Corporate strategies – the institutional approach

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June 2010

Discussion papers series, June 2010

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Keywords: institutional economics, strategy, corporation

Contents

Abstract

The present paper introduces a model of corporate strategies, based on institutional theories of the firm and formalized with the concepts of the theory of games. Corporate strategies are balanced outcomes of four social games: capital market, corporate governance, product market and social responsibility. Two empirical applications of the model are then introduced: a qualitative one, consisting in comparative study of strategies deployed by Royal Dutch Shell and Israel Corporation, then a quantitative one, presenting a study of capital accumulation and operational efficiency in 79 companies listed in the Warsaw Stock Exchange.

Executive summary

Somewhere halfway between classical economics and management science, institutional economics seem to be a good ground for predicting the behaviour of corporations, taking into account their role as social structures and social players, but without psychologizing and with a clear focus on facts and not on forward – looking statements. Using the theory of games as a means of formalizing and putting together different institutional theories of the firm, the present paper introduces a model in which corporate strategies, defined as sets of real behaviour, are a balance between four social games: capital market, corporate governance, product markets and social responsibility. All the four games are, on the long – run, subgames of the Selten's extensive game with imperfect recall, and, on the short – run, they are Harsanyi's games with imperfect information, in which players play mixed Nash's strategies composed of pure, univariate strategies. Each game is assumed to have the potential to evolute in two opposite directions: towards the Nash's dynamic equilibrium or towards a clear lack of such dynamic equilibrium. In the first case, firms integrate the outcomes of all the four games into relatively consistent corporate strategies focused on maximisation of the rate of return on capital invested, with tendency to balance, more of less fairly, externalities absorbed with those emitted in the social responsibility game. Should there not be dynamic equilibrium in any of the games, corporate strategies lack consistency and more or less aimed at exploiting uncertainty rather than maximising efficiency of the business. In order to evaluate the practical cognitive value of the model and deepening its assumptions, two empirical applications of the model are introduced: a) a qualitative one, comparing corporate strategies of Royal Dutch Shell and Israel Corporation b) a quantitative one, studying the relationship between operational efficiency and capital accumulation in a sample of 79 companies listed in the Warsaw Stock Exchange, Poland. Comparing Royal Dutch Shell and Israel Corporation reveals that the hierarchy of size in the oil & gas sector further shapes all the aspects of corporate strategies, capital accumulation and corporate governance included. This, in fact, inverts the popular view according to which the structure of the

sector is the result of individual strategies. The case study allows to define to types of corporate strategies: that of the “established giant” and that of “the aggressive challenger”. The first type is represented by Royal Dutch Shell and is characterised by: a relatively high uncertainty in the capital market game, a corporate governance marked by relatively a financial structure durably balanced between debt and equity, dominant position of management and the main lines of internal conflicts entangled around the redistribution of a substantially positive cash flow, a tendency to divest and discontinue business, with a clear focus on the core one, rather that acquiring new ones, a relatively high efficiency at the operational level and a demonstrable leadership in the technological race in core businesses. The second one, exemplified by Israel Corporation, features a relatively lower uncertainty as for capital markets, combined with both a strong position of block – holders and a strong financial leverage, key internal conflicts focusing on ways to acquire cash, notoriously lacking to cover all the plans of extensive growth, the latter being linked to a clearly pronounced corporate diversification, a relatively low operational efficiency and a position of technological follower. The quantitative study of companies listed in the Warsaw Stock Exchange, conducted via testing the dynamic correlation between their Tobin's q and their operational profit ratio, lead to conclude that an emerging capital market, like the Polish one, creates strong incentives for publicly listed companies to play on uncertainty rather than maximising efficiency of their businesses. However, those incentives taken into account, there seems to be a natural tendency of some companies to bet rather on long – term search of dynamic equilibrium rather than on short - term exploitation of uncertainty.

1. Introduction

Corporations are some of the biggest private organisations in the known history of the mankind. They display a highly developed ability to survive and maintain their institutional continuity in complex, quickly changing environment and their future behaviour is an important issue for many economic decisions are related to predicting the future possible behaviour of corporations. Consumers, employees, social activists, governments, as well as other corporations, have to make such predictions. In 1950 the net profits of the corporate sector corresponded to 0,2% of the US Gross Domestic Product, whilst the outlays of the US federal budget made 15,6%. In 1970 the same percentages changed to 0,3% for net corporate profits and 19,3% for federal budget outlays, then in 2007 the corporate sector in US generated an aggregate net profit of 14,9% of the GDP and the federal budget spent 19,6%. When the federal state remained at more or less the same position in relation to the whole US economy, the corporate sector greatly increased its relative importance. In United Kingdom, the total market value of shares listed in the London Stock Exchange was of some 8% of the GDP in 1950 and reached over 140% of the GDP in 2004 (Michie 2000). In 2008, the joint net losses of the two biggest American automotive companies, GM and Ford, were enough to cover five times the budgetary deficit of Poland. Besides the obvious need for corporate managers to predict the future decisions and reactions of other corporations - competitors, corporate clients and suppliers – corporations become increasingly important social partners for governments, social activists and employees, and predicting their behaviour is vital for many social decisions. Between the classical paradigm of optimisation on one hand, and the radical critics of corporations, like J.K. Galbraith or Naomi Klein, on the other hand there is quite a pragmatical need to predict the future behaviour of corporations. For example, what is the British Petroleum's behaviour likely to be in the next two years, after the catastrophe of its drilling platform in the Mexico Bay ? What actions are likely to undertake other oil & gas companies ? Will they reduce underwater drilling to the profit of exploiting oil sands in Northern Canada or, on the contrary, will they invest more in drilling

platforms to make them technologically more predictable ? Even if Naomi Klein is right, calling corporations a “de facto global government” and calling to “forces opposing corporate rule” (Klein 2009), what is the practical predictability of this alleged “global government” and what social actions are really sound as opposition to the “corporate rule” ? The goal of the present paper is twofold. From the theoretical point of view this is an attempt to find a viable compromise, as for assessing and studying corporate strategies, between two perspectives : the one of economics on one hand and that of management science on the other hand, with an underlying assumption that the so – called 'institutional school' is an appropriate background for seeking such a correspondence. From a more practical point of view the article aims at showing how to study information disclosed by corporations in the prospect to assess their future actions.

2. The theoretical background

First, let's point out an important fact concerning the very definition of strategy. In management science the concept uses to be approached from a militaristic point of view, as a plan or a bundle of plans (Hoskisson et al. 1999; Ansoff 1965; Learned et al. 1965; Porter 1980, 1981, 1985, 1991; Pralahad, Hamel 1990), with, however, a visible dissonance between plans and their real implementation (Quinn 1980; Mintzberg,Waters 1985; Kaplan, Norton 1992, 1996, 2000; Schendel, Hofer 1979; Horovitz 1979; Vancil 1973; Lorange, Scott Morton 1974; Newman 1975; Camillus, Grant 1980; Simmonds 1981; Band, Scanlan, 1995; Oldman, Tomkins 1999). There is another way of understanding the word strategy, more in the lines of natural sciences, like 'survival strategy' or 'hunting strategy'. In this second approach strategy is behaviour rather than plans. As prediction of corporate actions comes, it seems more important and more pragmatic to predict what the given corporation is likely to do than what it is likely to plan to do. The term of behaviour, applied to corporations, is a simplifying anthropomorphism too, however the concept is scalable. Individuals behave and collectivities behave too, but whilst individuals think and behave, collectivities behave only, without thinking. Thus, the so – called 'behaviour' of organisations can be

observed, at the difference of individuals' behaviour, without direct reference to any mental processes at the steering wheel, with grouping observations in modalities of a scale. As far as behaviour is concerned, observability of corporations comes as a key issue. There is a sharp difference between observing a corporation from inside and observing it from outside. The former, more frequently used in management science, focuses on peculiarities of every given firm and on processes going on inside this firm. The latter, more typical to economic sciences, seeks common denominators among firms and tends to put forth, with variable emphasis, financial information disclosed by and about corporations. The confrontation of these two perspectives of observation raises questions about accuracy and predictive power of financial statements (Shank, Govindarajan 1989; Wilson 1995; Khandawalla 1972; Gordon, Miller 1976; Otley 1994; Fisher 1995; Brancato 1995; Neely 1999) as well as that of non – financial disclosures, presentations of strategies included (Ferraro, Pfeffer, Sutton 2005; Ghoshal 2005). Classical and neoclassical economics assume that a firm maximises profits, cash - flows and shareholders' value, through operational excellence in product markets, in presence of relatively neutral financial markets (see for example: Friedman 1970; Modigliani, Miller 1958; Tobin 1961, 1969; Tobin, Brainard 1968, 1977; Backus, Brainard, Smith, Tobin 1980; Brainard, Shapiro, Shoven 1990). These assumptions encounter puzzling empirical evidence. Puzzling, because neither exactly confirming nor definitely rejecting the optimisation hypothesis. Mergers and acquisitions are among the most noticeable examples. On one hand, they are presented by corporate managers as rational decisions aimed at maximising shareholders' value. On the other hand, they use to take place in massive, cyclical waves, with very problematic efficiency, subsequent waves of divestitures and financial markets not neutral at all (Golbe, White 1993; Sudarsanam 2003; Salter, Weinhold 1979; Jensen 1986, 1993/1999; Gort 1962; Rumelt 1974; Meeks 1977; Steiner 1975; Seth 1990a; Seth 1990b; Singh, Montgomery 1987; Lubatkin 1987; Murphy 1985; Stewart, Glassman 1988). Corporate strategies seem to be much more about risk management, experimenting and coordination, with the trial and error method strongly present in the background, than about optimisation (Knight 1921; Kaldor 1935; Alchian,

Demsetz 1972). We are in the world of transaction costs, imperfect contracts, opportunistic behaviour and capital services supplied in discrete bundles, not by units (Coase 1937; Penrose 1959; Chandler 1962, 1977; Williamson 1975, 1985; Jensen 1993/1999).

Now, what's so special about corporate strategies, compared to strategies of smaller businesses ? In fact, three issues make crucial difference: size, continuity and interaction with financial markets. A corporation is not just a participant of broader social structures, this is a structure by itself, with its own vertical and horizontal dynamics, a well developed division of labour and conflicts of interests (Selznik 1957). Size gives it a unique influence upon its social responsibility, which includes market power, transmission of externalities and systemic risk to the aforementioned social responsibility (Means 1967), as well as the ability to create internal labour markets, more attractive financially than self - employment (Hamilton 2000; Poutvaara, Tuomala 2004; OECD 1992). Small private businesses seldom evolute to the institutional form of corporations. In that respect, corporations are not just a bigger copy of small firms, they are a completely different institutional type of economic agent (Uhlaner, Thurik 2003; Gyntelberg, Kyhl 1999; Kor, Mahoney 2000; Garnsey et al. 2003; Khan 2003). The difference covers institutional continuity, too. At the difference of private businesses, which do not develop economically important inter – generational transmission of knowledge, experience and capital, corporations display a highly developed ability of such transmission (Selznik 1957; Nelson, Phelps 1966; Clark et al. 1994). Size and institutional continuity of corporations are grounded in their peculiar contractual structure and the corresponding link with financial markets. Limited liability of every shareholder, freely tradable shares, legal personality and ability to act on behalf of its shareholders (debt contracting included) , separation of ownership and management, power and internal influence proportional to the capital invested and to information - all this makes that corporations offer unique possibilities of investment, and, in the same time, have immense possibilities of growth (Knight 1921; Stout 2004; Blair 2003; Hansmann et al. 2006; Alchian, Demsetz 1972; Jensen, Meckling 1976; Fama, Jensen 1983).

Whilst strongly linked to massive investment in new technologies (Weidenbaum, Jensen 1991; Roy 1997), corporations display a peculiar tendency to accumulate capital, increase profits and invest in R&D even when return on innovation is null or negative. In fact, the bulk of the global innovative effort takes place in 5 countries: USA, Japan and China as leaders, with France and United Kingdom as immediate followers, which all display, on the long run, a negative marginal value added on innovation. However, financial markets offer the possibility to compensate, by successful financial placements, the downturns of innovative projects. This possibility can be easily overused, which leads to frequently observed underinvestment of plant, property and equipment in corporations (Scitovsky 1954; Murphy et al. 1989; Redding 1996; Acemoglu 1996; Masters 1998). This, in turn, allows financial markets to reach such a Nash's dynamic equilibrium, in which it is dominated by corporations whose accumulation of capital is independent from their operational efficiency (Waśniewski 2008, 2009, 2010).

3. The model

On the long run, the basic question about future behaviour of any corporation is: will they focus on investing in the development of new technologies or will they try to minimize risk through extensive investment in non – specific financial assets. It is argued in the present paper that any action undertaken by any corporation will firstly aim its survival in terms of institutional continuity, then the moderation of its internal, natural conflicts of interests and only then, in the third place, any kind of economic optimisation comes as a motive. The theory of games, with behaviour as the unknown variable and the set of motives as a known constant, offers the possibility to translate general and quasi – tautological concepts like 'survival', 'conflicts' or 'optimisation' into practical tools of prediction. Basing on the three economic Nobel prized (1994) game theories – those of John Nash (Nash 1950a, 1950b, 1951, 1953), John Harsanyi (Harsanyi 1953; 1966; 1967; 1968) and Reinhard Selten (Selten 1975) – it is possible to build and validate a model of corporate strategies. These are the outcome of four games: CM, CG, PM and SE, played respectively at four

different plans: capital markets, corporate governance, product markets and social responsibility. In each of the four games a finite set of players plays Harsanyi's games with imperfect information, which are, in turn, subgames of a Selten's extensive game with imperfect recall. Each player *i* at the given moment *t* uses a set of pure Nash's strategies, which together for a mixed Nash's strategy, associated with a pay – off function (*Equation 1*).

Equation 1 – General formula of strategy in a game

$$S(i;t) = [MA(i;t); R(i;t)]$$

- where *S(i;t)* is the mixed strategy of the player *i* at the moment *t, MA(i;t)* is the set of modalities of action of the player *i* at the moment *t*, R(i;t) is the set of results achieved by the player *i* at the moment *t*.

The set of results *R(i;t)* is causally and functionally derived from the set of modalities of action *MA(i;t)*. Both causality and function are expressed by a general ratio *R(i;t)/MA(i;t),* which varies from player to player, as their individual strategies display different efficiency. *R(i;t)/MA(i;t)* varies in time, too, as players modify and test their modalities of action, evaluating them on the grounds of their own results and other players' results. Any given set of strategies *S* (for the same player at different moments or at the same moment for different players) is characterised by a variance *V(S)* of *R(i;t)/MA(i;t),* which, in turn, is the inversely proportional estimator of the overall consistency of the given set of strategies. At any given moment *t* in the given set of players there is a reference value *V*(S;t)* of *V(S;t)*, which is the critical level and beyond which strategies become inconsistent. There is dynamic equilibrium in the given game when *V(S;t)* remains below *V*(S;t)* (*Equation 2*).

Equation 2 – Condition of dynamic equilibrium

$$V(S;t) < V^*(S;t) \qquad or \qquad V(S;t)/V^*(S;t) < 1$$

In dynamic equilibrium every individual strategy *S(i;t)* is in interaction with the space of the game in the sense that individual strategies of different players mutually shape one another. This, in turn,

leads to a certain degree of isomorphism among individual strategies. Modalities of action *MA(i;t)* are imperfectly heterogeneous among players. Mutual observation and imitation make some typical modalities *M*(x;t)* of action arise, where *x* is a variable describing the type of modality. A common reference level *R*(t)* may be defined at the moment *t* for the aggregate results *R(i;t)* of every given player *i*. All strategies *S(i;t)* that bear results *R(i;t)* lower than the reference level *R*(t)* are unsatisfactory for players. On the other hand strategies *S(i;t)* with results *R(i;t) > R*(t)* are satisfactory. The dynamic equilibrium at the moment *t* corresponds to a given structure of the set of players. This set is fundamentally divided into two subsets:

a) subset $\{R(i;t) > R^*(t)\}$ of those players, whose strategies bring satisfactory results;

b) subset $\{R(i;t) < R^*(t)\}$ of players with unsatisfactory results;

Players that belong to $\{R(i;t) > R^*(t)\}$ are motivated to carry on the current game in the sense of Harsanyi's theory and they do so, tending to keep their modalities of actions unchanged. Those belonging to $\{R(i;t) < R^*(t)\}$ have interest to change the rules of the game and to pass to another game, and they correspondingly modify their modalities of action. In the absence of dynamic equilibrium no typical modalities of action *M*(x;t)* as well as no common reference level *R*(t)* for results can arise as uncertainty is too high. Players define their relative satisfaction on the grounds of risk moderation, not results *R(i;t)* as such. They seek to reduce uncertainty first and only then to optimize their results. As for modalities of action, high uncertainty makes them change so quickly that types have no time to form. Such a situation is self – propelling mechanism until some players reach the state described in *Equation 2*, which can become the core of new dynamic equilibrium.

Corporate strategies in the given set of firms are described as the (current, historical or future) state of four games: CM (capital markets), CG (corporate governance), PM (product markets) and SR (social responsibility). The state of each game is given by four variables: V*(S;t), V*(S;t), M*(x;t), R*(t)* and by two ratios: *V(S;t)/V*(S;t)* and *M*(x;t)/R*(t)*. The ratio *V(S;t)/V*(S;t)* is the relative consistence of strategies played and *M*(x;t)/R*(t) i*s the relative efficiency of typical modalities of action. Dynamic equilibrium does not require, to exist, any minimum level of efficiency

R(i;t)/MA(i;t) and can arise on the grounds of both highly efficient and clearly inefficient strategies, with many possible intermediate states in between.

As four games go on simultaneously, real corporate strategies are balanced outcomes of the same four games. The essential attribute of every corporation is to keep working the institutional cogwheels joining the capital markets, the corporate governance, product markets and the broad social responsibility. Those cogwheels can work in two broadly defined configurations: in presence of dynamic equilibria in all four games or in absence of such equilibria. In the present model dynamic equilibrium is essentially a reasonable level of predictability: any strategy is subjectively rational when players can predict with satisfactory accuracy the outcomes of their actions. Only then mixed strategies, composed of pure strategies, can emerge, with dynamic equilibrium as a consequence. In markets bearing a reasonable level of predictability corporate strategies balance the four games and optimize results of each. As predictability disappears, corporate strategies are only balancing, without optimization. This is a little more formalized approach of the Frank Knight's opinion (Knight 1921), that corporation are unique in their ability to manage risk and to make a link between the financial markets and those of goods and services. After all that's how the first corporations, like the East India Company or the early Bank of England, worked. They were bundles of relatively autonomous enterprises and the company as legal entity was more a middleman between the investors and the active merchants that a typical hierarchy. Risks were so high and diverse that optimization was not at all the chief goal of the company, which was much more oriented on maintaining its own institutional continuity (Harris 2005; Hansmann et al. 2006).

The big question is how, in practice, dynamic equilibrium can appear and disappear in a social game. According to the Nash's theory, dynamic equilibrium is the normal state of a game played along consistent rules. Logically, dynamic equilibrium disappears or does not have the chance to appear when rules of the game are inconsistent, i.e. when causality between action and results is troubled and uncertain. In real social games such troubled causality appears mainly when some players has privileged positions compared to others, and, consequently, when they play according to

special rules. This is the proverbial ace up one's sleeve. Privileges consist in various kinds of specific social influence, or power, shortly. Information is one of the most important factors of that, insider trading in capital markets coming as a very illustrative example. Thus, dynamic equilibrium is there when all players have more or less the same influence upon the space of the game. Should any significant privileges appear, dynamic equilibrium cannot be.

Besides the concept of dynamic equilibrium, the model has another cornerstone, as far as empirical development is concerned: the reference values. They concern results (*R**) and uncertainty (*V**). Whatever kind of social game is taking place, players tend to establish benchmarks for assessing both results and uncertainty. More organized is the game, more institutionalized and intersubjective are these benchmarks. In capital markets there are market indexes (sometimes combined with references to the real estate market), in product markets there are operational and financial ratios. Thus these two games – capital market and product market - display pretty obvious empirical reference values. For the other two: corporate governance and social responsibility, reference values are more vague.

The benefits covered by the expectations of the participants in the corporate governance game are various in kind. There is no even one definition of shareholders' value, as for many shareholders the real benefit is power and control, whilst for other this is plain cash that counts above anything else. These two can vary independently and it is practically impossible to set one common variable to measure them, and this is only a sample of the true complexity. Thus it is assumed that every stream of cash flowing to the firm or out of it results from a contract being consumed. Following the Williamson's theory of imperfect contracts (Williamson 1975, 1985), those contracts are assumed to give occasion to imperfect redistribution of economic rent. Consequently, the gross total of cash flows incoming to the corporation and going outside raise a total sum of economic rent, imperfectly redistributed. The total population of stakeholders in a corporation is composed both of capital and labour providers, however capital providing plays the chief role. Thus the rate of return on capital invested is the reference value *R*(t)* for results *R(i;t)* obtained by individual players and the

volatility of the same rate of return in the reference value *V** for assessing uncertainty.

A similarly complicated picture emerges as different kinds of benefits are considered in the social responsibility game. For such local government a satisfactory interaction with a corporation's local plant would sum up to a given amount of taxes paid, whilst some others would look for stabilization of the local labour market or proper preservation of local tourist sites. That's why the theory of games is so useful to model such situations. It avoids psychologizing when it becomes too complicated to be empirically operational, and, in the same time, allows to formulate assumptions referring to subjective expectations. Even if this is not possible to measure exactly the reference values, given the complexity of expected states of nature, the most important assumption is that those reference value are actively researched and assessed by players, in more or less rational ways.

In the capital market game CM the great majority of players are both on the supply and the demand side, as in real capital markets most participants are investors and capital takers as well. This is pretty obvious for corporations, but this is true for small individual market players as well who can contract bank loans to invest in the stock market. Each player (*i*) in the capital market game plays a real mixed strategy *S(i;t)* with modalities of action *MA(i;t)* composed of a set of investments made *Iv(i;t)* and liabilities contracted *Lb(i;t)*, the set of results (expected pay – offs) consisting of a rate of return on capital invested in presence of the given level of risk. It is assumed, following the Tobin's q theory (Tobin 1961, 1969; Tobin, Brainard 1968, 1977) that there is a theoretical, empirically unobservable, though expected by market participants, free – of - risk rate of return on capital invested (*IR**). The real rate of return IR is compared with IR* by market participants and according to the current level of market volatility they expect a given real rate of return IR. In presence of dynamic equilibrium in the capital market game the ratio of IR/IR* is equal to the Tobin's q coefficient, computed with the formula: $q = [(n*p + a – eq)/a]$ (Tobin, Brainard 1968, 1977) where *n* is the number of outstanding shares listed, *p* is the average price of shares, *a* is the book value of assets and *eq* is the value of equity. In other words, in presence of dynamic equilibrium in the capital market the overall market value of assets, in which the given investor had

invested, including the debt possible to raise with the backing of these assets, all this measured with the Tobin's *q* coefficient is enough for investors to compensate their subjectively observable risk (*Theorem 1*). Without dynamic equilibrium the subjectively observable risk is so high that the overall market value of assets possessed is not enough to compensate it. Therefore the expected rate of return IR, given the risk incurred, is so high that no realistically possible capital gains from investments in productive assets can satisfy it. Consequently, players focus on risk management through hedging and diversification of investments, instead of maximizing the overall rate of return IR. The ratio of efficiency $M^*(x;t)/R^*(t)$ is impossible to compute then. Players divide into two groups: those minimizing volatility and those trying to maximize it (*Theorem 2*).

Theorem 1 – The capital market game CM with Nash's dynamic equilibrium

$$[V(S;t;CM) < V^*(S;t;CM)] \Rightarrow [IR(S;t;CM)/IR^*(S;t;CM)] = [(n*p + a - eq)/a]$$

$$[V(S;t;CM) < V^*(S;t;CM)] \Rightarrow S(i;t;CM) = \{[Iv_1(i;t), Iv_2(i;t),..., Iv_n(i;t); Lb_1(i;t), Lb_2(i;t),..., Lb_m(i;t)]; maxIR/IR^*\}$$

Theorem 2 – The capital market game CM without Nash's dynamic equilibrium

$$[V(S;t;CM) > V^*(S;t;CM)] \Rightarrow [IR(S;t;CM)/IR^*(S;t;CM)] > [(n*p + a - eq)/a]$$

$$[V(S;t;CM) > V^*(S;t;CM)] \Rightarrow S(i;t;CM) = \{[Iv_1(i;t), Iv_2(i;t),..., Iv_n(i;t); Lb_1(i;t), Lb_2(i;t),..., Lb_m(i;t); maxV(S;t;CM)\}$$

or

$$[V(S;t;CM) > V^*(S;t;CM)] \Rightarrow S(i;t;CM) = \{[Iv_1(i;t), Iv_2(i;t),..., Iv_n(i;t); Lb_1(i;t), Lb_2(i;t),..., Lb_m(i;t); minV(S;t;CM)\}$$

***Note**: the ' =>' used in the formal notation of both theorems is the symbol of implication used in formal logic and is to be interpreted as 'if A, then B'.*

In the corporate governance game CG each player (*i*) plays a strategy *S(i;t)* with modalities of action *MA(i;t)* composed of a real voting power position *Pv(i;t)* (which may also be indirect, in the case of debtholders) and information gathered *If(i;t)*, in the prospect of maximizing results *R(i;t)* consisting of cash flows received *Cf(i;t)* and indirect benefits *Bn(i;t)* (influence upon important

contracts of the corporation with third parties or the governance of affiliates, for example). Extending the Tobin's q theory it is assumed that in presence of dynamic equilibrium both *Cf(i;t)* and *Bn(i;t)* have theoretical, though unobservable risk – free reference values, *Cf*(i;t)* and *Bn*(i;t),* respectively. Players aim at maximizing the ratios of *Cf(i;t)/Cf*(i;t)* and *Bn(i;t)/Bn*(i;t).* Thus, in presence of dynamic equilibrium *Cf*(i;t)* and *Bn*(i;t)* sum up to a certain rate of return IR on capital invested in presence of a given level of risk. Further on results are maximised in the same way than in the capital game which makes the Tobin's q coefficient the empirical result to maximise. *(Theorem 3).* Should dynamic equilibrium not occur in corporate governance, no risk – free reference values exist and players split into two categories: those willing to minimize uncertainty on one hand and those striving to maximize it, in the prospect of gaining additional benefits as risk premiums (*Theorem 4*).

Theorem 3 – The corporate governance game CG with Nash's dynamic equilibrium

$$[V(S;t;CG) < V^*(S;t;CG)] \Rightarrow S(i;t;CG) = \{Pv(i;t), If(i;t); \max[Cf(i;t)/C^*(i;t)]; \max[Bn(i;t)/Bn^*(i;t)]$$

and

$$[V(S;t;CG) < V^*(S;t;CG)] \Rightarrow \{\max[Cf(i;t)/C^*(i;t)]; \max[Bn(i;t)/Bn^*(i;t)]\} = [IR(S;t;CM)/IR^*(S;t;CM)] = [(n^*p + a - eq)/a]$$

Theorem 4 – The corporate governance game without Nash's dynamic equilibrium

$$[V(S;t;CG) > V^*(S;t;CG)] \Rightarrow S(i;t;CG) = \{Pv(i;t), If(i;t); [Cf(i;t)/C^*(i;t)]; \max V(S;t;CG)]$$

or

$$[V(S;t;CG) > V^*(S;t;CG)] \Rightarrow S(i;t;CG) = \{Pv(i;t), If(i;t); [Cf(i;t)/C^*(i;t)]; \min V(S;t;CG)]$$

It is to notice that depending on the presence or absence of dynamic equilibrium the corporate governance dame CG displays different kinds of link with the capital markets game CM. Should both of them reach dynamic equilibrium, they also both favour strategies aimed at maximising the same rate of return on capital invested. Consequently, the corporate governance game CG is simply a prolongation (or a particular case) of the capital markets game CM. Voting power and

information in hand serve the players to achieve results expected from rational investments or loans. If any of the two games does not reach dynamic equilibrium, this link is broken and the capital market game CM is played independently from the corporate governance game CG. The game or games played without dynamic equilibrium favour strategies oriented at exploiting short – term advantage resulting from imperfect information.

The product markets game PM covers all operational, financial and investment activities of the corporation, supposed to be previously agreed as a temporary outcome of the corporate governance game CG. Thus, the product market game include all organizational aspects of the corporation. Such an approach is based on the assumption that, though frequently suboptimal, the organizational structure of the corporation is rational in the sense that it is shaped in the prospect of maximizing efficiency. In the product markets game players are corporations themselves, at the difference of the capital markets game CM (players are investors) and the corporate governance game CG (players are stakeholders of the corporation). Corporations aim at maximizing a complex set of results *R(i;t;),* composed of: the scale of activity *AS(i;t),* profitability *PR(i;t)*, short – term accumulation of capital *SCA(i;t)* and the long – term ability to accumulate capital *LCA(i;t).* In order to maximize these results corporations use twofold modalities of action *MA(i;t)*: a) projects related to investment in and exploitation specific technologies *tech(i;t)* and b) investments in non – specific financial assets *fa(i;t),* as a compensation of risks incurred in *tech(i;t;)* projects. Modalities of action are twofold in kind but multiple in practical application: a firm can lead many investment projects in the same time in each of the two categories. In presence of dynamic equilibrium the components of the set of results are causally linked: scale of activity *AS(i;t)* and profitability *PR(i;t)* generate short – term accumulation of capital *SCA(i;t),* which is the same as the long – term ability to accumulate capital *LCA(i;t).* The latter finds its outcome in the ability of the corporation to bring to its shareholders the rate of return expected on the grounds of the risk observed, estimated in the same way that in the capital markets game, with Tobin's *q*. This causality assumed, the set of modalities of action is composed essentially of the *tech(i;t)* projects, the *fa(i;t)* investments playing a marginal

role, as maximizing investment in adequate *tech(i;t)* projects allows the maximization of results *R(i;t)* (*Theorem 5*). Without dynamic equilibrium in the product markets the risk related to *tech(i;t)* projects is so high that they remain under-invested, an over – important part of capital being placed in *fa(i;t)* investments, no obvious causality linking the components of the set of results *R(i;t)* (*Theorem 6*).

Theorem 5 – The product markets game PM with Nash's dynamic equilibrium

$$[V(S;t;PM) < V^*(S;t;PM)] \Rightarrow S(i;t;PM)=\{\max[tech_1(i;t),tech_2(i;t),..., tech_o(i;t)]; [fa_1(i;t),fa_2(i;t),...,fa_p(i;t;)]; \max[AS(i;t);PR(i;t); SCA(i;t); LCA(i;t)]\}$$

and

$$[V(S;t;PM) < V^*(S;t;PM)] \Rightarrow [\max AS(i;t) \Rightarrow \max PR(i;t) \Rightarrow \max SCA(i;t) \Rightarrow [\max LCA(i;t)]$$

and

$$[V(S;t;PM) < V^*(S;t;PM)] \Rightarrow \{[\max LCA(i;t)] = \max[(n*p + a - eq)/a]\}$$

Theorem 6 – The product markets game PM without Nash's dynamic equilibrium

$$[V(S;t;PM) > V^*(S;t;PM)] \Rightarrow S(i;t;PM)= \{[tech_1(i;t),tech_2(i;t),..., tech_o(i;t)]; \max[fa_1(i;t),fa_2(i;t),...,fa_p(i;t;)]; \max[AS(i;t);PR(i;t); SCA(i;t); LCA(i;t)]\}$$

The social responsibility game covers all of those interactions of the corporation with the outside world which are externalities. Players in this game are corporations as well as its social partners: governments, non – profit organisations etc. Each player uses various modalities of action *MA(i;t),* which aim either at the transfer of externalities outside *ExO(i;t)* or at absorption of externalities from outside *ExIn(i;t).* In presence of dynamic equilibrium players aim at homoeostasis, balancing *ExO(i;t)* and *ExIn(i;t)* (*Theorem 7*), whereas in absence of dynamic equilibrium they aim at maximizing *ExO(i;t)* at the expense of *ExIn(i;t)* (*Theorem 8*).

Theorem 7 – The social responsibility game SR with Nash's dynamic equilibrium

[V(S;t;SE) < V(S;t;SE)] => S(i;t;SE)={ MA(i;t);[ExO(i;t) = ExIn(i;t)]}*

Theorem 8 - The social responsibility game SR without Nash's dynamic equilibrium

[V(S;t;SE) > V(S;t;SE)] => S(i;t;SE)= {MA(i;t);max[ExO(i;t)/ExIn(i;t)]*

Here below two kinds of empirical application of the model are introduced, the qualitative one and the quantitative one. Both serve as examples of the possibilities offered by the model and also provide additional insights into the central research problem, which is the predictability of corporate strategies.

4. Qualitative empirical study – Royal Dutch Shell vs. Israel Corporation

One of the typical prediction problems relating to corporate strategies consists in assessing whether there is a lasting, qualitative disparity between strategies adopted by firms of different sizes in the same industry. The issue has already been addressed, especially by the theory of industrial organisation (see for example: Porter 1980, 1981, 1985, 1991), though these developments remain restricted to the purely operational level of activity, i.e. production and marketing. From this point of view there is nor material difference between corporate strategies and those of private firms. The model of corporate strategies introduced in the present paper broadens the scope of research and orients it on peculiarities of corporations as market players, through hypothesizing about financial and investment activities, corporate governance and systemic risk also taken into account.

Royal Dutch Shell is the biggest firm in the oil & gas sector and the biggest corporation in the world, from the point of view of net revenues. It is also one of the oldest, with its institutional roots in the Samuel brothers' invention of tanker ships and the Dutch oil exploitations in Sumatra, at the end of the nineteenth century. Israel Corporation is at the 47th place in the global oil & gas sector, regarding net revenues, and it's a relatively young firm, created by the Israeli government in 1968

and then, during the following 14 years, progressively privatized.

Regarding both the scale of activity and the capital accumulated Royal Dutch Shell belongs to the subset of $\{R(i;t) > R^*(t)\}$ of successful players, whilst Israel Corporation belongs to the subset $\{R(i;t) < R^*(t)\}$ of players with unsatisfactory results. Thus, Royal Dutch Shell plays a leader's strategy, Israel Corporation playing a challenger's one. Is is argued, on the grounds of the model, that this strategic disparity does not only appear at the operational level, but also at the business and corporate one, and, operational disparities are visible through different investment behaviour.

For the purpose of comparing these two firms, a **hypothesis** is stated, according to which there are significant disparities between Royal Dutch Shell's and Israel Corporation's corporate strategies, in terms of the model introduced in the previous chapter. Consistently with the theoretical foundations of the model, validating this thesis covers observations of real behaviour of both companies, during a moderately long period of time, from 2005 until 2008, letting aside as much as possible their officially declared plans. The aforementioned real behaviour covers all four games of the model and had been studied on the grounds of publicly available official corporate documents published by the two companies.

Beginning with the capital market game, a noticeable difference appears. Royal Dutch Shell's shares are listed in three stock markets: New York, London and Amsterdam, all big, diversified and relatively stable. Israel Corporation is listed only in one stock market, the Tel Aviv one, small in terms of capitalization and subject to strong fluctuations, both cyclical and non - cyclical. The level of uncertainty in the Royal Dutch Shell's capital market game seems to be fairly lower than it is for Israel Corporation. However, the information supplied by the computation of the Tobin's q coefficient contradicts this assumption. At the end of 2005, the Tobin's q coefficient for Israel Corporation took the value of $q = 1,95$, to fall to $q = 1,84$ at the end of 2008. For Royal Dutch Shell the two values are respectively of $q(2005) = 2,47$ and $q(2008) = 1,68$. Israel Corporation seems to be less exposed to sudden fluctuations of the rate of return on capital, than his bigger competitor.

Israel Corporation accumulates capital much faster than Royal Dutch Shell. Between the end of

2005 and the end of 2008 the book value of assets of Israel Corporation rose by 149%, from USD mln 5 914,4 to USD mln 14 706. The resulting accumulation of USD mln 8 791,6 was invested mainly (some 60%) in specific assets: plant, property, equipment and intangibles. In the same period the Royal Dutch Shell's book value changed from USD mln 219 516 to 282 401, thus by some 29% or USD mln 62 885. Some 40% of this accumulation had been invested in plant, property and equipment, 25% was due to an increase in operational receivables and 18% was linked to acquisitions of businesses. On the passive side of the balance sheet, capital accumulation in Israel Corporation has been a little more supported by a growth of equity (+196%) than by the growth of debt (+136%), thus changing the financial leverage of the company from 79,09% to 75,13%. The almost twofold growth of value of equity resulted mainly from accumulation of profits whilst the number of outstanding shares has hardly grown, by 1%. For Royal Dutch Shell the capital structure had barely changed between 2005 and 2008, the financial leverage passing from 55,39% to 54,36%, the number of outstanding shares falling significantly, however, by almost 8%, due to buyback operations.

The corporate governance of Israel Corporation seems to be marked, in the first place, by conflicts related to insufficient cash resources, measured against the ambitious investment plans[1]. On the other hand, the corporate governance game at Royal Dutch Shell appears to be focused on the redistribution of a strongly positive cash flow[2]. Those qualitatively different internal conflicts are moderated within equally different frameworks of power and influence. Some 55% of Israel Corporation's equity belongs to an Israeli financial group OFER, another 18% to the Bank Leumi Le-Israel Ltd. Only some 27% of equity is more or less free – float. Thus, direct voting power is strongly concentrated, with, however, important indirect influence of debt – holders, due to the important financial leverage. The corporate governance pattern is strongly oriented on balancing between block – holders and debt – holders. In the case of Royal Dutch Shell, according to its own official statements there is no shareholders holding individually more than 5% of votes. That, with a

1 see for example Financial Times from September the 25th 2009, June the 17th 2008, August the 04th 2009, February the 26th 2008

2 see for example Financial Times from: April the 29th 2009, September the 11th 2009, September the 4th 2009

business generating a strong surplus of cash and a noticeably lower indirect power of debt - holders, indicates a corporate governance oriented on moderating the conflicts between management and small shareholders.

During the 2005 – 2008 period each firm went through a different path of growth. As for Israel Corporation it was almost exclusively extensive growth through acquisitions and joint ventures, summing up to 1661,5 millions of USD, among which the most significant were: a) the 605 million automotive joint – venture with the Chinese company Chery Automobiles Ltd. b) the 547 million acquisition of Globeleq Ameicas Ltd., a South American company operating in the electric power production business c) the 361,5 million acquisition of Supresta LLC, a Delaware (US) based chemical company. Royal Dutch Shell displays the opposite tendency – it has been divesting parts of businesses or entire businesses without acquiring new ones.

The path of intensive development, through technological progress, is noticeably different in those two companies. Both seem to spend a significant percentage of their revenues on R&D, sector specificity taken into account, which means 0,35% on average for Israel Corporation and 0,25% for Royal Dutch Shell. As their scale of activity is noticeably different, these average percentages give respectively some 45 millions of USD a year for the former and about 900 millions for the latter. Israel Corporation does not directly own any patents or innovations filed in for patenting at the international scale, whereas Royal Dutch Shell display some patenting activity, though very uneven in time (50 patent applications in 2005 and only one in 2008). As it comes to embodiment of technology, both firms display positive net investment, amortization taken into account. The ratio of net investment, when the latter is related to revenues, displays a tendency for growth in both cases, however the values and their change are significantly different. In 2005 the net investment ratio of Israel Corporation was of 0,29%, whilst at Royal Dutch Shell it was 1,3%. In 2008 Israel Corporation passed to 2,57% and Royal Dutch Shell to 4,67%. As for the return on capital, the ratio of return on assets (ROA = net profit/ book value of assets) in 2005 was of 6,2% at Israel Corporation and 12,0% at Royal Dutch Shell, and in 2008 it reached 8,0% at Israel Corporation and

fell to 9,4% at Royal Dutch Shell.

The comparison of Royal Dutch Shell and Israel Corporation, summarized above, shows that being different in scale in the same branch of business does not sum up, on the qualitative side, just to different marketing strategies. It covers all aspects of the organisation: legal, financial, scientific. This is just what states the model introduced in the present paper. Disparities in relative success in playing the same game make the players adopt **completely** different strategies and as it is question of corporations, with their unique legal and financial pattern, the differences cover all aspects of this pattern.

The model states that the most important kind of dynamics governing any reasonably selected set of social players is the tension between the leaders and the challengers. The leaders tend to conserve the *status quo*, the challengers strive to change the rules of the game. The formal line of demarcation between the conservative leaders and the challenging revolutionaries is the reference value of results $R^*(t)$. The present comparative case study indicates that in the oil & gas sector $R^*(t)$ seems to be a composite value, encompassing the scale of activity, the rate of return on capital, the free cash – flow at hand and the relative ability to legally appropriate important technologies. The $R(i;t) < R^*(t)$ player that is Israel Corporation seems to adopt modalities of action $MA(i;t)$ focused on a strong orientation at financial levering of extensive growth of an organisation closely supervised by important block – holders, combined with noticeable diversification of activity. Also, Israel Corporation seems to be the type of social player who purposefully tends to destabilise all four games (capital market, corporate governance, product markets and social responsibility) and seeking opportunities in managing high uncertainty. Royal Dutch Shell, belonging to the $R(i;t) > R^*(t)$ class, slopes towards a stable financial structure, supporting an organisation clearly driven by managers rather than by block – holders, which tends to focus on its core businesses and even within this core businesses it is really selective as for projects to carry on the long run. The general goal seems to be maintaining dynamic equilibria in all four games.

What does the model add to this case study what other theories would not lead to ? After all, what

have been observed may be interpreted simply as multi – aspect economies of scale combined with a sensible assumption that firms listed in small stock markets would not develop such an important capital basis of equity as those listed in big stock markets. Well, the model adds specific causality. The bigger Royal Dutch Shell is not more profitable, ROA taken into account, simply because it is bigger and exploits economies of scale but because its position in the social game makes it follow a complex corporate strategy which aims at maximising ROA, minimising uncertainty, focus on core business and qualitative technological changes. The smaller Israel Corporation does not display a lower ROA because it can't exploit economies of scale, but because its overall social position in the oil & gas business makes it follow a strategy aimed at exploiting and actively creating situations of high uncertainty, as well as diversify its business even if it is at the expense of technological position in the core business.

Such interpretation leads to a more general conclusion that once an industry had developed a hierarchy of size among its participants, this hierarchy becomes an autonomous social force shaping future behaviour of the social players involved. The current position of a firm in the hierarchy of size in its core business is not simply a result and it does not simply allow to predict its future individual results. The aforementioned position also allows to predict a whole set of future modalities of action endeavoured by the firm. The leaders of the sector are likely to behave as if they have had reached the Coasean optimal size of organisation (Coase 1937), whereas the challengers seem to strive for reaching it. Furthermore a hypothesis arises that new industries are likely to grow through migration of capital from relatively small players operating in older, more established and structured sectors.

The careful leader will notice that the case study does not mention actual facts about interactions of both firms with the broad social responsibility, thus about the SR game. This is because that aspect is to deduce out of observations about the other three games. Behaviour grouped under the general category of “social responsibility” is one of the hardest to predict as far as corporations are concerned. The popular assumption is that corporation are socially responsible when it pays off.

The question is how to predict whether the given corporation will judge the future probable pay-offs out of socially responsible actions high enough to undertake them. The model allows to deduce that if the given corporation strives to maintain dynamic equilibrium in three out of the four games, i.e. in capital market, corporate governance and product markets, then it is likely to strive for the same in the social responsibility game. Thus, it will try to find a balance between absorption and emission of externalities. Should the corporation leverage on uncertainty in capital markets, corporate governance and product markets, it will probably search maximum emission of externalities and minimum absorption in the social responsibility game. To generalise, large, well established corporations playing the leader's strategies in their respective core businesses are more likely to be socially responsible than aggressive challengers.

5. Quantitative study – the Warsaw Stock Exchange

As the model introduced above comes to empirical applications, a question arises: if most players in a market tend to play their individual strategies out of Nash's dynamic equilibrium, are they not likely to shape, involuntarily, another kind of dynamic equilibrium ? Generalising, isn't a game likely to achieve dynamic equilibrium even if most players purposefully act in the opposite direction, i.e. to exploit uncertainty, playing the strategies typical for aggressive challengers ? Are individual strategies, aiming at exploiting uncertainty resulting from the lack of clear causal rules of the game, paradoxically likely to shape the space of the game so as to create such predictable causalities ? Taking these questions into consideration, the following **hypothesis** has been formulated: a capital market can reach such a Nash's dynamic equilibrium, in which capital accumulation is independent from operational efficiency of businesses.

Emerging markets are a good place to observe the “aggressive challenger” type of corporation. Companies listed there are relatively young and are forced to face global rivals, whose both scale of activity and capital resources are much bigger. The still relatively small but quickly growing

Warsaw Stock Exchange in Poland is a good example. Companies listed in Warsaw seem to be bound to slope towards corporate strategies of the “aggressive challenger” type, thus favouring the exploitation of uncertainty rather than its minimisation and the struggle to maximise return on capital. Seventy - nine companies listed in had been observed, polled out from a total population of some 400 . The sample is composed of companies with different length of public listing history, ranging from 15 to 84 months. For all of them the time series of trimestrial observations of operational profit ratio and the Tobin's q coefficient had been construed, since the first trimester of public listing until the 31st of December, 2008. Then the time series for each company were tested for correlation with the Pearson's correlation coefficient. Of course, Pearson's test assumes linearity of correlation, but as the goal of the test was to find interdependence between marginal values, linearity is what was searched. Curvilinear correlation was not really in the scope of interest. The detailed list of companies, with their correlation coefficients, is provided in the annex at the end of the present paper.

As a result of the test, nine firms revealed a significantly negative correlation, 47 displayed insignificant correlation and for 23 correlation was significantly positive. Some 63,5% of the sample's book value of assets is concentrated in companies with negative or insignificant correlation between operational profit ratio and Tobin's q. Two paradigms of corporate strategies coexist in the emerging Polish public capital market. One is oriented at accumulating capital whatever the operational efficiency is and it effectively works, i.e. accumulation takes place indeed and investors do not seem to be bothered by the operational side of the businesses they invest in. In other words, the capital market game in this case is independent from the product market game. Mutual independence means that in each game the results *R(i;t)* aimed at in are different. This, in turn, can take a twofold shape. Both games may be played without Nash's dynamic equilibria, thus in both games players aim at exploiting uncertainty rather than at maximising return on capital. However it is possible that just one of the games is played without dynamic equilibrium, the other one being played with it. That means strategies combining rational maximisation of operational efficiency in

product markets with highly risky exploitation of uncertainty in financial markets, on one hand, or rational maximisation of return on capital in the capital market combined with the “hit and run” strategies in product markets. In both cases the capital market, for those firms, is a highly inefficient one. The other pattern of corporate strategies, being a minority in the studied sample of firms works on the grounds of significant interdependence between those two games. Logically, such interdependence implies the simultaneous existence of dynamic equilibria in both games, with strategies played accordingly. For those firms, the capital market is close to perfect efficiency, as is serves to allocate financial resources according to operational efficiency of businesses.

Is any kind of dynamic equilibrium arising from these results ? Is there any viable causality underpinning the players' individual strategies ? Firstly it is to notice that even if the majority of players, owning the majority of assets, apparently play without dynamic equilibrium in the capital market and thus the aforementioned market is highly inefficient in their case, a minority plays according to rules linked with dynamic equilibrium. There seem to be some market forces, both in the capital market and the product markets games, which push at least a certain percentage of corporate strategies into the framework of rational maximisation, instead of exploitation of uncertainty. Thus, the hypothesis of dynamic equilibrium built around independence between operational efficiency of businesses and their ability to accumulate capital has been partly confirmed. Whereas in the emerging Polish capital market most players seem to play corporate strategies of the “aggressive challenger” type and the market seems to accept it, some market players choose a different path. Therefore, if most players purposefully act in order to exploit uncertainty and not to achieve dynamic equilibrium in the game, they succeed in those goals but in the same time they make some other players take on a completely different pattern of balance between the capital market game and the product markets game, a pattern oriented on dynamic equilibrium. It can be further hypothesised that in any social game those two types of players stimulate each other. Seeing that most players accept and actively create dynamic equilibrium incites some others to play “berserk”, breaking the well – known causal rules of the game. On the

other hand, a general tendency to play strategies based on uncertainty motivates some players to play sounder and more in the long – term prospect.

6. Conclusion

Both the theoretical model and the empirical evidence, introduced in the present paper allow to extend the analytical toolbox used for prediction of corporate strategies, defined in terms of real behaviour rather than forward – looking statements. The model, being an application of the games theory as well as of the institutional approach to economics, is grounded on one central assumption: corporations are structures much more than intentional entities and these structures are in interaction with still broader social structures. Therefore the essential causality of the model is the interaction between structure and behaviour. The model can support both qualitative and quantitative research. The two sample empirical studies, introduced in this paper, should be considered as examples of a much wider range of applications. They bring, however, significant insights to the theory of the firm. Sectoral hierarchies of size and market power seem to be not only the result but also, and maybe in the first place, the motive force that creates the dichotomy between the strategy of "established giant" and that of "aggressive challenger", disparities between them reaching to every aspect of corporate strategy, far beyond technological and marketing choices. The "aggressive challengers" focus on exploiting uncertainty rather than on maximising the return on capital, however, with time, through corporate diversification peculiar to their strategies they are likely to create new industries. This is an extension of the monopolistic competition theory (Chamberlin 1933) as well as of the theory of industrial organisation (Mason 1939; Bain 1951; 1954; Porter 1980, 1981, 1985, 1991). Then, capital markets seem to naturally create mutual tension between corporate strategies characterised by capital accumulation well – aligned with technological development, visible in operational efficiency on one hand, and those featuring an

accumulation of capital quite independent from technology. This, in turn means that whatever are the gains offered by investment in technology, there will always be a substantial set of capital market players for whom efficient allocation is not the same at all that the most profitable one. That is a contribution to both the theory of capital markets and the theory of economic growth.

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Appendix – list of companies studied at the Warsaw Stock Exchange and their correlation coefficients

Company	Pearson's correlation coefficient	Company	Pearson's correlation coefficient	Company	Pearson's correlation coefficient
ABG Spin	0,407099	Elzab	0,52887	PGF	-0,202426
ABPL	0,241398	Energopol Południe	-0,030474	PGNiG	-0,208692
Agora	0,41308	Eurocash	-0,255938	PKN Orlen	0,385591
Alchemia	-0,28134	Grajewo	0,154512	Polimexms	0,044053
Alma	-0,034757	Groclin	0,348338	Polnord	0,313031
Ambra	-0,782218	GTC	0,334015	Prokom	0,03148
AMICA	0,313493	Hyperion	-0,09598	Puławy Zakłady Azotowe	0,097012
Apator	0,049077	IB System	0,207174	Rafako	-0,043507
Asseco Polska	0,211387	IGroup	0,35046	Ropczyce	0,07158
Atlanta Poland	0,137037	Indykpol	-0,161373	Simple	0,236288
ATM	0,135592	Instal Lublin	0,406878	Spray	0,159243
ATM Grupa	0,011259	Intercars	0,761488	Swarzędz	-0,131522
Bakalland	-0,674609	Irena	-0,116734	Sygnity	0,312791
BankierPL	-0,231166	Kęty	-0,169827	Świecie	0,764073
Betacom	-0,288226	KGHM	0,687003	Talex	-0,109348
Bioton	0,152023	Krosno	-0,295089	Techmex	-0,019491
Boryszew	-0,57296	Kruk	0,489487	Teta	-0,505672
Budimex	-0,05699	Lotos	0,327251	TPSA	0,055389
Cersanit	-0,095787	LZPS	0,23336	TVN	0,172209
Comarch	0,374265	Macrologic	0,377731	Vistula	0,358698
Comp	-0,386417	Mediatel	-0,186774	Wandalex	0,007536
Dębica	0,300083	Mieszko	-0,43867	Wasko	0,35116
Echo Investment	0,09704	MNI	0,037128	Wawel	0,558553
Elektrobudowa	0,153675	Netia	-0,129233	Yawal	-0,359651
Novitus	0,447167	Orbis	0,208565	Żywiec	0,296376
One2One	-0,181954	PBG	-0,420156		
Optimus	-0,132648	PCGuard	-0,650153		

Detailed data about each of the companies studied is available from the author, upon request.