000	.4425389	.7064762
_cons	36.77909	.7727172	47.60	0.000	35.26055	38.29762

reg dehat ehat_1

Source	SS	df	MS
Model	3933.94874	1	3933.94874
Residual	17250.6009	423	40.7815623
Total	21184.5496	424	49.9635604

Number of obs	=	425
F(1, 423)	=	96.46
Prob > F	=	0.0000
R-squared	=	0.1857
Adj R-squared	=	0.1838
Root MSE	=	6.386

dehat	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
ehat_1	-.3323362	.0338373	-9.82	0.000	-.3988463	-.2658261
_cons	14.76741	1.604415	9.20	0.000	11.61379	17.92103

11. VECM estimates

Vector Error Correction Estimates
Date: 01/10/10 Time: 13:55
Sample(adjusted): 7 988
Included observations: 368
Excluded observations: 614 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1,B(2,2)=1,B(3,3)=1,B(1,2)=0,B(1,3)=0,
B(2,1)=0,B(2,3)=0,B(3,1)=0,B(3,2)=0,A(2,2)=0
Convergence achieved after 40 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 3):
Chi-square(1) 0.001888
Probability 0.965339

Cointegrating Eq:	CointEq1	CointEq2	CointEq3
SCORES(-1)	1.000000	0.000000	0.000000
SLSG3Y(-1)	0.000000	1.000000	0.000000
INVSLSR(-1)	0.000000	0.000000	1.000000
LNCSV(-1)	-5.476119	-11.11554	-11.82662
	(0.45965)	(1.02741)	(1.16543)
	[-11.9138]	[-10.8190]	[-10.1478]
C	-27.47159	29.26784	25.74983

Error Correction:	D(SCORES)	D(SLSG3Y)	D(INVSLSR)	D(LNCSV)
CointEq1	-1.058857	-0.167424	-0.089498	-0.156944
	(0.06372)	(0.02947)	(0.13659)	(0.06308)
	[-16.6182]	[-5.68044]	[-0.65524]	[-2.48793]
CointEq2	0.396708	0.000000	0.519707	0.200564
	(0.04660)	(0.00000)	(0.10247)	(0.04999)
	[8.51279]	[NA]	[5.07193]	[4.01226]
CointEq3	0.088394	0.067477	-0.473114	-0.023411
	(0.03680)	(0.01263)	(0.07980)	(0.03783)
	[2.40230]	[5.34381]	[-5.92908]	[-0.61892]
D(SCORES(-1))	0.220055	0.249301	0.240849	0.113142
	(0.06226)	(0.03357)	(0.13222)	(0.05969)
	[3.53427]	[7.42684]	[1.82159]	[1.89544]
D(SCORES(-2))	0.200998	0.188171	0.048293	0.018357
	(0.05226)	(0.02817)	(0.11097)	(0.05010)
	[3.84628]	[6.67898]	[0.43518]	[0.36640]
D(SLSG3Y(-1))	-0.143552	0.011171	-0.369275	-0.107942
	(0.10189)	(0.05493)	(0.21638)	(0.09769)
	[-1.40882]	[0.20334]	[-1.70660]	[-1.10498]
D(SLSG3Y(-2))	-0.178485	-0.085387	-0.055885	-0.109988
	(0.09122)	(0.04918)	(0.19370)	(0.08745)
	[-1.95674]	[-1.73634]	[-0.28851]	[-1.25775]
D(INVSLSR(-1))	-0.012954	-0.022019	-0.422724	-0.000347
	(0.04042)	(0.02179)	(0.08583)	(0.03875)
	[-0.32049]	[-1.01047]	[-4.92509]	[-0.00895]
D(INVSLSR(-2))	-0.010905	0.005339	-0.206936	-0.051127
	(0.03288)	(0.01773)	(0.06983)	(0.03153)
	[-0.33163]	[0.30117]	[-2.96345]	[-1.62180]
D(LNCSV(-1))	-0.088545	-0.075298	-0.312683	0.050419
	(0.09789)	(0.05278)	(0.20788)	(0.09385)
	[-0.90452]	[-1.42676]	[-1.50417]	[0.53725]
D(LNCSV(-2))	0.011876	-0.063730	-0.126742	0.029468
	(0.06585)	(0.03550)	(0.13983)	(0.06313)
	[0.18037]	[-1.79521]	[-0.90641]	[0.46681]
C	-12.21091	-1.729543	-0.865774	-2.475480
	(1.00810)	(0.54349)	(2.14075)	(0.96646)
	[-12.1128]	[-3.18228]	[-0.40442]	[-2.56139]
NIAT	1.439284	0.195236	-0.063830	0.332760
	(0.09736)	(0.05249)	(0.20676)	(0.09334)
	[14.7827]	[3.71942]	[-0.30872]	[3.56497]
RDSTSLSR	-0.021882	-0.017088	0.027087	-0.035755
	(0.02883)	(0.01554)	(0.06123)	(0.02764)
	[-0.75892]	[-1.09928]	[0.44239]	[-1.29351]

R-squared	0.538419	0.275118	0.387407	0.512021
Adj. R-squared	0.521468	0.248498	0.364910	0.494100
Sum sq. resids	22644.94	6581.916	102117.6	20813.01
S.E. equation	7.998046	4.311958	16.98434	7.667712
F-statistic	31.76376	10.33502	17.22086	28.57233
Log likelihood	-1280.177	-1052.825	-1557.316	-1264.655
Akaike AIC	7.033573	5.797962	8.539761	6.949215
Schwarz SC	7.182250	5.946639	8.688439	7.097892
Mean dependent	-0.498446	-0.368402	-0.821554	-0.335443
S.D. dependent	11.56188	4.974042	21.31234	10.78037
Determinant Residual Covariance		10536289		
Log Likelihood		-5035.473		
Log Likelihood (d.f. adjusted)		-5064.019		
Akaike Information Criteria		27.89141		
Schwarz Criteria		28.61356		

12. Engle-Granger 2-step method

reg D.scores D.slsg3y D.invslsr D.lncsv

Source	SS	df	MS		
				Number of obs =	425
				F(3, 421) =	32.04
Model	10336.0019	3	3445.33396	Prob > F =	0.0000
Residual	45274.0139	421	107.539225	R-squared =	0.1859
				Adj R-squared =	0.1801
Total	55610.0158	424	131.155698	Root MSE =	10.37

D.scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
slsg3y						
D1	.7240184	.0965704	7.50	0.000	.5341981	.9138386
invslsr						
D1	.0376623	.0251986	1.49	0.136	-.0118685	.0871931
lncsv						
D1	.2864375	.0480241	5.96	0.000	.1920407	.3808344
_cons	.3282901	.5068488	0.65	0.518	-.6679793	1.324559

dfuller ehat, regress lags(4) trend
Augmented Dickey-Fuller test for unit root Number of obs = 288

	---------- Interpolated Dickey-Fuller ---------			
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.827	-3.988	-3.428	-3.130

* MacKinnon approximate p-value for Z(t) = 0.0000

reg D2.scores D2.niat D2.slsg3y D2.rdstslsr D2.invslsr D2.lncsv ehat_1

Source	SS	df	MS
Model	69707.2647	6	11617.8774
Residual	51114.2917	389	131.399207
Total	120821.556	395	305.877358

Number of obs = 396
F(6, 389) = 88.42
Prob > F = 0.0000
R-squared = 0.5769
Adj R-squared = 0.5704
Root MSE = 11.463

D2.scores	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
niat						
D2	1.752097	.0939325	18.65	0.000	1.567419	1.936776
slsg3y						
D2	.3987001	.1245823	3.20	0.001	.1537613	.643639
rdstslsr						
D2	-.6047723	.2098999	-2.88	0.004	-1.017452	-.1920922
invslsr						
D2	.0519927	.018127	2.87	0.004	.0163536	.0876319
lncsv						
D2	.2183997	.0409348	5.34	0.000	.1379185	.2988809
ehat_1	-.2120185	.1751036	-1.21	0.227	-.5562865	.1322494
_cons	-.4649414	.5770968	-0.81	0.421	-1.59956	.6696776

13. Pairwise Granger causality test

Pairwise Granger Causality Tests
Date: 12/20/09 Time: 17:05
Sample: 1 988
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
NIAT does not Granger Cause SCORES	858	4.25394	0.01451
SCORES does not Granger Cause NIAT		13.9907	1.1E-06
SLSG3Y does not Granger Cause SCORES	807	1.94821	0.14320
SCORES does not Granger Cause SLSG3Y		26.7578	5.6E-12
RDSTSLSR does not Granger Cause SCORES	858	3.97854	0.01906
SCORES does not Granger Cause RDSTSLSR		13.4682	1.7E-06
INVSLSR does not Granger Cause SCORES	858	0.76937	0.46363
SCORES does not Granger Cause INVSLSR		6.09063	0.00236
LNCSV does not Granger Cause SCORES	401	12.5003	5.4E-06
SCORES does not Granger Cause LNCSV		0.39315	0.67519

14. Model re-estimation

newey2 d2scores d2niat d2slsg3y d2rdstslsr d2invslsr d2lncsv, lag(1) force

```
Regression with Newey-West standard errors          Number of obs  =     396
maximum lag : 1                                        F( 5,  390)  =   37.66
                                                       Prob > F     =  0.0000

Newey-West
d2scores      Coef.      Std. Err.     t      P>t     [95% Conf. Interval]
-----------------------------------------------------------------------------
d2niat       1.756917   .1758125    9.99   0.000    1.411258    2.102576
d2slsg3y     .472882    .1347359    3.51   0.001    .2079824    .7377816
d2rdstslsr  -.5830842   .3489266   -1.67   0.096   -1.269097    .1029283
d2invslsr    .0564139   .0192935    2.92   0.004    .0184816    .0943462
d2lncsv      .2494379   .0373197    6.68   0.000    .176065     .3228109
_cons       -.4321849   .3912249   -1.10   0.270   -1.201359    .3369889
-----------------------------------------------------------------------------
```

newey2 d2scores d2niat d2slsg3y d2invslsr d2lncsv, lag(1) force

Regression with Newey-West standard errors	Number of obs =	396
maximum lag : 1	F(4, 391) =	41.55
	Prob > F =	0.0000

Newey-West d2scores	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
d2niat	1.814098	.1685284	10.76	0.000	1.482763	2.145433
d2slsg3y	.6324777	.1091291	5.80	0.000	.4179245	.8470309
d2invslsr	.0546092	.0197678	2.76	0.006	.0157447	.0934737
d2lncsv	.2482477	.0375936	6.60	0.000	.1743369	.3221585
_cons	-.4539073	.3965288	-1.14	0.253	-1.233503	.3256879

xtserial d2scores d2niat d2slsg3y d2rdstslsr d2invslsr d2lncsv

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
F(1, 24) = 20.680
Prob > F = 0.0001

xtreg d2scores d2niat d2slsg3y d2rdstslsr d2invslsr d2lncsv, re

Random-effects GLS regression		Number of obs =	396
Group variable (i): id		Number of groups =	26
R-sq: within = 0.5806		Obs per group: min =	1
between = 0.2878		avg =	15.2
overall = 0.5753		max =	33
Random effects u_i ~ Gaussian		Wald chi2(5) =	528.40
corr(u_i, X) = 0 (assumed)		Prob > chi2 =	0.0000

d2scores	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
d2niat	1.756917	.0939042	18.71	0.000	1.572868	1.940966
d2slsg3y	.472882	.1085417	4.36	0.000	.2601442	.6856198
d2rdstslsr	-.5830842	.2092591	-2.79	0.005	-.9932245	-.1729438
d2invslsr	.0564139	.0177661	3.18	0.001	.0215931	.0912347
d2lncsv	.2494379	.0319338	7.81	0.000	.1868488	.3120271
_cons	-.4321849	.5768067	-0.75	0.454	-1.562705	.6983355
sigma_u	0					
sigma_e	11.727155					
rho	0	(fraction of variance due to u_i)				

. xttest0
Breusch and Pagan Lagrangian multiplier test for random effects:

d2scores[id,t] = Xb + u[id] + e[id,t]

Estimated results:

	Var	sd = sqrt(Var)
d2scores	305.8774	17.48935
e	137.5262	11.72715
u	0	0

Test: Var(u) = 0
chi2(1) = 10.46
Prob > chi2 = 0.0012

Appendix 8c. The Overall Performance Model. "Newey2" HAC- Heteroscedasticity and Autocorrelation Consistent Covariance matrix estimator results.

$\text{Scoring}_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}$

1. The Newey-West HAC covariance matrix estimator with lags 0, 1 and 2.

. newey2 scores niat slsg3y invslsr lncsv, lag(0)

Regression with robust standard errors Number of obs = 459
maximum lag : 0 F(4, 454) = 286.48
Prob > F = 0.0000

scores	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.479919	.0764528	19.36	0.000	1.329674	1.630165
slsg3y	.3024311	.0635199	4.76	0.000	.1776016	.4272607
invslsr	.0830972	.0288461	2.88	0.004	.0264087	.1397856
lncsv	.405712	.0435894	9.31	0.000	.32005	.491374
_cons	28.04928	.7415724	37.82	0.000	26.59194	29.50662

The Newey-West variance estimator with autocorrelation up to and including a first and second lag. This assumes that any autocorrelation at lags greater than two can be ignored.

. newey2 scores niat slsg3y invslsr lncsv, lag(1) force

Regression with Newey-West standard errors Number of obs = 459
maximum lag : 1 F(4, 454) = 224.63
Prob > F = 0.0000

scores	Coef.	Newey-West Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.479919	.0877062	16.87	0.000	1.307559	1.65228
slsg3y	.3024311	.0725384	4.17	0.000	.1598784	.4449838
invslsr	.0830972	.0299399	2.78	0.006	.0242592	.1419352
lncsv	.405712	.0422506	9.60	0.000	.3226809	.4887431
_cons	28.04928	.8037888	34.90	0.000	26.46967	29.62889

. newey2 scores niat slsg3y invslsr lncsv, lag(2) force

Regression with Newey-West standard errors Number of obs = 459
maximum lag : 2

F(4, 454) = 200.43
Prob > F = 0.0000

Scores	Coef.	Newey-West Std. Err.	t	P>t	[95% Conf.	Interval]
niat	1.479919	.0962962	15.37	0.000	1.290678	1.669161
slsg3y	.3024311	.0812585	3.72	0.000	.1427417	.4621206
invslsr	.0830972	.0312126	2.66	0.008	.021758	.1444363
lncsv	.405712	.0418476	9.69	0.000	.3234729	.4879511
_cons	28.04928	.8381754	33.46	0.000	26.40209	29.69646

Appendix 8d. The Overall Performance Model. The Prais-Winsten model with panel-corrected errors.

$$\text{Scoring}_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \quad \text{where} \quad \varepsilon_{it} = \rho\, \varepsilon_{i,t-1} + \eta_{it}$$

1. The Prais-Winsten Regression

a. Panel-specific AR(1) autocorrelation

. xtpcse scores niat slsg3y invslsr lncsv, correlation(psar1) hetonly

Number of gaps in sample: 8
(note: computations for rho restarted at each gap)

Prais-Winsten regression, heteroskedastic panels corrected standard errors

Group variable: id	Number of obs = 459
Time variable: year	Number of groups = 26
Panels: heteroskedastic (unbalanced)	Obs per group: min = 3
Autocorrelation: panel-specific AR(1)	avg = 17.65385
	max = 35
Estimated covariances = 26	R-squared = 0.8274
Estimated autocorrelations = 26	Wald chi2(4) = 915.13
Estimated coefficients = 5	Prob > chi2 = 0.0000

	Coef.	Het-corrected Std. Err.	z	P>z	[95% Conf. Interval]	
niat	1.762156	.0817682	21.55	0.000	1.601893	1.922419
slsg3y	.268088	.0618976	4.33	0.000	.1467711	.389405
invslsr	.0582457	.0171259	3.40	0.001	.0246796	.0918119
lncsv	.3221434	.0345705	9.32	0.000	.2543865	.3899003
_cons	27.25314	.7826427	34.82	0.000	25.71919	28.78709

rhos = .6655463 .2385379 .2189805 .2680098 .6772625 ... .5578486

b. Common AR(1) autocorrelation

. xtpcse scores niat slsg3y invslsr lncsv, correlation(ar1) hetonly

Number of gaps in sample: 8
(note: computations for rho restarted at each gap)

Prais-Winsten regression, heteroskedastic panels corrected standard errors

Group variable: id		Number of obs =	459
Time variable: year		Number of groups =	26
Panels: heteroskedastic (unbalanced)		Obs per group: min =	3
Autocorrelation: common AR(1)		avg =	17.65385
		max =	35
Estimated covariances =	26	R-squared =	0.6829
Estimated autocorrelations =	1	Wald chi2(4) =	814.24
Estimated coefficients =	5	Prob > chi2 =	0.0000

	Coef.	Het-corrected Std. Err.	z	P>z	[95% Conf. Interval]	
niat	1.680867	.0850919	19.75	0.000	1.51409	1.847644
slsg3y	.2824864	.0653449	4.32	0.000	.1544128	.41056
invslsr	.0631896	.0195909	3.23	0.001	.0247921	.1015871
lncsv	.3076982	.0371683	8.28	0.000	.2348497	.3805468
_cons	26.93296	.9041865	29.79	0.000	25.16079	28.70513
rho	.4447615					

Appendix 8e. The Overall Performance Model. The Fixed Effects (within) linear model with an AR(1) disturbance

$$\text{Scoring}_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \quad \text{where} \quad \varepsilon_{it} = \rho\, \varepsilon_{i,t-1} + \eta_{it}$$

1. The Fixed Effects (within) linear model with an AR(1) disturbance

. xtregar scores niat slsg3y invslsr lncsv, fe lbi

```
FE (within) regression with AR(1) disturbances  Number of obs      =     433
Group variable (i): id                          Number of groups   =      26

R-sq:  within  = 0.6503                         Obs per group: min =       2
       between = 0.8527                                        avg =    16.7
       overall = 0.7459                                        max =      34

                                                F(4,403)           =  187.32
corr(u_i, Xb)  = -0.5272                        Prob > F           =  0.0000

scores        Coef.   Std. Err.      t    P>t     [95% Conf. Interval]
-----------------------------------------------------------------------------
niat       1.810311   .0868707   20.84   0.000    1.639535    1.981087
slsg3y     .4703951   .0541862    8.68   0.000    .3638721    .5769181
invslsr    .0568728   .0177653    3.20   0.001    .0219486    .0917969
lncsv      .3213197   .035989     8.93   0.000    .25057      .3920695
_cons      24.88305   .603177    41.25   0.000    23.69728    26.06882
-----------------------------------------------------------------------------
rho_ar    .35059457
sigma_u   7.2716998
sigma_e   5.9462822
rho_fov   .59927562   (fraction of variance due to u_i)
-----------------------------------------------------------------------------
F test that all u_i=0:     F(25,403) =     3.76          Prob > F = 0.0000
modified Bhargava et al. Durbin-Watson = 1.3632863
Baltagi-Wu LBI = 1.5598144
-----------------------------------------------------------------------------
```

Appendix 9. Initial Investigation

The main general activities performed for the empirical research during the initial investigation have been:

1. Activity report. I was sending a report of activities every month and a half to my Supervisors (F. FitzRoy and G. Reid) during the first and second year. This activity was discontinued during the third year due to the difficulties in cleaning the databases downloaded from Standard and Poor's – Backdata and Compustat, specially the Bankruptcy Database.

1. Databases. The main acquired databases for the empirical research have been:
   - Standard and Poor's. Backdata- historical database back to 1962. The Research and Development expenditures were separately franchised for the S&P 100 and the period 1960-2002
   - IBES-First Call Thomson. Forward EPS diluted excl. extraordinary items covering the S&P 500 and back to 1960 for annual, and 1982 for quarterly data
   - Stearn Stewart- Value Vault Database. EVA, and MVA quarterly data covering the S&P100 and back to 1982

2. Software. The main acquired software has been:
   - Research Insight 7.8 from Standard and Poor's
   - eViews 4.0. The main advantage is the possibility to regress panel data with specific coefficients by cross section without defining dummies
   - Stata 8.0. It includes all the Arellano-Bond panel-data dynamic estimators. I received personalised training conducted by Prof Josep Mestres at the Pompeu Fabra University in Barcelona

3. Website Working Papers search. The main sites have been:
   - Jstor used mainly for the Journal of Economics, Banking and Finance, Applied Econometrics, Industrial Economics and Political Economy.
   - NBER used mainly for all the Patents, Productivity and R&D working papers. Z. Griliches, B. Hall, J. Mairesse, A. Jaffe, and A. Pakes.
   - Wopec – EconPapers used mainly for the working papers on Shareholder Value.
   - Science Direct – Elsevier used for all kind of working papers

All based on the Athens password supplied by the IT Department of the University of St Andrews.

4. Corporate Management Meetings. The main personal meetings were conducted at the beginning of the research. The people interviewed were:

Company	Meeting with:	Responsibility	Industry
Terra Networks	Joaquim Agut	CEO worldwide	Telecom
Gen. Electric PC	Mike Popielec	CEO worldwide	Electrical
American Standard	Francisco Vilagut	CEO Spain	Consumers
Goldman Sachs	Antonio López	Derivatives London	Private Equity
Gas Natural	Carlos Miravent	Marketing Director	Energy
Invercaixa Bolsa	Pere Mateu	Managing Director	Brokerage
Terasaki	Jaume Baldé	CEO Spain	Electrical
Grundig	Lorenzo Ricci	CEO Spain	Consumers
Almirall Laboratories	Pere Berga	R&D Director	Pharma

Table 9.1 Analysis of Customer expectations on the empirical research.

Meetings conducted in 1st,Qtr.,2003.

The main comments were:

1. They would like to see the results of the regression of specific coefficients by cross section at the level of the sector and benchmarking the key competitors, with the objective to understand the behaviour of the competition.
1. They would be interested if we could include the Look forward EPS measure in the Market Value model.
2. You need to find out if a model could include a way to prioritise investments for new Setups.
3. Felix FitzRoy was teaching me on the Stock of R&D Capital in Feb., 2003 and I found many people interested in knowing about it, mainly in the Pharmaceutical Industry (Almirall, J. Uriach, etc..)

6. <u>Academic Personal Meetings.</u>

University	Meeting with:	Comments:
University of St Andrews	Felix Fitzroy	Supervisor
University of St Andrews	Gavin Reid	Supervisor
CEMFI- Bank of Spain	Manuel Arellano	* He recommended instrumental variables for the System GMM on levels not first differences. * Use IV Stacked Anderson-Hsiao first differenced if problems with large panel-data for dynamic models, instead of the GMM option.
Center for Global Development	David Roodman	* He wrote the xtabond- Arellano-Bond estimators for STATA. I requested many items, and he was always very supportive.
UAB - University Autonomous of Barcelona	Manuel Delfino & Mª Paz de Andrés.	* They deployed a special PC with 3.5 MB RAM memory to run the large panel data Arellano-Bond estimators.
STATA Customer Service	Gustavo Sánchez & Brian Poi. PhDs.	* I have contacted them many times. They were key in the cleaning of the main databases, and the identification of special commands.

Table 9.2 Academic Personal meetings.

Appendix 10. Implications of the Results for Corporate Management

10.a The Sales Model

Our research has been based on the implications of the main processes to the contribution to the Sales. We develop a breakdown of long and short-term actions (sub-processes) to keep on a track leading to a successful management. This list of actions allows us to close the loop between the importance of discriminating the long-term (1^{st}-lag) and short-term (1^{st}-diff.) variables, as well as differentiating the processes to be managed in daily basis in a practical way. The list has been built based on the most relevant basic economic literature. These are:

<u>Business Process. Market Situation:</u>

Long-term actions.

- GPD's international evolution
- National economy, new government rules, and economic indicators

Short-term actions.

- Interest rates, etc..
- Foreign exchange: currency rates, etc..

<u>Business Process. Resources:</u>

Long-term actions:

- Market Shares by geography, by product ranges and cross selling, by distribution channel, and by key accounts.
- Estimated market shares for the new market segments.
- Balanced deployment of the Salesforce (Syntex model) by District Offices.

Short-term actions:

- Sales Gaps to budgets by geography, by product ranges and cross selling, by distribution channel, and by key accounts.
- Sales Gaps to budgets by new market segments.
- Teleconferences: follow-up of weekly orders/sales, competition, opportunities, internal District Offices needs, and issues.

- Size of current resources (salesforce, customer service, etc..) to generate sales and provide support to the market.

Business Process. Research & Development:

Long-term actions:

- Set up a team of New Products Development & Introduction composed by people from Technology, Marketing and Business Development (M&A-Mergers & Acquisitions) with the objective to implement the Long-term Product Planning.
- Long-term Product Planning. Evaluate market needs and select projects based on the best estimated NPV-Net Present Values, IRR-Internal Rate of Returns, and Pay-back periods.
- Process Innovation Projects (longer than one year), and quick reaction to short-term opportunities.
- Outsourced products filling product gaps.

Short-term actions:

- Follow-up of the sales generated from the New Products Introduction already launched. Track the current percentage of sales coming from the last 3 years of the New Products Introductions.
- Follow-up of Sales coming from the short-term opportunities provided mainly by the Salesforce, and the outsourced products.
- Size of the current resources (technology,..) to support the Ongoing & New Products Development, short-term opportunities, and outsourced products.

Business Process. Investments:

Long-term actions:

- Identify the Investment needs of the current Business in working capital and fixed capital (Cash flow needs, IT Equipment, P&E-Plant & Equipment, Research & Development, and new P&E green-field operations)
- Identify potential Competition to be acquired. The new Mergers & Acquisitions must provide new geographical coverage (market access) or new additional product ranges.
- Identify potential Companies to be acquired providing new lines of Businesses unrelated to the Core.

Short-term actions:

- Follow-up of the current status of the programmed investments in working capital and fixed capital (Cash flow needs, IT Equipment, P&E, R&D, and new P&E Green-field projects).
- Follow-up of the current sales coming from the acquired Companies (geographical, new products based, and unrelated to the core businesses) against the targeted budgets.
- Identify the Directors and deploy resources to be dedicated to due diligence, closing of the acquisition, and integration.

10.b The Profit-Cash Flow Model

Our research has been based on the implications of the main processes to the contribution to the company profitability. Based on the main results of our research we develop a breakdown of long and short-term actions (sub-processes) to keep on a track leading to a successful management. This list of actions allows us to close the loop between the importance of discriminating the long-term (1^{st}-lag) and short-term (1^{st}-diff.) variables, as well as differentiating the processes to be managed in a daily basis in a practical way. The list has been built based on the most relevant basic economic literature. These are:

<u>Business Process. Market Situation:</u>

Long-term actions.

- GPD's international evolution
- National economy, new government rules, and economic indicators

Short-term actions.

- Interest rates, etc…
- Foreign exchange: currency rates, etc…

<u>Business Process. Sales:</u>

Long-term actions:

- Market Shares by geography, by product ranges and cross selling, by distribution channel, and by key accounts
- Estimated market shares for the new market segments

- Balanced deployment of the Salesforce (Syntex model) by District Offices

Short-term actions:

- Sales Gaps to budgets by geography, by product ranges and cross selling, by distribution channel, and by key accounts
- Sales Gaps to budgets by new market segments
- Teleconferences: follow-up of weekly orders/sales, competition, opportunities, internal District Offices needs, and issues
- Size of current resources (salesforce, customer service, etc..) to generate sales and provide support to the market

<u>Business Process. Research & Development:</u>

Long-term actions:

- Set up a team of New Products Development & Introduction composed by people from Technology, Marketing and Business Development (M&A-Mergers & Acquisitions) with the objective to implement the Long-term Product Planning
- Long-term Product Planning. Evaluate market needs and select projects based on the best estimated NPV-Net Present Values, IRR-Internal Rate of Returns, and Pay-back periods
- Process Innovation Projects (longer than one year), and quick reaction to short-term opportunities
- Outsourced products filling product gaps

Short-term actions:

- Follow-up of the sales generated from the New Products Introduction already launched. Track the current percentage of sales coming from the last 3 years of the New Products Introductions
- Follow-up of Sales coming from the short-term opportunities provided mainly by the Salesforce, and the outsourced products
- Size of the current resources (technology,..) to support the Ongoing & New Products Development, short-term opportunities, and outsourced products

<u>Business Process. Variable Cost Productivity:</u>

Long-term actions:

- Set up annual VCP target based on the Business needs, and potential projects
- Set up annual Direct Material, Direct Labour, and Overhead targets
- Clarify funded Programmes, Projects Deck, and carryover targets
- New Products Introduction impact
- Low cost Manufacturing sites
- Pruning of obsolete, end life & low sales product ranges targets
- Resale and Outsourced Products Material Deflation
- Size of the current resources (finance, manufacturing,..) to support the VCP projects follow-up

Short-term:

- Weekly VCP reviews with the Manufacturing, R&D Technology, Finance, Supply Chain and Marketing teams
- VCP reviews tracking the carryover, execution, and mix
- Review execution of the VCP Projects Deck, Labour Planning, Project Identification, and Approvals
- Review the Small Process Innovations
- Review the Mix Calculations
- Keep track of unusual events
- Review the Resale and Outsourced Products Material Deflation
- Size of the current resources to support the weekly and monthly reviews

<u>Business Process. Investments:</u>

Long-term actions:

- Identify the Investment needs of the current Business in working capital and fixed capital (cash flow needs, IT Equipment, P&E-Plant & Equipment, Research & Development, and new P&E green-field operations)
- Identify potential Competition to be acquired. The new Mergers & Acquisitions must provide new geographical coverage (market access) or new additional product ranges
- Identify potential Companies to be acquired providing new lines of Businesses unrelated to the Core

Short-term actions:

- Follow-up of the current status of the programmed investments in working capital and fixed capital (cash flow needs, IT Equipment, P&E, R&D, and new P&E green-field projects)
- Follow-up of the current sales coming from the acquired Companies (geographical, new products based, and unrelated to the core businesses) against the targeted budgets
- Identify the Directors and deploy resources to be dedicated to due diligence, closing of the acquisition, and integration

10.c The Overall Performance Model

Based on the main results of our research we can develop a breakdown of long-term actions to keep track and lead to a successful corporate performance. The list has been built based on the most relevant basic economic literature. These are:

<u>Profitability. Return on Assets.</u>

The processes to be monitored are:

- Manufacturing, and sourcing measurements
- Variable & Base Cost Productivity
- Cash management – cost control (indirect costs follow-up...)
- Divestments (non profitable businesses, facilities and equipment)
- Human resources (headcount follow-up...)
- Market intelligence (pricing and contribution margin updates...)
- Financial cost (level of debt…)
- EFQM and Six Sigma quality
- Approval authority (cost, $ limit, responsible, and rules in place)

<u>Sales Growth.</u>

The processes to be monitored are:

- New products development and introduction
- Salesforce (efficiency, knowledge, deployment, motivation and incentives)
- Market intelligence (sales and orders calls, competition, market shares...)

- CMS-Commercial management system and CRM-Customer relationship management (customer service measurements...)

Investment. Investment to sales ratio.

The processes to be monitored are:

- R&D-Research and development (innovations...)
- P&E-Plant and equipment (new green-field, expansions, upgrades, relocations...)
- Working capital (inventories, debtors, creditors...)
- M&A-Mergers and acquisitions (past, ongoing and future opportunities)
- IT Solutions (PSI-Product schedule inventory, e-Business, mobility...)
- Foreign companies and subsidiaries follow-up

Expectations. Created Shareholder Value.

The processes to be monitored are:

- Equity market value (S&P 500, net income, over and undervalued shares gap, potential growth path,..)
- Payment of cash dividends
- Repurchase of shares (buy-backs)
- Capital increases
- Exercise of options and warrants
- Retirement of debt
- Conversion of convertible debentures
- Required return to equity

Risk. Market and Credit Risk.

The market risk processes to be monitored are:

- Interest rates
- FX exchange rates and currency risk
- Commodity prices
- Stock exchange prices
- Insurance prices

The credit risk processes to be monitored are:

- Credit monitoring (own, customers and creditors)

- Default probability (own, customers and creditors)
- Credit scoring and ratings (own, customers and creditors)

The CEO-Chief Executive Officer must have these variables as the main priorities to review in his Operating Mechanism Agenda, and at the same time he must provide his leadership, guidance, and coaching to his Directors Staff. It is very important to set-up the review processes through meetings and calls with the objective to avoid surprises and closely monitoring the budgets drilled down from an annual to a quarterly and a weekly basis. Some processes require a weekly call, and others a monthly review. The above mentioned processes seek to emphasize the main concepts as a consequence of the research findings, but the list must be considered an open list to be modified depending on the sector and the main business objectives. As an example: a non-profit organization is far from this kind of schedule.

Our research is very much oriented to identify the processes through financial measures and it does not consider the customer satisfaction measurements. It is impossible to find out these measurements for historical research at the company level and for so long a period of years. We list below the main frameworks for further research and the implications of taking a short-term panel oriented of companies.

Trying to avoid missing processes, we would like to review two very important contributions to a Balanced Set of Measures coming from an Integrated Performance Management System. The first proposal is from Kaplan & Norton in their *Balanced Scorecard.* They propose four perspectives, which are:

- Financial
- Internal Business Processes
- Learning & Growth, and
- Customer Perspectives

The second one is from Mark Graham Brown (1996) in their *Keeping Score*, he proposes five views of business:

- Financial Performance
- Process/Operational Performance
- Customer Satisfaction

- Employee Satisfaction, and
- Community & Stakeholder Satisfaction

Other contributions come from "The Foundation for Performance Measurements" with its UK and US Chapters, and the "PMA Performance Measurement Association" organised by the "Centre for Business Performance" at the Cranfield School of Management. In our proposal we have concentrated on the Financial and Operational Performance, with the focus to identify the measures to be traced in a continuous way in the Business. The initial outcome of the research comes from financial measures to perform the econometric regressions and no qualitative measures have been considered due to the long-term period. However, we fully support the qualitative measures tracing Customer Satisfaction, Employee Satisfaction, Community Actions, etc..

Appendix 11. Applications

11.1 Wal-mart's Example. The Market Value Model

Our main objective is to familiarize the reader with all the previous mentioned concepts showing the main feature of displaying the main variables contributing to the created shareholder value, and applying the proposed model to forecast a real case. We will analyse the Wal-mart's Market Value Model with data from 1988 till 1997 and then we will estimate the Market Value for 1998.

In this section we can draw a graph with the main variables with a best fit to the Market Value evolution in the Stock Exchange. We can demonstrate with the graph that the Created Shareholder Value based on Pablo Fernandez's calculations, Market Value Added to Sales ratio from Stern Stewart, and CFROI from Bartley Madden are good estimators. CFROI does not provide a measure of value creation as such. A company creates value if the CFROI is greater than the WACC- weigthed average cost of capital, but the economic profits like EVA or the variables like Return on Equity or on Assets are not adequate. We will demonstrate this statement with the correlation matrix.

years	TSR-Idx	ROE	ROA	CFROI	MVA/Sales	CSV/1000	EVA/100	MVA/1000
1983	35.90	26.38	11.88	13.29	89.32	1.05	1.39	4.17
1984	31.77	27.34	12.28	14.10	116.99	0.85	1.63	7.49
1985	15.73	25.53	10.55	13.15	132.55	1.63	2.90	11.20
1986	37.61	26.62	11.12	15.12	102.04	3.41	4.08	12.15
1987	11.44	27.81	12.23	14.78	89.88	0.10	5.34	14.34
1988	11.64	27.83	13.16	15.46	101.42	1.78	6.72	20.94
1989	-0.19	27.13	13.12	15.19	61.39	2.62	5.23	15.84
1990	62.02	24.06	11.34	14.10	80.67	9.48	6.71	26.30
1991	39.91	23.01	10.42	14.24	108.27	18.85	9.77	47.52
1992	16.88	22.77	9.70	12.75	118.23	4.80	9.18	65.60
1993	-25.27	21.70	8.82	12.07	73.77	-22.37	7.31	49.68
1994	-12.11	21.07	8.17	12.20	47.52	-15.28	4.16	39.20
1995	-43.68	18.57	7.30	10.98	33.35	-11.78	4.16	31.23
1996	-2.71	17.83	7.72	11.39	34.73	1.16	4.30	36.42
1997	34.24	19.06	7.77		59.59	30.91	9.53	70.29
1998	87.96	20.98	8.86		123.90	92.43	20.81	170.52
1999	8.46	20.81	7.64		132.48	30.97	20.72	218.61
2000	14.62	20.08	8.06		116.44	-24.64	20.63	222.79
2001	18.91	19.00	7.99		106.41	-18.02	21.83	231.75

Table 11.1 Wal-mart. Benchmarking of variables.

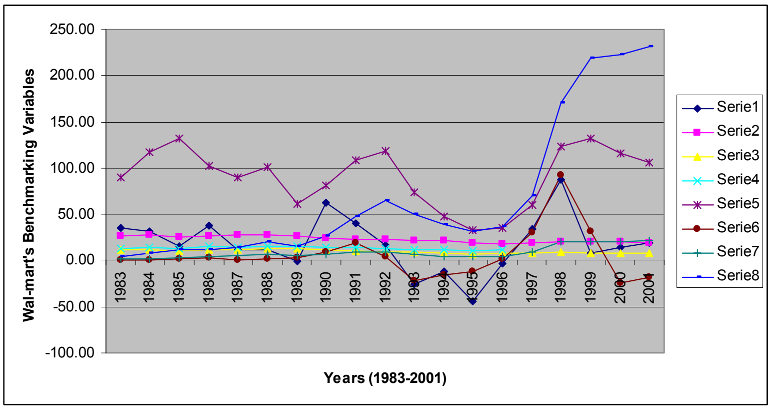


Figure 11.1 Wal-mart. Graph of the main variables.

Series 1. Wal-mart´s TSR related to market S&P 500 Index return

Series 2. Return on Equity

Series 3. Return on Assets

Series 4. CFROI- Cash Flow Return on Investment, comparable against the "WACC"

Series 5. Market Value Added to Sales ratio

Series 6. CSV- Created Shareholder Value scaled divided by 1000

Series 7. EVA- Economic Value Added scaled divided by 100

Series 8. MVA- Market Value Added scaled divided by 1000

The main takeaway of the graph is that Management in the past thought that the Total Shareholder return was based on ROE, but the market was reacting based on other variables. This finding is consistent with Warner and Hennell (2001)[274]. Looking at the correlation matrix, we obtain the following results:

	tsridx	roe	roa	cfroi	mvasls	csv1000	eva100	mva1000
tsridx	1.0000							
roe	0.5409	1.0000						
roa	0.5888	0.9534	1.0000					
cfroi	0.6147	0.8903	0.9188	1.0000				
mvasls	0.6209	0.6544	0.5563	0.5362	1.0000			
csv1000	0.7890	0.3584	0.4877	0.5589	0.4933	1.0000		
eva100	0.0434	-0.1890	-0.0878	0.1053	0.1089	0.2609	1.0000	
mva1000	-0.2994	-0.6525	-0.6059	-0.4768	-0.1689	-0.1326	0.7770	1.0000

Table 11.2 Correlation Matrix

274 Warner, A. and Hennell, A., 2001, *Shareholder Value Explained*, 2nd Ed., Pearson Education, 7, 90.

The highest correlation coefficients against the Total Shareholder Return are reached by Created Shareholder Value, Market Value Added to Sales, and CFROI and confirm that they are the best variables. ROE, ROA, and EVA are not adequate measures for Value Creation when compared with the previous ones.

Created Shareholder Value shows the highest correlation coefficient at 0.789 against the second MVA to Sales at 0.620, and CFROI at 0.614. We expected MVA-Market Value Added at higher values, because MVA is a clear Value Creation variable. Conversely, ROE, ROA, and the economic profit EVA are not correct for Value Creation.

Based on the historical Wal-mart's data downloaded from Standard and Poor's Compustat, we have:

Years	S&P Index x16	W.Average C. Capital wacc	Market Value x1	Net Income x23	Free Cash Flow x7	Debt Total x27	Com Shares Outstanding x17	Price High 12 Months x37	Price Close Monthly x36	Purchase of Stocks x3	Sale of Stocks x4
1988	277.72	12.95	19085.05	837.22	50.78	1233.83	4524.73	4.23	4.22	0.00	3.89
1989	353.40	15.70	24124.81	1075.90	-212.28	1481.21	4529.08	5.92	5.33	0.00	6.24
1990	330.22	15.11	37346.27	1291.02	-251.30	2324.91	4569.13	9.19	8.25	25.83	4.96
1991	417.09	13.06	61880.50	1608.48	-643.64	3771.93	4596.11	14.97	13.47	0.00	12.56
1992	435.71	11.04	74844.32	1994.79	-2719.45	6493.21	4599.28	16.47	16.28	0.00	16.04
1993	466.45	10.40	60910.83	2333.28	-1747.11	9606.31	4597.54	17.06	13.25	0.00	9.69
1994	459.27	11.39	52205.01	2681.00	-1219.00	11591.00	4594.00	14.63	11.44	0.00	0.00
1995	615.93	13.05	46751.35	2740.00	-1641.00	13398.00	4586.00	13.81	10.19	0.00	0.00
1996	740.74	10.36	54479.06	3056.00	2806.00	10634.00	4570.00	14.13	11.88	208.00	0.00
1997	970.43	11.74	89414.04	3526.00	3876.00	10815.00	4482.00	20.97	19.91	1569.00	0.00
1998	1229.23	11.44	191217.05	4430.00	3153.00	10613.00	4448.00	43.22	43.00	1202.00	0.00
1999	1469.25	13.37	243842.39	5377.00	1121.00	22082.00	4457.00	70.25	54.75	101.00	0.00
2000	1320.28	12.55	253706.52	6295.00	492.00	22316.00	4470.00	64.94	56.80	193.00	581.00
2001	1148.08	10.51	267336.01	6671.00	628.00	21880.00	4453.00	59.98	59.98	1214.00	0.00

Table 11.3 Wal-mart. Fundamental data.

Based on the Market Value model described in the Chapter 5.8. The outcome of the regression considering the data from the years 1988 through 1997 can be seen in the Appendix 7i. At this stage, we want to forecast the 1989 values based on the results of the regression. We will assume that the 1989 budgeted values are exactly the true data for simplicity.

The current Market Value reached $89.41 billion US Dollars in 1997, and the current one at 191.21 bln in 1998, whereas our forecast was at $200.52, so it has been overvalued by a +4.87%. In other words, the current market value grew $101.8 billion and the market value growth in our forecast was at $111.11 billion. This is a $9.3 billion difference in the changes.

Variables Description	Mnemonic	Coeff. 1997 included	1998 Budget Amounts	
Lag of Mkt Value	m_1	-0.4535	11.4010	-5.1704
Change S&P Index	dsp	-0.2588	0.2364	-0.0612
Change Net Income	dni	-0.7600	0.2282	-0.1734
Over & Undervalued	v	-1.2948	-3.7616	4.8705
Potential Growth Path	p	-0.0492	6.8860	-0.3388
Change Repurchase of C.Shares	dr	-0.1486	-0.2644	0.0393
Change of Sales of C.Shares	ds	-0.0731	0.0000	0.0000
	cons	13.0426	1.0000	13.0426
			Total	12.2087
1998	Est Market Value = 2.71828^12.2087 =			200524.51
1998	Current Market Value =			191217.05
	Difference (Gap) =			9307.46
	Gap vs Current Market Value (%)=			4.87

Table 11.4 Wal-mart. 1998 Forecasting Results based on the 1988-1997 regression.

Important takeaways are that we have been able to show in very simple graphs as Total Shareholder Return related to the market is highly correlated with the Created Shareholder Value, MVA to Sales ratio, and CFROI. Due to the fact that we have identified with our empirical work for the considered period the significant variables, we have an additional tool to forecast the Market Value, and very clearly we respect and understand the random behaviour of the share prices due to unexpected shocks. But, the quarterly and annual regressions with the right variables transformation are a very powerful tool to project nine Quarters or Annual observations into the forecasted amount, due to the number of independent variables to be considered. Additionally, the Total Shareholder return to the market must be compared to the required return to equity Ke. A company creates value if the TSR-Total Shareholder Return is greater than Ke.

11.2 Challenging our results against the A. Rappaport's Created Shareholder Value principles

Alfred Rappaport wrote the "10 Ways to Create Shareholder Value" article in the Harvard Business Review, September, 2006. He provides the ten basic governance principles that combined with a well executed business model allow to excel in creating shareholder value, as defined by the same author.

Our objective is to review these principles and challenge our research results against them. This is as follows:

<u>Principle 1. "Do not manage earnings or provide earnings guidance".</u>

Companies have been usually providing the following quarterly information:

- Change of quarterly earnings per share, earnings, and revenues against last year results in percentage
- Details of the main drivers of growth (globalisation, e-business, productivity, etc...)
- Quarterly Operating Margin to Sales ratio against last year results
- Earnings by segment with emphasis in the the most important facts
- Cash Flow generated from operating activities against last year results

A 2006 National Investor Relations Institute study found that 66% of 654 companies provide regular profit guidance to Wall Street Analysts, as mentioned by Alfred Rappaport.

Corporate Management believes that when they provide earnings guidance, they achieve lower share price volatility, and improvements of valuation multiples, share's liquidity, and shareholder returns. However, Peter Hsieh, Timoty Koller, and S.R. Rajan - McKinsey (2006)[275] in their survey called "The misguided practice of earnings guidance" found no evidence that earnings guidance provide the above mentioned improvements. In the article it is also said that earnings guidance provides greater volumes but "this is an opportunity for the short-term traders acting on the news of the earnings guidance, but have no lasting relevance for the shareholders", as mentioned by the authors.

In our research, the Look forward EPS to current variable was eliminated due to the high correlation with the Over and Undervalued Stocks variable, and was less significant in the Market Value model than in the latter. This means that the difference between the projected share price from the Free Cash Flows and the current one is a more robust process than the earnings guidance provided by the companies in agreement with A. Rappaport.

[275] Hsieh, P., Koller, T., and Rajan, S.R., 2006, *The misguided practice of earnings guidance.* The McKinsey Quarterly, Corporate Finance, Performance.

Based on the above concept, the common belief that earnings announcements drive short and long-term valuations up encouraged some Management to commit short-term creative earnings management, as well as business practices at the edge of fraud. Some Management argue that the holding period of shares by the big Mutual Funds is decreasing and this is forcing Management to continue focused on the short-term actions.

Additionally, actions like setting a longer time for cash out of stock options forcing to retain the talented people in the Companies, and the Sarbanes-Oxley Act are refraining Management from implementing creative earnings management.

Principle 2. Make strategic decisions that maximize expected value, even at the expense of lowering near-term earnings.

The strategic decisions must be based on value-oriented analysis, which means that in addition to the Net Present Value of Free Cash Flows, we need to include the investment outlays and the time value of money. Projects being selected based on positive Net Present Values, Internal Rates of Return higher than Weighted Average Cost of Capital, and Pay-backs according to the strategic interest of the company are critical to add value.

Our research is not based on linear programming and we cannot identify the best opportunities maximizing the shareholder value creation. Our models allow us to perform the Panel Data econometrics and to identify the significant variables by Sector. We can also identify the coefficients at the company level by regressing the specific coefficients by cross section. This is critical to focus and to know the most relevant processes in every sector and company.

Principle 3. Make acquisitions that maximize expected value, even at the expense of lowering near-term earnings.

The traditional EPS, or company's multiple approach to the acquisitions do not tell us anything about the long term potential added value to the acquirer company. It is clear that the value-oriented analysis requires the identification of the multi-year forecasted cash flows of all the most important business opportunities that the acquired company is bringing to our business. The analysis must include: the additional synergies to be brought with the combined company and the estimation of certain inefficiencies in the integration processes. There are many good companies performing due diligences, that get the acquisitions done but that are very bad in integrating people, processes, leverage knowledge and in retaining talented people of different cultures.

Like in the previous Principle 2, our research is not based on linear programming and we cannot identify the best acquisitions maximizing the shareholder value creation. However our models perform the Panel Data econometrics and we can identify the significant variables by Sector and alternatively at the company level.

The long and short-term of the Invested Capital (lag and the first differences) have been significant in the Market Value Model in the Difference GMM-2, and the first differences have also been significant in the Created Shareholder Value Model in the newey2 estimator.

<u>Principle 4. Carry only assets that maximize value.</u>

Being focused on high value added activities and outsourcing the low added value ones the companies can reduce the capital they employ and increase its value.

With our models we cannot lead the business to discriminate between different businesses, investing or divesting from activities, but we can provide guidance on how to focus on the main processes leading to maximize value at the business unit level:

- Sales growth
- Profit-Cash Flow (EBITDA to Total Assets ratio)
- Risk (credit and market)
- Market Value, and Created Shareholder Value

These processes are impacting on different teams in the company and the actions are not financial adjustments. The processes are familiar to each one of the teams, but they must be performed efficiently.

<u>Principle 5. Return cash to shareholders when there are no credible value-creating opportunities to invest in the business.</u>

When the leading "Cash rich companies" face limited opportunities to invest, they return the cash to shareholders through Dividends and Share repurchases. Additionally, this is very important because the share repurchases boost the share price up.

In our models, the change of the repurchase of shares is highly significant in the market value model Diff. and Sys. GMM-2. Moreover we could find high significance of the lag of Payment of Cash Dividends at the Diff. GMM-2. This is confirming that the Share Repurchases is a very robust process being used by the companies for the analysed period.

Principle 6. Reward CEOs and other senior executives for delivering superior long-term returns.

The reward of CEOs is not considered in our models, although we fully agree with the principle. The rewards based on driving the short term market values up acting in the earnings per share are not over.

Principle 7. Reward operating-unit executives for adding superior multiyear value.

The incentive compensation to the operating-unit executives based on shareholder value added metrics are not considered in our models. We have developed the created shareholder value model with the variables involved, but they are not covering the aspects of rewarding the executives. Our contribution helps the executives to understand the significance of each variable to the value creation process for the analysed period, and it also helps to select the right measures which identify the Value Creation of the Company.

Principle 8. Reward middle managers and frontline employees for delivering superior performance on the key value drivers that they influence directly.

In the article Rappaport argues that sales growth, operating margins, and capital expenditures are correct for tracking the operating-unit Shareholder Value Added. However, he argues they are too broad to provide day to day guidance for the middle managers and frontline employees, and, as he suggests, leading indicators of value.

In this case, our contribution fits very well in the process. The CEO and Board of Directors set the annual budgets estimating the key metrics like Sales, Operating Margin, Created Shareholder Value, and Market Value. All these financial metrics must be drilled down to the next layer of operating-unit executives to make sure that they develop the adequate set of actions, so as not to miss the numbers for the year. Quarterly monitoring milestones must be observed and supported with the detailed budget data. The CEO operating mechanism is critical to make sure that the monitoring process of financial metrics and actions is in place. Our econometric models show the most significant variables, which are the ones we need to put more emphasis on the different processes.

It is clear that, in the budgeting processes, a certain degree of inefficiency must be set and considered. Not all the actions are successful and we need to consider certain coefficients to count for negative shocks depending on the different processes.

As it has been explained in the previous principle, we have not considered the CEOs, operating-unit executives, middle managers and frontline employees' rewards as variables in our econometric models.

Principle 9. Require senior executives to bear the risks of ownership just as shareholders do.

This aspect is not covered in our econometric models. It is a way of balancing the executives and shareholders risk in the business.

Principle 10. Provide investors with value-relevant information.

In our framework of econometric models and key variables to be tracked, we need to facilitate the value-relevant information statement showing the evolution of every one of the variables against the forecasted value in the annual budget for every process to secure the internal information and the back-up for the external information.

Trying to summarise the challenge of our findings against the Rappaport's principles, we can state that the ten principles provide the framework for the companies to have the right approach to create value for the shareholders. Our research provides with in-depth detail the variables affecting every process thanks to the econometric models. The Principles are based on definition models and are subjected to little changes for the near future. In our case, we need to understand that our empirical research has the limitation that the accurate results are for the period and they cannot be extrapolated to the future in an easy way. However, it sets the basis for a good understanding of the short and long term effect of the variables, and gives a clear picture of how the different variables play in the business processes.

11.3 The Microsoft Operating Mechanism Case. The Overall Performance Model.

The enclosed figure 11.2 shows Microsoft's historical scoring for the period 1986 to 2001. The average scoring is at the level of 75.45 out of 100. As previously mentioned in section 6.4.1 the scoring is the addition of ten financial measures treated with the same weight, and it has been calculated relative to the other Dow Jones Industrials-35 companies (26 Companies, after excluding the financial ones). The graph of the evolution of Microsoft's Scoring is:

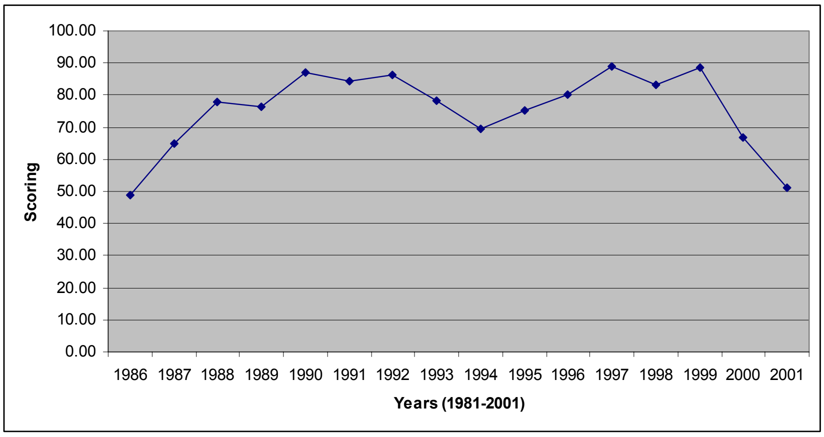


Figure 11.2 Microsoft. Historical evolution of the annual scoring.

This is an excellent performance. If we take into account the key factors of the success. Based on Steve Balmer's speeches we can deduce the following:

Management:

- Strong leadership, knowledgeable, experienced with 25 years in the Information Technology Industry
- Execution in two fronts: innovation and growth. High Management commitment, strongly focused on customers
- Company attracting the best and the brightest people in the Industry

Innovation:

- R&D spending as the best proxy for the company's investment in its future. Annual spending increased by 25% in five years

- Picking the right areas to innovate
- Reshape portfolio of products: reshaping a broad portfolio of opportunities. Innovating in several areas to get synergies
- Keeping at the edge of the major industry transformations
- High prospective capabilities: new areas such as entertainment, communications, information access, business, and e-commerce have been already identified as key fields to innovate
- Monitoring Risk: Open source software, intellectual properties, piracy, etc..

Growth:

- Anchor business: Windows, Office and Server business
- In the last five years they have been able to expand the Market Demand by about a third, and their Operating Income going from 18 to almost 23% of the sharing in profit out of the benchmarked group of 25 larger IT Companies
- Acquisitions focused on improving the Innovation and R&D portfolio
- New services opportunity: some based on advertising or subscription revenues targeting consumers, small and larger business
- Drive Shareholder return. Buybacks: around 10% of company's market value bought in 2005.

The Microsoft Operating Mechanism is very accurate and shows a high discipline. It has the following chapters:

Figure 11.3 Microsoft Operating Mechanism. Chris Liddell, CFO.
Source: Financial Analysts Meeting, 2006.

Driving factor	Rank order	Business Process
Growth	1	Growth rate in core businesses
		Future growth – long term
	2	Strategy to win online
	3	Entertainment profitability
Cash	4	Return on cash
		New buyback programme
		Cash flow and capex
		Cash generated vs uses
Investment	5	Overall operating income margin structure
		Shifting mix in expenditures structure
		Changing business mix
		Segment margin
	6	Investment discipline
		Marketing, salesforce, and launch related cost
		Operating costs/acquisitions
		Online services
		High growth products/business
		Investment curve
		ROI approach
		Investment discipline
	7	Communication
		Growth and long term investment
		Risk factor/opportunities
		Continuous product innovation

Table 11.5 Microsoft Operating Mechanism. Chris Liddell, CFO.

The operating system captures the following driving factors: growth, cash, and investment. The investments are traced by the Return on Investment curve. Projects in the early stages show a negative ROI and as soon as they reach more mature stages the ROI becomes positive, and in the end it reaches the saturation level. All the projects are very carefully monitored for performance and the situation in the ROI curve delivering as expected. If we look back to our results in the overall performance model, we get: profitability, sales growth, investment, and the created shareholder value. We can see that the results are quite similar.

The annual R&D expenditures to Net Sales have increased from 10.4 to 17.3 in percentage. This means 6.9 points of improvement, with a Sales growth at 38.3% CAGR and the Market Value growing at 52.9% CAGR for the period 1986 until 2001. Microsoft has been able to cope with the market challenges (operating systems, software, server applications, etc...) and in a balanced way. They know that they grow in this way, with a high discipline monitoring the investments in every project and delivering good products to the Customers.

Figure 11.4 ROI Investment traced by Project.

This is a good example to understand the influence and importance of the Research and Development and Investments in the long term profitability of the business. Additionally, the enthusiasm, knowledge, and experience of the Microsoft Management is a plus against other companies with weaker operating mechanisms more oriented to short-termism, and which use creative accounting (earnings management) to influence the net income and market value.

It is clear that the companies in favour of the short-termism operating mechanisms are widely criticizing the long term Research and Development expenditures and investments.

The Microsoft Management shows Risk under the investment driving factor. The reasoning behind this concept is that the Information Technology industry is very much affected by changes in the technology, market trends evolution, customer needs and the presence of substitute products. The main Risk is not being present at the top of the technology wave. Microsoft copes very well with the continuous launching of innovative products through the R&D driving factor. In the context of the Overall Performance Model the risk is more related to our own credit monitoring and customers, as well as the risk management of FX exchange rates etc..., than to the future technological evolution.

We can compare the Overall Performance Model and the Microsoft's Operating Mechanism in the following table:

Driving factor	Microsoft's Operating Mechanism	Overall Performance Model
Growth	Growth rate in core business	Three-year net sales growth
Profitability	Return on Cash	Return on Assets
Investment	Investment and ROI analysis	Investment to Sales ratio
Shareholder Value		Created Shareholder Value
Risk	Part of the Investment analysis	Market and Credit Risk

Table 11.6 Benchmark of Driving factors between the Microsoft's operating mechanism and the Overall performance model.

The Market Value in Microsoft is the consequence of the discipline in taking care of all the other concepts like growth, profitability and investment. In our research, the Shareholder Value is the consequence of monitoring and control all the variables related to the Shareholder value creation. In our approach, the Investors shares purchasing behaviour variables are also included. Our research demonstrates that our analysis is a more general one and the Microsoft's variables are embedded in our Overall Performance Model.

11.4 The Jack Welch's GE Growth Model and Operating Mechanism

Jack Welch performed five stages in his career to grow the business. These are the following:

1. Jack Welch's CEO job. He got the CEO job for GE Plastics at the age of 33 years old In 1968. He delivered the huge growth with "Noryl", and later the internal competition between "Lexan" and "Noryl" provided the ground for growth at the GE Plastics level, and his personal development at the GE corporate level started. After managing GE Medical Systems, and Financial Services he finally got the CEO Corporate job on December, 19th, 1980.
2. Restructuring from 1981 till 1985. GE earnings grew from \$1.7 to \$2.3 billion. This was the time to divest in low profit operations (125 businesses divested). The workforce went from 404000 to 304000 employees a decrease of 24.75%. A very serious discipline was developed at the GE corporate level keeping the high profit

operations and the rest closed. At that time the message was: "Grow in selective markets and stop business with low profits in high competition markets".

3. Work-out from 1988 till 1992. People wanted to improve profits and work-out meetings were conducted to get new ideas and eliminate unproductive tasks all across the organization. Earnings grew from $3.4 to $4.7 billion.
4. Change acceleration process from 1992 till 1995. After eleven years of excellent success Jack Welch concentrated on developing the Industrial and Financial operations, trying to develop an excellent management team. Jack Welch was very charismatic, very demanding and tough. This approach meant for GE a loss of $1.2 billion with $878 million in 1994 due to the liquidation of the Kidder Peabody operations. The huge wealth of the GE business model made the acquisitions the way to go, and earnings grew from $4.7 to 6.6 billions.
5. Six Sigma from 1995 till 2000. The Cash machine was at full speed and Jack Welch needed to provide a credible framework to recover credibility. Earnings were in a saturation level, new fresh ideas were very important, and the ones from Motorola meant a fresh air to grow the business. GE and Allied Signal embraced the new Six Sigma concepts, and very good projects were in place. However, the process was exaggerated in the implementation to a level that officially was correct, but in practice many people at management level did not believe in the process as implemented, and the benefits were limited.

The most successful initiatives were implemented from 1981 until 1992 and Jack Welch deserves the credit of this, but the main success comes from the three processes he was able to develop more in the strategic side. These are:

1. Keeping a balance in profits through the Portfolio of Businesses. The balance is between low profit, high competition, cash providers, low Assets, short term cycle (Appliances, Industrial Systems, etc..) against the high profit, low competition, non-cash providers, high Assets, and long term cycle (Aircraft Engines, Plastics, etc…) businesses.

   A Business can be considered short cycle when the Salesforce gets an order in less than one year and long cycle when this period is longer than one year.

On the left hand side the enclosed figure shows how the short term cycle businesses with lower assets provide lower profit, and they are the source of cash in the short term. On the right hand side the businesses with higher assets provide higher profit, and they require cash in the short term. The total assets are a clear barrier to the market entry and the long cycle business are poor cash providers in the short term.

Segment	Revenues	Profit	Assets	Profit to Revenues
Aircraft Engines	10779	2464	9816	22.86
Appliances	5887	684	2775	11.62
Ind Systems	11848	2187	7869	18.46
NBC	6797	1797	4965	26.44
Plastics	7776	1923	9561	24.73
Power Systems	14861	2809	11618	18.90
Tech Products	7915	1718	6016	21.71
Amounts in $ US millions				

Table 11.7 General Electric. Financial Segment Information (2000).

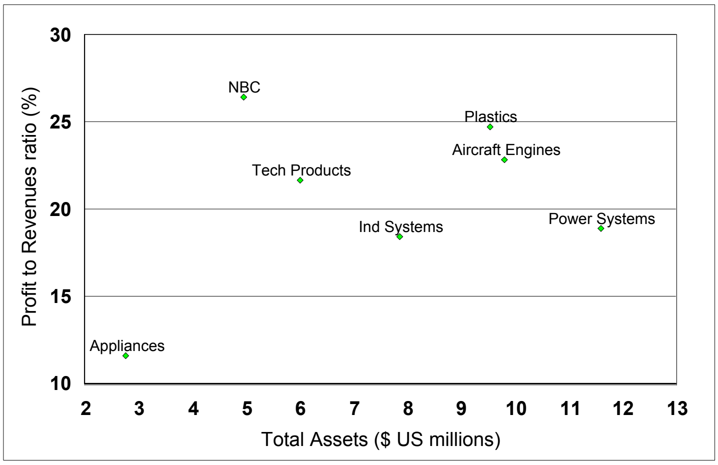


Figure 11.5 General Electric. Total Assets as entry barrier against the Profit to Revenue ratio (2000).

2. <u>Combined cash generation between the Industrial and the Financial Businesses.</u>
   Welch, Fresco and Opie (1996) introduced the GE Growth Model describing the main features of the model. These were: very simple, the group of 11 businesses are supporting the "triple A" debt rating of the parent company and improving operating margins, earnings and cash flow. On the other hand, the 27 diverse global financial

services also rated "triple A" grew earnings consistently at double-digit rates.

As quoted by the above mentioned authors: "The uniqueness of this model lies in its consistency, the consistent growth is the output of this model and the fuel that drives it the energy behind it is the GE culture... how we behave"

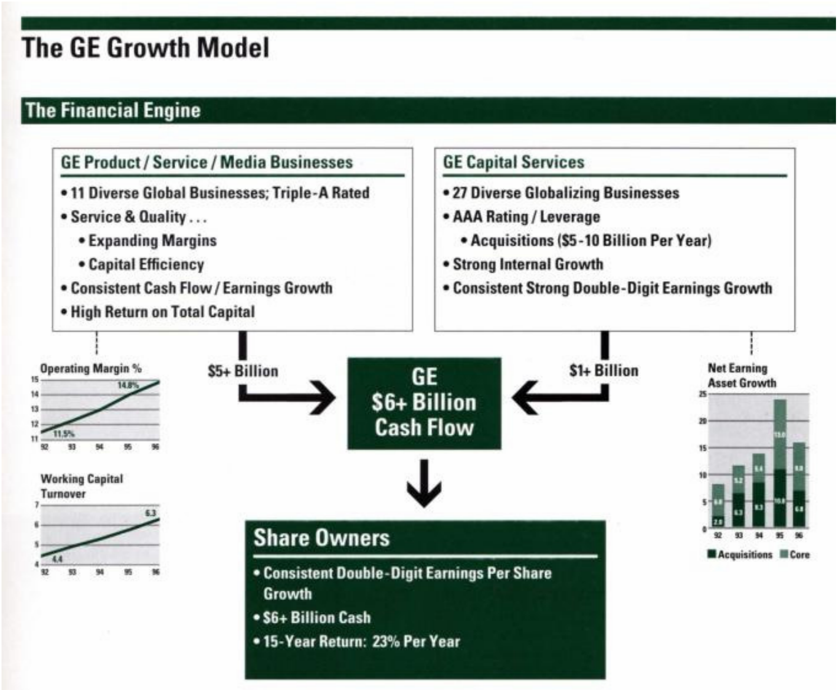


Figure 11.6 The GE Growth Model. Welch J., Fresco P., and Opie J. (1996).

3. The GE Operating Mechanism. During his last year as CEO of the corporation, Jack Welch set up the main poles of the operating mechanism, which were: Globalization, Six Sigma Quality, Product Services, and e-Business. This operating mechanism is completed in one year through different learning sessions, corporate meetings, etc...

The main benefit for the GE company is sharing the intellectual capital; the best ideas coming from internal and external people to GE, the main benefit for the management is being motivated and integrated in a very high challenged environment, entrepreneurship, very ambitious management and being embedded in a learning culture.

The GE Operating Mechanism makes the sharing of ideas and best practices flow into the company very quickly so that the initiatives become operational across the company within one month of launch, and produce a high positive financial effect on the company performance.

We can summarise the GE Business Growth Model under the following three items:

a. Diverse set of businesses delivering high performance
b. Operating rigour and cash generation
c. Learning culture through the Operating Mechanism

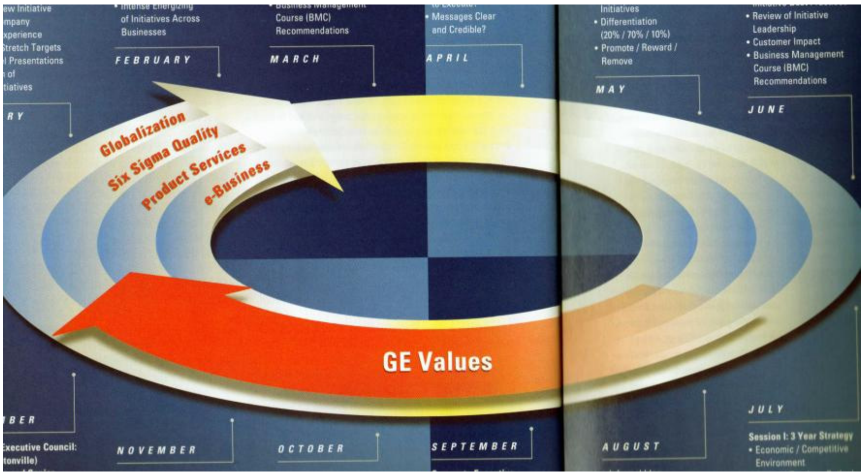


Figure 11.7 The GE Operating Mechanism.

11.5 The Best Performers Ranking

One of the most practical applications of the Overall Performance Model already described in Section 6.3 is the Best Performers Ranking by economic sector. The dependent variable: the scoring was built based on the variables considered by Standard and Poor's:

- One-year Total Return
- Three-year Total Return
- One-year Sales Growth
- Three-year Sales Growth
- One-year Net Income Growth
- Three-year Net Income Growth

- Net Income to Sales in percent
- Return on Equity
- Net Sales
- Long-term Debt to Capital ratio

The first claim against the Standard and Poor's approach is that Net Sales and Long-term Debt to Capital ratio have been introduced to correct the size of the companies and it is very clear that we need to introduce and discriminate among three concepts to pursue a broader scope:

- One-year growth ranking. This allows us to identify the small companies growing faster in the sector. It can happen that a company grows in an opportunistic way and we need to correct this issue with the three-year growth ranking
- Three-year growth ranking
- Corporate size ranking

The second claim against the above mentioned approach is that a high Total Return is achieved through satisfying the investors expectations, but first we need to get the financial metrics right. We cannot mix the causes (Actions to generate: Sales growth, Cash Flow, Investments,..) and the effects (Total Shareholders Return,..) variables.

The third claim against the above mentioned approach is that the Investment variable is not considered at all, and it is very significant in our regression outcomes.

Based on the above mentioned claims, we propose the three main frameworks to analyse the Best Performers Ranking. This is assuming, in general terms, that small companies grow very fast but the results are not so good, and large companies grow slower with good and consolidated results. In this scenario, the trade off is solved selecting the best companies with the higher level of investments. It is very common to find in every sector small companies, which are very confident in the future with high investments relative to its size, with sales growing and with very poor results, and large companies anchored in a certain inertia without investments and slowly growing sales and results. Our approach is solving this dilemma, however the Standard and Poor's one cannot even identify this issue. It is also important to consider the Corporate Size Ranking recognizing the complexity to manage large companies

Our criteria of valuation is numerical with the scoring at 1= lower than the first quartile;

3= lower than the median; 6=lower than the third quartile, and 9=higher than the third quartile by variable (one-year sales growth, etc...), and the final outcome multiplying the related factors by Company. Our calculation is more transparent than the letters used by Standard and Poor's. See Appendix 11c.

Our approach is based on the three above mentioned rankings and the variables to be considered are the following:

ONE-YEAR GROWTH	THREE-YEAR GROWTH	CORPORATE SIZE
One-year Sales Growth	One-year Sales Growth	Net Sales for the analysed year
	Three-year Sales Growth	
One-year Net Income Growth	One-year Net Income Growth	Net Income for the analysed year
	Three-year Net Income Growth	
Investment to Earnings before Interest and after taxes ratio	Investment to Earnings before Interest and after taxes ratio	Cash Flow generated for the analysed year
Net Income to Sales ratio	Net Income to Sales ratio	Net Income to Sales ratio
Net Income to Total Assets ratio	Net Income to Total Assets ratio	Net Income to Total Assets ratio

Table 11.8 Best Performers Ranking. Criteria: short, long-term growth and size

An example of the calculation of the final ranking for the One-year growth is shown in the enclosed table for the 2004 Spanish Manufacturers of Electrical Products sector. This is as follows:

Companies	2004-03 % CAGR Net Sales	2004-03 Scores	2004-03 % CAGR Net Income	2004-03 Scores	2004-03 % Investment Rate	2004-03 Scores	2004 Net Income to Sales ratio	2004 Scores	2004 ROA-% Net Income to T.Assets	2004 Scores	TOTAL Scores
ABB AUTOMATION PRODU	6.67	6	28.63	6	33.51	3	4.95	6	9.82	9	5832
LEGRAND ESPANOLA SL	12.33	9	72.25	9	43.06	3	-0.64	1	-0.23	1	243
CAHORS ESPANOLA SA	3.87	3	-10.70	3	153.85	6	6.93	9	7.38	6	2916
CIMA BOX 2000 S.L.	1.43	1	21.49	6	747.18	9	10.52	9	5.22	6	2916
CIRCUTOR SA	7.84	6	6.11	6	84.23	3	9.82	9	10.56	9	8748
CLAVED SA	10.00	9	-59.24	1	203.87	6	1.62	3	1.70	3	486
DRAKA CABLES INDUSTR	33.50	9	-86.50	1	1764.67	9	0.83	1	0.93	1	81
ELDON ESPANA SOCIEDA	9.02	6	168.30	9	400.44	9	0.90	1	1.38	3	1458
FABRICA ELECTROTECNI	7.24	6	-1268.39	1	-453.70	1	-23.06	1	-15.77	1	6
FEGEMU SA	3.96	3	51.24	6	385.77	9	1.49	3	1.20	3	1458
GE POWER CONTROLS IE	0.73	1	93.93	9	208.43	9	-2.29	1	-2.66	1	81
GRUPO DE EMPRESAS TE	5.75	6	653.36	9	688.35	9	0.93	3	0.64	1	1458
GRUPO GENERAL CABLE	37.86	9	4.88	3	320.94	9	3.24	3	5.00	3	2187
HAGER SISTEMAS S.A.	11.34	9	119.65	9	115.80	6	4.76	6	7.53	6	17496
HAZEMEYER S.A.	2.12	1	-39.14	1	-55.01	1	0.73	1	1.07	1	1
HISPANO MECANO ELECT	5.35	3	-21.47	1	108.51	3	5.72	6	8.63	6	324
JUNG ELECTRO IBERICA	19.75	9	17.91	6	205.13	6	8.41	9	18.31	9	26244
LEGRAND ESPANOLA SA	7.94	6	56.84	9	-31.17	3	4.87	6	6.66	6	5832
MOELLER ELECTRIC S.A.	4.14	3	-655.99	1	-123.92	1	-4.13	1	-7.19	1	3
NEXANS IBERIA S.L.	4.29	3	64.02	9	206.50	6	-3.99	1	-6.88	1	162
OMRON ELECTRONICS IB	2.59	1	-18.43	3	-55.60	1	4.36	6	7.63	6	108
ORBIS TECNOLOGIA ELEC	4.55	3	11.00	6	111.36	6	20.13	9	9.40	9	8748
PEPPERL FUCHS SOCIED	1.30	1	0.58	3	-61.09	1	5.52	6	11.93	9	162
PRYSMIAN CABLES Y SIST	23.24	9	31.01	6	107.63	3	4.66	6	7.64	6	5832
RITTAL DISPREL S.A.	3.02	1	-20.49	1	1555.54	9	1.30	3	2.19	3	81
ROCKWELL AUTOMATION	0.43	1	-28.95	1	-97.22	1	1.22	3	1.88	3	9
SCHNEIDER ELECTRIC ES	8.58	6	165.47	9	-415.70	1	15.15	9	22.33	9	4374
SICK OPTIC ELECTRONIC	15.44	9	4.19	3	167.29	6	6.56	9	11.73	9	13122
SIEMENS-PRODUCTOS SI	-10.37	1	-15.08	3	-558.72	1	3.47	3	5.19	3	27
SIMON SA	5.55	3	-3.02	3	22.97	3	23.52	9	16.07	9	2187

Table 11.9 The One-year growth for the Spanish Manufacturers of Electrical Products Sector.

In the Corporate Size Ranking we have changed the Investment to Earnings ratio for the Cash Flow generated for two reasons: In large companies it is better to show the Cash Flow generated coming from the past successful Investments due to the high percentage of failure of the integration of the acquisitions. The second reason quoting J. Colley, J. Doyle, and R. Hardie (2001)[276] in their "*Corporate Strategy"* follows the same approach.

Corporate Management is very interested in finding out and understanding the enclosed four items with these Corporate Ranking by Sector:

- Which are the companies growing fastest in the last year?
- Which are the companies growing fastest in the last three years?
- Which are the largest companies in the sector?
- Which are the smallest companies consistently growing fastest and in consequence will be positioned in the future at the top of the Corporate Size Ranking?

Additionally Corporate Management is very interested in this kind of work. This is due to the fact that this is not a simple Net Sales Ranking, but involves the most critical financial metrics to grow in a balance, sustainable and profitable growth. In our experience, the Companies that care about these criteria are the most successful.

Trying to solve the last item we have defined the Dynamism coefficient as follows:

Dynamism Coefficient = Corporate Size Rank – Three-year Growth Rank

Example: Checking the three different ranking for the Spanish Manufacturers of Electrical Products Sector in the period 2002 till 2004. See Table 8.10.

The Dynamism Coefficient of Jung Electro at +16, Hager Systems at +12, and Sick Optic at +12 shows that they are medium size companies enjoying a very high growth, and, for the near future, they will be in higher positions in the Corporate Size Ranking. It is worth mentioning that the Dynamism Coefficient shows very close results with the positioning in the Productivity-Economies of Growth, and the best positioned companies in the graph showing the One-year change of the Cash Flow generated by the Operations and the one-year change of the Net Sales. The three tools are very important to identify the best positioned companies to grow in a sustainable and profitable way. The different outcomes show very similar results.

---

[276] Colley, J.L., Doyle, J. and Hardie, R., 2001, *Corporate Strategy*, McGraw-Hill, 11, 119.

ONE-YEAR GROWTH RANKING 2004 vs 2003			THREE-YEAR GROWTH RANKING 2004 vs 2002			CORPORATE SIZE RANKING 2004			DYNAMISM (Size less Three-year growth)
Rank	Company	Scores	Rank	Company	Scores	Rank	Company	Scores	
1	JUNG ELECT	26244	1	JUNG ELECT	2125764	1	SCHNEIDER	59049	-7
2	HAGER SIST	17496	2	HAGER SIST	944784	2	SIMON SA	59049	-11
3	SICK OPTIC I	13122	3	SICK OPTIC I	354294	3	ABB AUTOM/	39366	-1
4	CIRCUTOR S	8748	4	ABB AUTOM/	314928	4	PRYSMIAN C	26244	-1
5	ORBIS TECN	8748	5	PRYSMIAN C	314928	5	CIRCUTOR S	17496	-2
6	ABB AUTOM/	5832	6	CIMA BOX 2C	236196	6	HIMEL SA	17496	-16
7	LEGRAND ES	5832	7	CIRCUTOR S	236196	7	ORBIS TECN	13122	-3
8	PRYSMIAN C	5832	8	SCHNEIDER	236196	8	LEGRAND ES	11664	-1
9	SCHNEIDER	4374	9	LEGRAND ES	209952	9	OMRON ELE(	7776	-15
10	CAHORS ESI	2916	10	ORBIS TECN	157464	10	G GRAL CAB	6561	-1
11	CIMA BOX 2C	2916	11	G GRAL CAB	118098	11	SIEMENS-PR	6561	-15
12	G GRAL CAB	2187	12	G E TEMPER	39366	12	CAHORS ESI	2916	-2
13	SIMON SA	2187	13	SIMON SA	39366	13	CIMA BOX 2C	1944	7
14	ELDON ESPA	1458	14	CAHORS ESI	8748	14	HAGER SIST	1944	12
15	FEGEMU SA	1458	15	ELDON ESPA	8748	15	SICK OPTIC I	729	12
16	G E TEMPER	1458	16	DRAKA CABL	6561	16	DRAKA CABL	324	0
17	CLAVED SA	486	17	NEXANS IBEI	2916	17	JUNG ELECT	243	16
18	HIMEL SA	324	18	LEGRAND ES	1458	18	PEPPERL FU	162	-3
19	LEGRAND ES	243	19	CLAVED SA	1458	19	CLAVED SA	81	0
20	NEXANS IBEI	162	20	FEGEMU SA	1458	20	FEGEMU SA	81	0
21	PEPPERL FU	162	21	PEPPERL FU	1458	21	G E TEMPER	81	9
22	OMRON ELE(	108	22	HIMEL SA	972	22	RITTAL DISP	81	-3
23	DRAKA CABL	81	23	GE POWER (	486	23	LEGRAND ES	36	5
24	GE POWER (	81	24	OMRON ELE(	324	24	GE POWER (	36	1
25	RITTAL DISP	81	25	RITTAL DISP	243	25	ELDON ESPA	27	10
26	SIEMENS-PR	27	26	SIEMENS-PR	162	26	NEXANS IBEI	9	9

Table 11.10 Summary of the three Corporate Rankings for the 2004 Spanish Manufacturers of Electrical Products.

It is worth pointing out that one of the nicest applications requested by Corporate Management is the Perceptual Map of Positioning of the One-year Growth Ranking based on the Companies and the attributes or variables considered in the calculation table. We include the perceptual map showing the positioning of the 30 companies mentioned and the 5 attributes in a single map. See Figure 11.8.

This Perceptual Map based on the Variables/Attributes of the One-year Growth Ranking shows the following Segments of Companies and reflects the last year behaviour of the Companies. See Table 11.11.

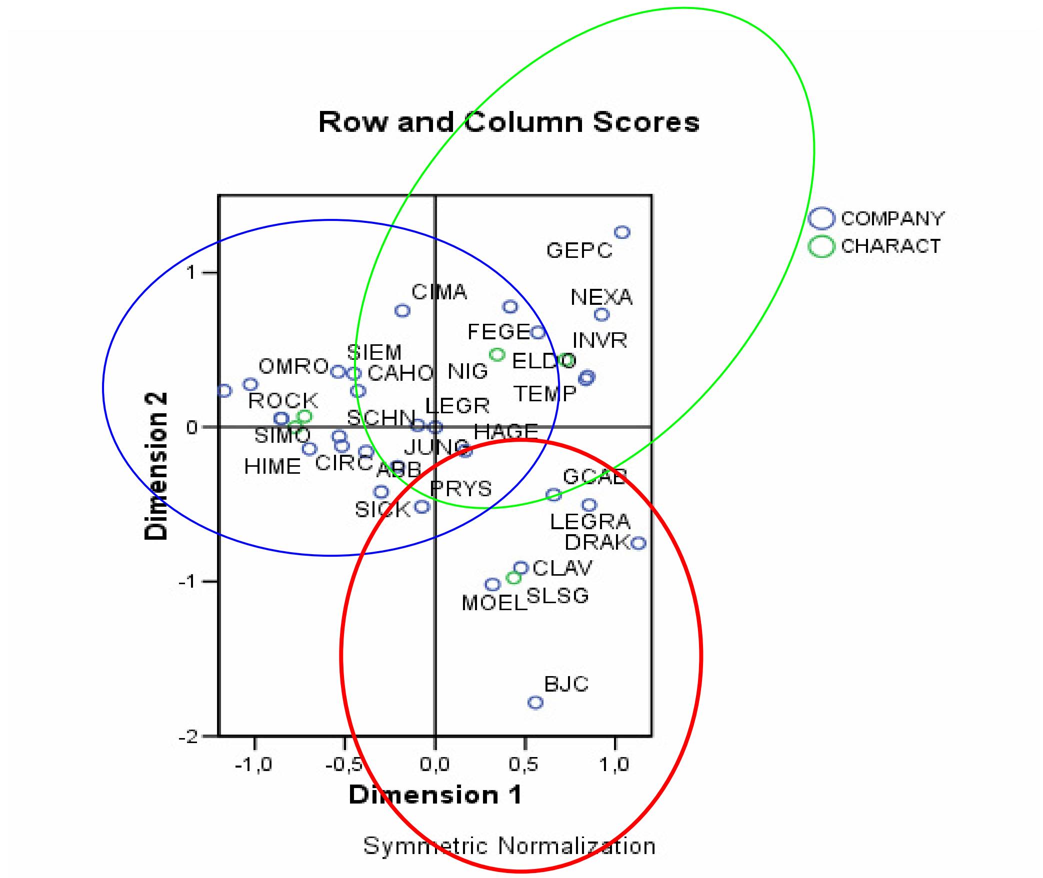


Figure 11.8 Perceptual Map. Spanish Manufacturers of Electrical Products (2004).

Segment	Variables/Attributes & Management Behaviour orientation	Companies
First. Red Colour	Sales Growth	Moeller, Claved, BJC, Draka, Legrand, General Cable, Sick, and Prysmiam
Second. Green Colour	Net Income Growth and Investment Rate	Fegemu, Eldon, Temper, Nexans, GE PC, Cima Box, Hager, Jung, and Schneider Electric
Third. Blue Colour	Net Income to Sales and Net Income to Total Assets ratios	Rockwell, Simon, Himel, Circutor, ABB, Siemens, Cahors, Omron, and Legrand

Table 11.11 Segments: Attributes and related Companies.

Appendix 11a. The Wal-mart's Example.

The outcome of the regression considering the data for the period 1988-1997 is the following:

```
. areg m m_1 dsp dni v p dr ds, absorb(id) robust

Regression with robust standard errors              Number of obs =      9
                                                    F(  6,     1)  =   42.43
                                                    Prob > F       =  0.1170
                                                    R-squared      =  0.9761
                                                    Adj R-squared  =  0.8092
                                                    Root MSE       =  .16875
------------------------------------------------------------------------------
             |               Robust
           m |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         m_1 |  -.4535484   .8712839    -0.52   0.694    -11.52426    10.61716
         dsp |  -.2588733   .9312172    -0.28   0.827    -12.09111    11.57336
         dni |  -.7600645   1.371528    -0.55   0.678    -18.18698    16.66685
           v |  -1.294838   .9420373    -1.37   0.400    -13.26456    10.67488
           p |  -.0492415   .0621559    -0.79   0.573     -.839007    .7405241
          dr |  -.1486973   .3414967    -0.44   0.739    -4.487824    4.190429
          ds |  -.0731547   .4313584    -0.17   0.893    -5.554083    5.407773
       _cons |   13.04263   7.286448     1.79   0.324    -79.54047    105.6257
-------------+----------------------------------------------------------------
          id |   absorbed                                       (1 categories)
```

Appendix 11b. The Microsoft Operating Mechanism Case. Historical Financial Performance.

The Microsoft Financials are:

	Sales-Net $US mln	Sales growth %	Cash Flow to AT (%)	R&D to Sales %	Mkt Value $US mln	Cash Dividends $US mln	TSR %
Jun-85	140.42						
Jun-86	197.51	40.66	26.33	10.39	667.74	0.00	
Jun-87	345.89	75.12	27.62	11.01	2666.89	0.00	399.39
Jun-88	590.83	70.81	28.64	11.81	3579.81	0.00	134.23
Jun-89	803.53	36.00	27.20	13.72	2880.70	0.00	80.47
Jun-90	1183.45	47.28	29.45	15.26	8533.73	0.00	296.24
Jun-91	1843.43	55.77	32.25	12.77	11843.53	0.00	138.78
Jun-92	2758.73	49.65	30.64	12.77	18858.00	0.00	159.23
Jun-93	3753.00	36.04	28.67	12.52	24728.00	0.00	131.13
Jun-94	4649.00	23.87	25.79	13.12	29529.50	0.00	119.42
Jun-95	5937.00	27.70	23.30	14.49	52779.00	0.00	178.73
Jun-96	8671.00	46.05	25.34	16.51	71474.38	0.00	135.42
Jun-97	11358.00	30.99	26.46	16.95	150512.63	15.00	210.60
Jun-98	14484.00	27.52	22.44	17.27	265952.25	28.00	176.72
Jun-99	19747.00	36.34	22.25	15.04	459144.56	28.00	172.65
Jun-00	22956.00	16.25	19.35	16.44	419360.00	13.00	91.34
Jun-01	25296.00	10.19	15.62	17.31	389528.00	0.00	92.89
CAGR-%	38.35				52.90		

Microsoft. Historical Financial Performance. Period: June, 85 till June, 01.

Appendix 11c. The Best Performers Ranking

The numerical score of the different variables is based on the statistical function and the key data points are:

Key data points	Score
Lower than the first quartile	1
First quartile to the median	3
Median to the third quartile	6
Higher than the third quartile	9

An example of the evolution of the Sales Growth variable for the analysed 2004 Spanish Manufacturers of Electrical Products Industry is:

Companies	2002 th euros	2003 th euros	2004 th euros	2004-03 % CAGR	2004-02 % CAGR	2004-03 % Scores	2004-02 % Scores	NIF
ABB AUTOMATION PRODUCTS S	194677	207345	221177	6.67	6.59	6	6	A08054447U
LEGRAND ESPANOLA SL	53941	56088	63003	12.33	8.07	9	6	B08272064U
CAHORS ESPANOLA SA	19140	18798	19526	3.87	1.00	3	1	A17015561U
CIMA BOX 2000 S.L.	10204	14181	14383	1.43	18.72	1	9	B61730487U
CIRCUTOR SA	39330	43627	47049	7.84	9.37	6	9	A08513178U
CLAVED SA	11647	11573	12730	10.00	4.55	9	3	A08261232U
DRAKA CABLES INDUSTRIAL SA	87471	97457	130104	33.50	21.96	9	9	A08395162U
ELDON ESPANA SOCIEDAD ANO	16951	17852	19462	9.02	7.15	6	6	A29904265U
FABRICA ELECTROTECNICA JOS	31796	35186	37733	7.24	8.94	6	9	A08074767U
FEGEMU SA	15783	15873	16501	3.96	2.25	3	1	A20078820U
GE POWER CONTROLS IBERICA	121680	121785	122673	0.73	0.41	1	1	B80487994U
GRUPO DE EMPRESAS TEMPER	32679	33145	35050	5.75	3.56	6	3	B33538760C
GRUPO GENERAL CABLE SISTEM	298169	311623	429600	37.86	20.03	9	9	A08102790U
HAGER SISTEMAS S.A.	33963	34170	38044	11.34	5.84	9	6	A58490392U
HAZEMEYER S.A.	16096	16395	16741	2.12	1.98	1	1	A08282337U
HISPANO MECANO ELECTRICA S	100087	98117	103363	5.35	1.62	3	1	A08114357U
JUNG ELECTRO IBERICA S.A.	3965	5068	6068	19.75	23.71	9	9	A61775227U
LEGRAND ESPANOLA SA (EXTIN	83321	88734	95776	7.94	7.21	6	6	A28188548U
MOELLER ELECTRIC S.A.	43735	39921	41572	4.14	-2.50	3	1	A08082158U
NEXANS IBERIA S.L.	113219	118894	123996	4.29	4.65	3	3	B08359879U
OMRON ELECTRONICS IBERIA S	72283	76668	78652	2.59	4.31	1	3	A28477271U
ORBIS TECNOLOGIA ELECTRICA	22137	23384	24447	4.55	5.09	3	3	A28757722U
PEPPERL FUCHS SOCIEDAD AN	9057	9359	9481	1.30	2.31	1	3	A48068506U
PRYSMIAN CABLES Y SISTEMAS	197284	203807	251180	23.24	12.84	9	9	A08958381U
RITTAL DISPREL S.A.	22555	23363	24070	3.02	3.30	1	3	A08829202U
ROCKWELL AUTOMATION SA	8908	8807	8845	0.43	-0.35	1	1	A28579902U
SCHNEIDER ELECTRIC ESPANA	551066	583185	633232	8.58	7.20	6	6	A08008450U
SICK OPTIC ELECTRONIC SA	12498	14030	16196	15.44	13.84	9	9	A59102368U
SIEMENS-PRODUCTOS SISTEMA	263571	264722	237268	-10.37	-5.12	1	1	A28006377U
SIMON SA	112913	123739	130601	5.55	7.55	3	6	A08078651U
Total	2600129	2716893	3008525					
Change in %		4.49	10.73					
			1st Quartile	3.2364495	2.26520598			
			Median	5.64626824	5.46279102			
			3rd Quartile	9.75635131	8.72090464			

CAGR = Compound Annual Growth Rate (%)

References

Abel, A., 1985, "A Stochastic Model of Investment, Marginal q and the Market Value of the Firm", *International Economic Review*, Vol. 26, No 2, 305-322.

Aigner, D., Lovell, C., and Schmidt, P., 1977, "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics,* 6, 21-27.

Ait-Sahali, Y., and Hansen, L.P., 2005, *Handbook of Financial Econometrics*, http://home.uchicago.edu/_lhansen/handbook.htm

Alexander, J., 2007, *Performance Dashboards and Analysis for Value Creation*, Wiley Finance.

Allen, P.,1988, Combining Directions and Methods of Development, Business Policy, University of Durham, 31.3, 25.

Altman, E., 1968, "The Prediction of Corporate Bankruptcy: A Discriminant Analysis", *Journal of Finance*, Vol. 23, No 1, 193-194.

_______, 1993, *Corporate Financial Distress and Bankrupcy*, John Wiley & Sons, Ch.8.

Alvarez, N., 2000, *Econometría I. Modelos Econométricos estructurales, multiecuacionales y otras cuestiones*. Editorial Centro de Estudios Ramón Areces.

_______., 1999, *Aplicaciones de Econometría*. Editorial Centro de Estudios Ramón Areces.

Andres, J., Escribano, A., Molinas, C., and Taguas, D., 1990, *La Inversión en España: Econometría con restricciones de equilibrio*, Antoni Bosch Editor, Instituto de Estudios Fiscales, 3.3, 91.

Andrews, K.R., 1971, *The Concept of Corporate Strategy*, 3rd Ed., Irwin, Homewood, IL.

Ang, A., and Bekaert, G., 2006, "Stock Return Predictability: Is it there?", *Columbia University and NBER.*

Ang, A., and Liu, J., 1998 and 2001, "A General Affine Earnings Valuation Model", Co*lumbia University,* UCLA and NBER.

Ansoff, H. I., 1965, *Corporate Strategy: An Analytical Approach to Business Policy for Growth and Expansion*, McGraw-Hill, New York.

Ansoff, H. I., and Mc Donnell, E., 1990, *Implanting Strategic Management*, 2nd Ed., Prentice Hall, New York..

Arellano, M., 2003, *Panel Data Econometrics*, Oxford University Press.

Ashworth, G., 1999, *Delivering Shareholder Value through Integrated Performance Management*, Financial Times-Prentice Hall.

Baghai, M., Coley, S. and White, D., 1999, *The Alchemy of Growth*, Orion Business, London.

Bakshi, G., and Chen, Z., 1998 and 2004, "Stock Valuation in Dynamic Economies", *Ohio State University,* Working Paper.

Baltaghi, B., 2006, *Panel Data Econometrics*. Theoretical Contributions and Empirical Applications. Elsevier Science.

________., 2008, *Econometric Analysis of Panel Data*, 4th Ed., John Wiley & Sons Ltd.

Balachandran, S., and Mohanram, P., 2006, "Is Residual Income Really Uninformative About Stock Returns?", *Columbia Business School.*

Barnhill, T.M. and Maxwell, W.F., 2002, "Modelling correlated market and credit risk in fixed income portfolios", *Journal of Banking and Finance*, 26, 347-374.

Bass, F.M. and Clarke, D.G., 1972, "Testing Distributed Lag Models of Advertising Effect", *Journal of Marketing Research*, Vol. 9, No 3, 303, Table 2.

Baum, C.F., 2006, *An Introduction to Modern Econometrics using Stata*, A Stata Press Publication, Texas, 9.

Beaver, W., 1966, "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, Vol. 4, 71-111.

_______, 1968, "Market Prices, Financial Ratios, and the Prediction of Failure", *Journal of Accounting Research*, Vol. 6, No 2, 179-192.

Benneth Stewart III, G., 2000, *The Quest for Value*, Spanish Edition, 3, 97.

Benninga, S., 2001, *Financial Modeling*, 2nd Ed., Massachusetts Institute of Technology.

Biddle, G., Bowen, R., and Wallace, J., 1997a, "Does EVA beat Earnings?: Evidence on associations with stock returns and firm values", *Journal of Accounting and Economics*, 24, 301-336.

_______, 1997b, "Does EVA beat Earnings ?. Evidence on Associations with Stock Returns and Firm Value", *Journal of Accounting and Economics*, 24, 3, 275-300.

Black, Dr A., Wright, P., Bachman, J., and Davies, J., 1998, *In Search of Shareholder Value: managing the drivers of performance*, Financial Times, Pitman Publishing, 7, 91.

Bloom, N., and Van Reenen, J., 2006, "Measuring and explaining management practices across firms and countries", *CEP- Center for Economic Performance*, Discussion Paper No 716.

Bloom, N., Sadun, R., and Van Reenen, J., 2007, "Americans Do IT Better: US Multinationals and the Productivity Miracle", *CEP-Centre for Economic Performance*, Discussion Paper No 788, 11.

Blundell, R., Bond, S., Devereaux, M. and Schiantarelli, F., 1992, "Investment and Tobin's Q", *Journal of Econometrics*, 51, 233-257.

Blundell, R., Griffith, R., and Van Reenen, J., 1999, "Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms", *Review of Economic Studies*, Vol. 66, No 3, 529-554.

Bodenhorn, D., 1964, "A Cash-Flow concept of Profit, *The Journal of Finance*, Vol. 19, No 1, 16-31.

Bower, D., and Bower, R., 1969, "Test of a Stock Valuation Model", *Journal of Finance*, Vol. 25, No 2, 483-492.

Brealey, R., and Myers, S., 1996, *Principles of Corporate Finance*, 5th Ed., McGraw-Hill.

Brigham, E., and Gapenski, L., 1997, "Business Risk", *Financial Management: Theory and Practice*, Ch. 6 and 10.

Brooks, C., 2005, *Introductory Econometrics of Finance*, 6th Ed., Cambridge University Press.

Brush, C., and Vanderwerf, P., 1992, "A comparison of methods and sources for obtaining estimates of new venture of performance", *Journal of Business Venturing*, Elsevier Science Publishing, 7, 157-170.

Campbell, J., Lo, A., and MacKinlay, A., 1997, *The Econometrics of Financial Markets*, Princeton University Press.

Canals, J., 2000, *Managing Corporate Growth*, Oxford University Press.

Carrascal, U., González, Y., and Rodríguez, B., 2001, *Análisis Econométrico con EViews*. RA-MA Editorial.

Carton, R., and Hofer, C., 2006, *Measuring Organizational Performance. Metrics for Entrepreneurship and Strategic Management Research*, Edward Elgar, Cheltenham.

Chakravarthy, B., 1986, "Measuring strategic performance", *Strategic Management Journal*, Vol. 7, No 5, 437-458.

Chandler, A., 1962, *Strategy and Structure*, The MIT Press, Cambridge.

_______, 1990, *Scale and Scope*, Harvard University Press, Cambridge.

Chang, C., Chen, Z., and Dong, M., 1999, "Investing with a Stock Valuation Model ", *Ohio State University,* Department of Finance.

Chen, S. and Dodd, J., 1998, "Usefulness of Operating Income, Residual Income, and EVA: A Value-Relevance Perspective", Working Paper, *Drake University*, Des Moines, Iowa.

Chen, P., and Zhang, G., 2007, "How do accounting variables explain stock price movements? Theory and Evidence", *Journal of Accounting and Economics*, Vol. 43, 219-244.

Choi, I., 2001, Unit root tests for Panel Data, *Journal of International Money and Finance*, 20, 249-272.

Clark, J., Chiang, T. and Olson, G., 1989, *Sustainable Corporate Growth: a model and management planning tool*, Quorum Books, Westport, Connecticut.

Clarke, T., and Clegg S., 1998, *Changing Paradigms: The transformation of Management knowledge for the 21st century*, Chapter 1. Paradigms: The Implications of Information Technology, 29-34, and Chapter 3. Digitalization, 145-190, HarperCollinsPublishers, London.

Coase, R.H., 1937, "The Nature of the Firm", *Economica*, 4, 386-405.

Cohan, P., 2000, "How e-Commerce creates competitive advantage", *e-Profit*, Amacom, New York, 4, 69-94.

Colley, J.L., Doyle, J. and Hardie, R., 2001, *Corporate Strategy*, McGraw-Hill, 11, 119.

Copeland, T., Koller, T., and Murrin, J., 2000, *Valuation: Measuring and Managing the Value of Companies*, 3rd Ed., John Wiley & Sons, New York.

Crouhy, M., Galai, D., and Mark, R., 2000, "A comparative analysis of current credit risk models", *Journal of Banking and Finance*, 24, 59-117.

Cubbin, J., and Geroski, P., 1987, "The convergence of Profits in the Long Run: Inter -Firm and Inter-Industry comparisons", *Journal of Industrial Economics*, 427-442.

Dambolena, I., and Khoury, S., 1980, "Ratio Stability and Corporate Failure", *Journal of Finance*, Vol. 35, No 4, 1017-1026.

Damodaran, A., 2002, *Investment Valuation*, 2nd Ed., John Wiley & Sons Inc.

Davidson, R. and MacKinnon, J., 1993a, *Estimation and Inference in Econometrics*, Oxford University Press, 11.6, 401 and 552-556

_______, 1993b, "Models and Data-generating process", *Estimation and inference in Econometrics*, Oxford University Press, 2, 53-54.

Dechow, P., Hutton, A., and Sloan, R., "An empirical assessment of the residual income valuation model", *Journal of Accounting and Economics*", 26, 1-34.

Dess, G., and Robinson, R., 1984, "Measuring organizational performance in the absence of objective measures: The case of the privately-held firm and conglomerate business unit", *Strategic Management Journal*", Vol. 5, No 3, 265-273.

Dillon, K. and Baden, C., 2006, "Growing your Business", *Harvard Business Review–Onpoint*, Executive Ed., Boston.

Dong, M., 2000, "A General Model of Stock Valuation", *Ohio State University,* Department of Finance.

Doorley III, T., and Donovan, J., 1999, *Value-Creating Growth*, Jossey-Bass Publishers.

Draca, M., Sadun, R., and Van Reenen, J., 2006, "Productivity and ICT: A Review of the evidence", CEP-*Center for Economic Performance*, Discussion Paper, 749.

Easton, P., and Harris, T., 1991, "Earnings as an Explanatory Variable for Returns", *Journal of Accounting Research*, Vol. 29, No 1, 19-36.

EBITDA is also named Operating Income Before Depreciation. It represents Net Sales less Cost of Goods Sold and Selling, General, and Administrative expenditures before deducting Depreciation, Depletion, and Amortization. Compustat (North America). Standard and Poor's, 1998, *Compustat (North America): Data Guide*, 6, 31.

Engle, R.E. and Granger, C.W.J., 1987, "Co-Integration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 2, 251-276.

Engle, R.F. and Yoo, B.S., 1987, "Forecasting and testing in co-integrated systems", *Journal of Econometrics*, 35, 157.

EViews5 User's Guide, 2004, "Granger Causality", *Quantitative Micro Software*, 12, 376.

Fama, E., and French, K., 1996, "Multifactor Explanations of Asset Pricing Anomalies", *Journal of Finance*, Vol. 51, No 1, 55-84.

Fernandez, P., 2002, *Valuation Methods and Shareholder Value Creation*, Academia Press, Elsevier Science.

Finkel, S., 1995, *Causal Analysis with Panel Data*, Sage Publications.

FitzRoy, F. and Kraft, K., 2004, "Co-Determination, Efficiency and Productivity", *IZA -Institute for the Study of Labour*, Discussion Paper, 1442, 14.

Frost., B., 1998, *Measuring Performance*, Fairway Press.

Fruhan, W., 1979, *Financial Strategy, Studies in the Creation, Transfer and Destruction of Shareholder Value*, Homewood, Illinois, Richard D. Irwin.

Garnier, J-P., 2008, "Rebuilding the R&D Engine in Big Pharma", *Harvard Business Review*, 68.

Garvey, G., and Milbourn, T., 2000, "EVA versus Earnings: Does it matter which is more highly correlated with Stocks Returns?", *Journal of Accounting Research*, Vol. 38, Supplement: Studies on Accounting Information and the Economics of the Firm, 209-245

Gasol, A., 2006, *La Industria Bancaria en el Marco de Basilea II*, ACCID Contabilidad y Dirección.

General Electric Co: Corporate Financial Planning and Analysis, 1996, "Measurements Analysis and Planning: Analysing changes in profitability", *MAP Financial Bulletins*, MAP-402, 3.

Geroski, P., Machin, S. and Walters, C., 1997, "Corporate Growth and Profitability", *Journal of Industrial Economics*, 45, 2, 171-189.

Geroski, P., and Jacquemin, A., 1988, "The Persistence of Profits: A European Comparison", *Economic Journal*, Vol. 98, No 391, 375-389.

Geroski, P., 1998, "An Applied Econometrician's view of Large Company Performance", *CEPR Centre for Economic Policy Research*, Discussion Paper No 1862.

_______, 1999, "The Growth of Firms in Theory and Practice", *CEPR Centre for Economic Policy Research*, Discussion Paper No 2092.

Ghosal, S., Hahn, M. and Moran, P., 1999, "Management Competence, Firm Growth and Economic Progress", Contributions to Political Economy, ConPec, *Cambridge Political Economy Society*, 18, 121-150.

González, X., and Jaumandreu, J., 1998, "Thresholds effects in product R&D decisions: theoretical framework and empirical análisis", *FEDEA*, 23

Gourieroux, C., and Jasiak, J., 2001, *Financial Econometrics*, Princeton University Press.

Graph borrowed from Lilien, G. and Rangaswamy, A., 2006, *Marketing Engineering: computer-assisted marketing analysis and planning,* 2nd Ed., Prentice Hall, 37- 40.

Greene, W., 2000, *Econometric Analysis*, 4th Ed., Prentice Hall, New Jersey.

Greiner, L.E., 1972, "Evolution and Revolution as Organizations Grow", *Harvard Business Review*, 37-46.

Griffith, R., Redding, S., and Van Reenen, J., 2004, "Mapping the two faces of R&D: Productivity growth in a panel of OECD Industries", *The Review of Economics and Statistics*, 86(4), 883-895.

Griliches, Z., 1981, "Market Value, R&D and Patents", *Economic Letters*, 7, 183-187.

Griliches, Z., Hall, B. and Pakes, A., 1988, "R&D, Patents, and Market Value revisited: Is there a second (technological opportunity) factor?, *NBER National Bureau of Economic Research*, Working Paper No 2624.

Gujarati, D., 1992, *Essentials of Econometrics*, McGraw-Hill.

Hall, B., 1990, "The Manufacturing Sector Master File", *NBER- National Bureau of Economic Research*, Working paper No 3366, Appendix B, 40.

_______., 1993, "The Stock Market's Valuation of R&D Investment during the 1980's", *American Economic Review*, Vol. 83, 2, 259-264.

Hall, B., Jaffe, A. and Trajtenberg, M., 2000, "Market Value and Patent Citations: A First Look", *NBER National Bureau of Economic Research*, Working Paper 7741.

Hamilton, J., 1994, *Time Series Analysis*, Princeton University Press.

Harvard Business Review, 1998, *Measuring Corporate Performance*, Harvard Business School Press.

_______., 2001, *Mergers and Acquisitions*, Harvard Business School Press.

_______., 1998, *Strategies for Growth*, Harvard Business School Press.

Hirschey, M., 1985, "Market Structure and Market Value", *Journal of Business*, Vol. 58, No 1, 89-98.

Hsieh, P., Koller, T., and Rajan, S.R., 2006, *The misguided practice of earnings guidance.* The McKinsey Quarterly, Corporate Finance, Performance.

Hsiao, C., 2003, *Analysis of Panel Data*, 2nd Ed., Cambridge University Press..

Huber-White HCCME. "Heteroskedasticity consistent covariance matrix estimator". See Davidson, R. and MacKinnon, J., 1993, "Covariance matrix estimation", *Estimation and inference in econometrics*, Oxford University Press, 17.5, 607-611.

Islam, S.M.N., and Watanapalacahikul, S., 2005, *Empirical Finance. Modelling and Analysis of Emerging Financial and Stock Markets*. Physica-Verlag Heidelberg.

Ittner, C., and Larcker, D., 2001, "Assessing empirical research in managerial accounting: a value-based management perspective", *Journal of Accounting and Economics*, 32, 349-410.

Jaffe, A., 1986, "Technological Opportunity and Spillovers of R&D: Evidence from Firm's Patents, Profits, and Market Value", *The American Economic Review*, Volume 76, Issue 5, 984-1001.

Jansen, D., and Wang, Z., 2006, "Evaluating the FED Model of Stock Price Valuation: An out-of-sample forecasting perspective", *Econometric Analysis of Financial and Economic Time Series/Part B, Advances in Econometrics,* Vol. 20, 179-204.

Jackson, M., and Stauton, M., 2001, *Advanced modelling in finance using Excel and VBA*, John Wiley and Sons Ltd.

Jarrow, R. and Turnbull, S., 2000. "The intersection of market and credit risk", *Journal of Banking and Finance*, 24, 271-299.

Jaruzelski, B, Dehoff, K, and Bordia, R., 2005, "Smart Spenders. The Global Innovation 1000 - Annual Analysis of the World's 1000 Largest R&D spenders", *Booz Allen Hamilton Consulting Company*, 50.

Johansen, S., 1988, "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, 12, 231-54.

_______, 1991, "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, 6, 1551-1580.

Johnston, J., and Dinardo, J., 2001, *Métodos de Econometría*, Vicens Vives.

Kaidos, W., 1999, *Operational Performance Measurement*, CRC Press LLC.

Kald, M., and Nilsson, F., 2000, "Performance Measurement at Nordic Countries", *European Management Journal*, Vol. 18, No 1, 113-127.

Khan, A., 1985, "Analysing financial statements for managerial performance measurement and bankruptcy prediction", *Engineering Management International*, 3, 165-174.

Knop, R., Ordovas, R., and Vidal, J., 2004, *Medición de Riesgos de Mercado y Crédito*, Editorial Ariel.

Lee, M-J., 2002, *Panel Data Econometrics*, Academia Press.

Löffler, G. and Posch, P.N., 2007, *Credit Risk Modelling using Excel and VBA*, Wiley Finance.

Kennedy, A., 2000, "Milking the Traditional Businesses", *The End of Shareholder Value*, Orion Business Books, London, Part 2, 4, 54-55.

Kleidon, A., 1986, "Variance Bounds Tests and Stock Price Valuation Models", *Journal of Political Economy*, Vol. 94, No 5, 953-1001.

Lilien, G. and Rangaswamy, A., 2006, *Marketing Engineering: computer-assisted marketing analysis and planning,* 2nd Ed., Prentice Hall, 37-40.

Little, J., 1979, "Aggregate Advertising Response Models: The State of the Art", *Sloan School of Management*, M.I.T., Working Paper: 1048-79.

Löffler, G. and Posch, P.N., 2007, *Credit Risk Modelling using Excel and VBA*, Wiley Finance.

Madden, B., 1999-2000, *CFROI Valuation. A Total System Approach to Valuing the Firm*, Oxford: Butterworth-Heinemann.

Mairesse, J., & Hall, B., 1996, "Estimating the Productivity of Research & Development: An exploration of GMM methods using data en French and United States manufacturing firms", *NBER-National Bureau of Economic Research*, Working Paper No 5501.

Marcus, A.A., 2006, *Big Winners and Big Losers: The 4 secrets of long-term business and failure*, Wharton School Publishing.

Martin., J., and Petty, J., 2000, *Value Based Management: the corporate response to the shareholder value*, Harvard Business School Press.

Martin, S., 1994, *Industrial Economics*: *Economic Analysis and Public Policy*, 2nd Ed., Prentice Hall, New Jersey, 1, 3.

Mauleón, I., 1986, "La Inversión en Bienes de Equipo: Determinantes y Estabilidad", Servicio Estudios Banco de España, *Investigaciones Económicas*, Vol. X, No 2, 251-278.

Mays, E., 2004, *Credit Scoring for Risk Managers – The Handbook for Lenders*, Thomson – South Western.

McFadden, D., 1974, "Conditional logit analysis of qualitative choice behavior", *Frontiers in Econometrics*, 105-142.

McGrath, J., Kroeger, F., Traem, M. and Rockenhaeuser, J., 2000, *The Value Growers: achieving competitive advantage through long-term growth and profits*, McGraw-Hill, New York.

McNeil, A. J., Frey, R. and Embrechts, P., 2005, *Quantitative Risk Management*, Princeton Series in Finance, Princeton University Press.

Meeusen, W, and Van den Broek, J., 1977, "Efficiency estimation from Cobb-Douglas production functions with composed error", *International Economic Review,* 18, 435-444.

Meyer, M.H., 2007, *The Fast Path to Corporate Growth: Leveraging knowledge and technologies to new market applications*. Oxford University Press.

Murphy, G., Trailer, J., and Hill, R., 1996, "Measuring Performance in Entrepreneurship Research", *Journal of Business Research*, Elsevier Science, 36, 15-23.

Nelson, R. and Winter, S., 1982, *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge.

Newey, W.K. and West, K.D., 1987, "A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica*, 55, 703-708.

Newey-West HACCME. "Heteroskedasticity and autocorrelation consistent covariance matrix estimator". See Davidson, R. and MacKinnon, J., 1993, "Covariance matrix estimation", *Estimation and inference in econometrics*, Oxford University Press, 17.5, 612.

Nissim, D., and Penman, S., 2001, "An Empirical Analysis of the Effect of Changes in Interest Rates on Accounting Rates of Return, Growth, and Equity Values", *Columbia University, Graduate School of Business.*

Novales, A., 2002, *Econometría*, McGraw-Hill.

O'Byrne, S., 1999, "EVA and its Critics", *Journal of Applied Corporate Finance*, Vol. 12, No 2, 92-96.

Officer, R., 1973, "The Variability of the Market Factor of the New York Stock Exchange", *Journal of Business*, Vol. 46, No 3, 434-453.

Ohlson, J., 1979, "Risk, Return, Security-Valuation and the Stochastic Behavior of Accounting Numbers", *Journal of Finance and Quantitative Analysis*, Vol. XIV, No 2, 317-336.

_______, 1980, "Financial Ratios and the Probabilistic Prediction of Bankruptcy", *Journal of Accounting Research*, Vol. 18, No 1, 109-131.

Olve, N.G., Roy, J., and Wetter, M., 1997, *Performance Drivers*, John Wiley and Sons.

Opinion Research Corporation, 2006, "The NYSE CEO Report 2007: Planning for Growth, Valuing People", *NYSE Group*, *New York*.

Otero, J. M., 1993, *Econometría. Series temporales y predicción*, Editorial AC, Madrid, 11, 369.

Pandey, I., 2005, "What Drives Shareholder Value", *Indian Institute of Management, Ahmedabad*, Working Paper No 2005-09-04.

Penrose, E., 1995, *The Theory of the Growth of the Firm*, 2nd Ed., Oxford University Press, New York..

Peña, J. I., 2002, *La Gestión de Riesgos Financieros de Mercado y Crédito*, Financial Times-Prentice Hall, 1, 3-115

Peña, J., Estavillo, J., Galindo, M., Leceta, M., and Zamora, M., 1999, *Cien Ejercicios de Econometría*, Editorial Pirámide.

Pérez, C., 2008, *Econometría Avanzada. Técnicas y Herramientas*, Pearson Prentice Hall.

Pindyck, R., and Rubinfeld, D., 1998, *Econometric Models and Economic Forecast*, 4th Ed., McGraw-Hill.

Prahalad, C.K., and Hamel, G., 1990, "The Core Competence of the Corporation". *Harvard Business Review.*

Quantitative Micro Software LLC, 2000, *EViews 4.0 and 5.0 User's Guide.* QMS Press.

Rajan, M., Reichelstein, S., and Soliman, M., 2006, "Conservatism, Growth, and Return on Investment", *Stanford University, Graduate School of Business.*

Ramanathan, R., 1989, *Introductory Econometrics with applications*, 4th Ed., The Dryden Press.

_______, 1997, "Multicollinearity and Forecasting Performance", *Introductory Econometrics with Applications*, 4th Ed., The Dryden Press, 5, 236.

Rappaport, A., 1998, *Creating Shareholder Value: a guide for managers and investors*, 2nd Ed., The Free Press, New York.

Reilly, F., and Brown, K., 1997, "Risk Analysis", *Investment Analysis and Portfolio Management*, 5th Ed., The Dryden Press, 12, 398.

Roberts, J., 2004, *The Modern Firm: organizational design for performance and growth*, Oxford University Press.

Ross, S., Westerfield, R., and Jordan, B., 1995, *Fundamentals of Corporate Finance*, 3rd Ed., Irwin.

Salvatore, D., 1982, *Statistics and Econometrics*, McGraw-Hill.

Scott, M.C., 1998, *Value Drivers. The Manager's Guide to Driving Corporate Value Creation.* John Wiley & Sons Ltd.

Shepherd, W., 1972, "The elements of market structure", *Review of Economics and Statistics*, Vol. 54, No 1.

Siegel, J., 2002, *Stocks for the Long Run*, 3rd Ed., McGraw Hill, Part 4, 17, 288.

Singleton, K., 2006, *Empirical Dynamic Asset Pricing*, Princeton University Press.

Slatter, J., 2001, *The 100 Best Stocks you can buy 2002*, Adams Media Corporation, Avon, 189.

Soley, J., and Rahnema, A., 2004, *Basilea II. Una nueva forma de relación Banca-Empresa.* McGraw-Hill.

Slywotzky, A., and Morrison, D., 1997, *The Profit Zone*, Times Books, Random House, New York, Appendix 1.

_______., 1999, *Profit Patterns*, Times Business.

Slywotzky, A., Wise, R. and Weber, K., 2004, *How to Grow when Markets Don't*, Warner Business Books, New York.

Standard and Poor's, 1998, "Income Statement", *Compustat (North America): Data Guide*, Mc Graw-Hill, Englewood, 6-1.

_______, 2002, "GICS-Global Industry Classification Standard". *S&P Analysts' Handbook*. Annual Edition, McGraw Hill, New York.

_______, 2005,"Annual Default Study: Corporate Defaults Poised to Rise in 2005", *Global Fixed Income Research*, Table 13, Column Y1, 18.

StataCorp, 2003, *Cross-Sectional Time-Series*, Release 8.0, Stata Press.

_______., 2009, *Longitudinal Data/Panel Data*, Release 11, Stata Press.

_______., 2009, *Time Series*, Release 11, Stata Press.

Stern, J., Shiely, J., and Ross, I., 2001, *The EVA Challenge*, John Wiley & Sons, New York.

Stewart III, G.B., 1991-1999, *The Quest for Value*, Harper, New York.

Stock, J., and Watson, M., 2006, *Introduction to Econometrics*, 2nd Ed., Addison Wesley Series.

Taylor, S., 2005, *Asset Price Dynamics, Volatility and Prediction*, Princeton University Press.

Tirole, J., 2006, *The Theory of Corporate Finance*, Princeton University Press.

Venkatraman, N., and Ramanujam, V., 1986, "Measurement of Business Performance in Strategy Research: A Comparison of Approaches", *Academy of Management Review*, Vol. 11, No 4, 801-814.

Verbeek, M., 2000, *A Guide to Modern Econometrics*, John Wiley & Sons.

Walsh, C., 1996, *Key Management Ratios*, FT Pitman Publishing, 3, 28.

Wang, P., 2008, *Financial Econometrics*, Routledge Advanced Texts in Economics and Finance.

Warner, A., and Hennell, A., 2001, *Shareholder Value Explained*, 2nd Ed., Financial Times, Prentice Hall.

White, G., Sondhi, A., and Fried, D., 1997, *The Analysis and Use of Financial Statements*, 2nd Ed., John Wiley & Sons.

________, 1998, "Earnings Variability", *The Analysis and Use of Financial Statements*, 18, 987-1018.

White, H., 1980, "Heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity", *Econometrica*, 48, 817-838.

Whittington, R., Pettigrew, A., Peck, S., Fenton, E., and Conyon, M.,1999, "Change and Complementarities in the new Competitive Landscape: A European Panel Study, 1992-1996". *Organization Science*, Vol. 10, No 5, 583-600.

Wilson, P., and Bates, S., 2003, *The Essential Guide to Managing Small Business Growth*, John Wiley and Sons.

Woo, C.Y., and Willard, G., 1983, "Performance Representation in Strategic Management Research: Discussions and Recommendations", Paper presented at the Annual Meeting of the Academy of Management, Dallas.

Wooldridge, J.M., 2002, *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, 10, 274-276.

Williamson, O., 1975, *Markets and Hierarchies*, The Free Press, New York..

Zimmerman, J., 1997, "EVA and Divisional Performance Measurement: Capturing Synergies and Other Issues", *Journal of Applied Corporate Finance*, 10, 98-109.

Subject Index

O

P

R

S

T

U

V

W