On the alternative proxies for estimating firm growth in empirical corporate finance literature: Evidence from Indian manufacturing sector

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On the alternative proxies for estimating firm growth in empirical corporate finance literature: Evidence from Indian manufacturing sector

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Abstract

Empirical tests of theoretical propositions necessitate quantitative estimation of qualitative firm level attribute. The challenges of such estimation are nowhere more pronounced than it is the context of estimating firm growth as evinced from the multiplicity of proxies used. However in using or theorizing about the validity of these alternative proxies in their quest to measure a common intangible called 'firm growth', the issue of inter-relationship between these variables and the dimensions of growth it is capable of capturing has never been explored. This research paper is an attempt to address this issue.

This paper uses a sample of 429 listed manufacturing firms for the period 2004-05 to 2010-11, and employs correlation analysis as well as a panel data model to reach its conclusion.

Findings of this research suggest that the alternative financial statements based measures of firm growth are not correlated to an extent that can warrant substitution or interchangeable use. And in certain cases correlations are stronger with time lags than without. Furthermore, it is also observed that financial statements based measures of growth have limited explanatory power when it comes to explaining variations in market-to-book ratio of firms. Findings of this paper coupled with studies on the linkage between macroeconomic and capital market conditions with equity prices, provides indirect evidence that market-to-book ratio factors in the forward looking perspective of growth that the other alternative measures are not capable enough to capture, given their historical nature.

Introduction

The seminal work of Modigliani and Miller (1958) on the irrelevance of capital structure choice in determining firm value remains the genesis of the most enduring debate in corporate finance literature; how do firms determine their (optimal) capital structure? However, even after five and a half decade of theoretical and empirical research and the emergence of a plethora of theories (based on agency costs, asymmetric information, product/input market interactions, corporate control consideration, taxes, market timing etc), the question is still largely unanswered and continues to puzzle, both theoreticians and practitioners alike. The problems associated with objectively estimating firm level attributes (Titman and Wessels, 1988) and, the qualitative and non-exclusive nature of alternative theories (Barclay and Smith; 1999, 2005), are viewed as biggest stumbling blocks in solving this puzzle. While several research papers have explored the issue of non-exclusivity (for instance, Cotei and Farhat, 2009; Serrasqueiro and Nunes, 2010; Mukjerjee and Mahakud, 2012), not many have focused attention on the challenges involved in choosing proxies for firm level attributes even when these problems are omnipresent in almost all empirical studies. This research is primarily motivated at highlighting problems of this latter category; and focuses on the attribute 'firm growth'. Objectively identifying the proxy for this attribute for estimation purposes has enormous implications not just in the field of applied corporate finance, but also for economic policy making; identifying the appropriate variable is the first most important step in understanding how the same can be influenced by micro management of firms and macroeconomic management of the economy. And the context of a developing nation further compounds its importance.

The rest of this paper is organized as follows. The next section provides a brief review of the alternative measures of firm growth, issues related to leading and lagging as well as the problems of availability, relevance and estimation, along with the propositions to be tested in paper. The methodology for this research is discussed next, followed by the findings and their analysis. The last section discusses the implications, before discussing the limitations of this paper before concluding.

A brief survey of alternative empirical measures of firm growth

Empirical proxies of firm growth used in econometric models are either market and financial statement based measures (market-to-book ratio), or they are pure financial statements based measures (like sales growth, asset growth etc.).

Myers (1977) opined that the market value of a firm is made up of the present value of assets already in place and the present value of future discretionary investment opportunities, or growth options. The decision to invest in these opportunities is contingent upon the state of nature prevalent when the option becomes due for exercise; hence there is a possibility of the firm not investing in these opportunities under unfavorable states. Larger the share of this discretionary component of future growth in total firm value, higher is equity price volatility over time in response to the changing likelihood of a favorable/unfavorable state of nature materializing. Market-to-book ratio as a proxy for firm growth has been used in a large body of empirical literature based on developed countries (Rajan and Zingales, 1995; Barclay *et al*., 1995; Beevan and Danbolt, 2002; 2004) as well as developing countries (Booth *et al*., 2001). In the Indian context Manos, *et al*., (2001) and Mahakud (2006) have used this measure of firm growth.

Pure financial statement based measures of firm growth have been numerous. Titman and Wessels (1988) employed the ratio of capital expenditure to total assets, growth in total assets and ratio of research and development expenses over sales revenue (the paper also uses R & D expenditure over sales as a proxy for the uniqueness variable as well) as proxies of firm growth in the context of US firms. Wald (1999) used sales growth as a proxy for firm growth in the context of five developed nations, while Norvaisiene and Stankeviciene (2007) used growth in total assets in the context of Baltic listed companies. Shah and Khan (2007) used the same proxy in the context of Pakistan, Chen (2004) in the context of China and Demirguc-Kunt and Maksimovic (1994) used growth in real assets in the context of ten developing countries. In the Indian context Bhaduri (2002a, 2002b), Mahakud and Bhole, (2003), Bhole and Mahakud (2004), Mishra (2011) also used growth in total assets and Kakani (1999) used annual growth in sales as a proxy for growth. (Incidentally Bhaduri (2002, 2002a) also uses the ratio of capital expenditure over total assets as an additional proxy).

The use of all these alternative proxies to capture a qualitative attribute like 'firm growth' in quantitative terms suggests that they are strongly correlated to each other in order to justify interchangeability/substitution. And given that increment/decline in the alternative financial statements based measures favorably/adversely affect present value of future cash flows, these variables individually or in unison must be able to explain variations in market-to-book ratio of firms in large sample tests.

A priori, however, there are important differences between these two classes of measures. First, the 'present value of future growth opportunities' component of market value incorporates growth in an *ex ante* sense, the decision to invest is contingent on future

states of nature and hence is essentially an intangible with zero collateral value; the variable is essentially forward looking in the same sense as market price of an asset is. In case of other proxies, it is as if the decision to invest has already been taken and hence is expected to be reflected in either value of capital employed or assets, or reflected in sales and is certainly tangible with non-zero collateral value (inventory can be collateralized, and so can capital and other fixed assets). Second, while the market's valuation of a firm's growth option is largely, if not entirely, conditioned by factors external to the firm like macroeconomic uncertainty and capital market conditions (Booth et al 2001), economic uncertainty does not deter investments in R&D or capacity creation (increase in cap-ex or fixed assets) as the options approach to capital investment suggests (Dixit and Pindyck, 1995). Hence there is a strong possibility that a forward looking measure like market-to-book may not move in tandem with financial statements based measures of growth, based largely on historical data.

At an operational level, measures of market value is available only for listed firms (hence this measure cannot be employed for unlisted firms), and even within the listed category, small and medium firms often face persistent problems of undervaluation owing to higher information asymmetry consequently biasing their market-to-book ratio downward. Furthermore for listed firms choosing a point estimate of market value is mined with challenges. Given the availability of financial statements based data (at best) on a quarterly basis and the markets assessment of a firm's market value at the end of every trading day, how do we reach a point estimate of market value to be used as a numerator in the ratio? Averaging (250 day average market capitalization) appears to be a solution but it certainly leads to a loss of information content of the variable. Using market price

data of balance sheet date leads to another set of problems; the numerator incorporates forward looking prospective information about the company's performance thereon, while the denominator incorporates the past accounting years economic performance! Moreover, given the market's proactive capacity to anticipate events/developments even before they become news, it is difficult to identify the time by which qualitative or quantitative changes in a firm's operation has been incorporated in prices.

It is possible that owing to these problems with respect to estimation and availability, one observes the increasing use of financial statements based measures of growth in large heterogeneous samples of firms. In this process, however, growth is being increasingly estimated in a 'transpired' sense, rather than an 'expected' or 'ex ante' sense.

As identified earlier, pure financial statements based measures of growth has been numerous, based on firm's assets, capital expenditure, sales and research and development expenses. In the developing country context, the variable research and development expenses ratio has limited use and hence has been used sparingly. Table 1 below provides details of research and development expenses and net sales figures for 254 manufacturing firms belonging to the BSE 500 index, the largest index of large, mid and small cap firms listed in the Bombay Stock Exchange. Available data suggests that while the incidence of R & D expenses is on the rise, the proportion of revenue spent on R & D is less than 0.4% for all the years between 2006 and 2011. Consequently, while this variable may have significant economic significance in terms of generating future growth, it has limited explanatory power as a variable in a regression equation.

Table 1: R&D expenses and net sales statistics for 254 manufacturing firms listed in BSE 500 index (computed using CMIE database)						
(in millions of Rs.)	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Net sales	8824175	11235167	13125767	15704538	16378557	19976785
R & D Expenses	18968	25247	43216	52944	61530	74974
Mean R & D Expenses	246	266	267	304	350	426
Median R & D Expenses	30	37	43	48	57	75
R&S to Sales Ratio	0.21%	0.22%	0.33%	0.34%	0.38%	0.38%
Incidence (number of firms with positive R & D Expenses)	77	95	162	174	176	176

Source: Compiled using CMIE Database

Of the other three measures, asset growth and capital expenditure appears to convey the same meaning; an expansion in a firm's productive capacity/productivity. They are expected to be strongly correlated with each other unless the growth in assets is an outcome of revaluation of assets or an increase in current assets (as an outcome of either inefficient working capital) or a mere accounting entry that inflates asset value with no commensurate rise in capacity/capital employed or productivity.

The last identified variable 'growth in sales' as a proxy of growth and its relationship with the two prior measures of growth seems prima facie simple; an increase in capital expenditure or total assets is expected to translate in increased sales and hence revenue. Or conversely, a rise in sales is expected to enhance current assets (like inventory, receivables etc.) and hence influence asset growth. What is however not clear is whether they are correlated at the same point in time or with a time lag? While an increase in assets and sales growth may still go hand-in-hand, does a rise in capital expenditure to

sales ratio enhances sales revenue in the same period or there is a time lag, especially in the context of manufacturing firms where project completion can take years? We do not know. What we know for sure is that empirical models do not lag independent variables differentially in constructing models; they usually lag all independent variables by one or more periods to avoid the problems of reverse causation.

Similar considerations exists when it comes to correlation between research and development expenses and the other proxies of firm growth; when does R&D expenses incurred in year 't' influence sales revenues or asset growth? When does a firm decide to commercially exploit an option created through years of investment in R&D? Is this time lag actually 'sector' independent or more specifically, does the fruits of R&D expenses translate into an expansion in sales or asset growth with the same time lag for the automobile and pharmaceutical sector?

Based on the discussion in the above sections, the rest of the paper is devoted to examining and explaining correlations between the pure financial statements based measures of growth as well as their correlation with market-to-book ratio. However given the evidence in table 1, this research does not include R&D expenses in any further analysis. Moreover, pure financial statements based measures of growth are expected to impact long-term market valuation of firms and hence are expected to favorably impact their market-to-book ratio. Consequently, we explore the explanatory power of growth in assets, capital expenditure to sales ratio and growth in sales on market-to-book ratio of firms using a panel regression model.

Methodology

The population for the study includes all manufacturing firms in the country. We focus on the listed part of this population given the requirement for market value data for the constituents. Based on the data available with the CMIE (Centre for Monitoring the Indian Economy) database PROWESS the total number of stand-alone manufacturing firms for which all the required data are available (365-day average market capitalization data for all the years from 2004-05 through to 2010-11, and asset, sales and capital expenditure values from 2003-04 to 2010-11) stood at 459. These 459 firms constitute our final sample.

In order to test the relationship between alternative measures of firm growth, we use the correlation matrix (and the statistical significance of variables involved). For the later part of the study this paper employs panel regression and tests the following empirical relation:

$$y_i=\alpha_i + \beta_i X_i +\varepsilon_i$$

where, y represent market-to-book ratio, X_i, represents the explanatory variables, ε is the error term, and i denotes the firm. Market-to-book ratio, following Rajan and Zingales (1995) and Beevan and Danbolt (2002, 2004) is defined as the ratio of the book value of assets less the book value of equity plus the market value of equity all divided by the book value of assets. The explanatory variables included are growth in total assets (and net fixed assets), growth in sales (and net sales), and capital expenditure as a ratio of sales. Conventional economic theory suggests that market-to-book ratio of firms is influenced by retention ratio as well as firm profitability (Damodaran, 2002), consequently these two variables are also included in the model.

Findings and observations

Table 2 presents the summary statistics for the sample used in this research. Mean values of the variables involved in the model indicates that market values of firms included in the sample are 3.24 times their book value on the average, with 22% growth in total assets and 28% growth in sales. However, standard deviation statistics of all the different estimates of firm growth indicate wide dispersion/heterogeneity within the sample as expected of a sample of small, mid and large cap firms.

Table 2: Descriptive Statistics for the sample of 459 firms under consideration, 2004-05 to 2010-11

	Mean	Std. Deviation
Market-to-book ratio	3.24491	4.027825
Growth in total assets	0.22441	0.501125
Sales growth	0.28673	1.752147
Capital expenditure to sales ratio	0.09236	1.517893
N	3213	

Source: Compiled using CMIE Database

Table 3 presents the un-lagged correlation values between different estimates of growth. Market-to-book ratio is found to be statistically significant to growth in total assets, but the correlation coefficient is only 0.04. Growth in total assets is positively correlated to growth in sales as well as capital expenditure to sales ratio; the relation is statistically significant in each case. Table 4 presents the correlation values assuming that growth in total assets and capital expenditure to sales ratio has a lagged effect on sales. Hence these two variables are lagged one period.

Table 3: Correlations (un-lagged)				
	Market-to-book	Growth in total assets	Growth in Sales	Cap-ex to sales ratio
Market-to-book	1.00	0.04*	-0.02	0.00
Growth in total assets		1.00	0.16**	0.211**
Growth in Sales			1.00	0.01
Cap-ex to sales ratio				1.00
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

Certain interesting observations emerge from Table 4. Firstly, market-to-book ratio is not correlated to asset growth of the previous period. Secondly, growth in sales in time t is positively correlated to growth in total assets in the same period, but uncorrelated to asset growth of the previous period. Consequently it seems that the positive correlation observed in table 3 is an outcome of increase in current assets that would happen with incremental sales (inventory, receivables etc). Thirdly, growth in sales in period t is

Table 4: Correlations (lagged)				
	Market-to-book (t)	Growth in total assets (t-1)	Growth in Sales (t)	Cap-ex to sales ratio (t-1)
Market-to-book(t)	1.00	0.034	-0.008	-0.007
Growth in total assets (t-1)		1.00	0.025	0.242**
Growth in Sales(t)			1.00	0.267**
Cap-ex to sales ratio(t-1)				1.00
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

positively and significantly related to capital expenditure of previous period.

Consequent to these findings, the panel data model set up for testing the explanatory power of the financial statements based measures of growth takes the following form:

$$(Market-to-book)_{i,t} = \alpha_i + \beta_1 (growth\,in\,total\,assets)_{i,t} + \beta_2 (growth\,in\,sales)_{i,t} + \beta_3 (cap-ex\,to\,sales\,ratio)_{i,t} + \beta_4 (retention\,ratio)_{i,t} + \beta_5 (return\,on\,investments)_{i,t} + \varepsilon_i \quad \text{.....(i)}$$

And

$$(Market-to-book)_{i,t} = \alpha_i + \beta_1 (growth\,in\,total\,assets)_{i,t-1} + \beta_2 (growth\,in\,sales)_{i,t} + \beta_3 (cap-ex\,to\,sales\,ratio)_{i,t-1} + \beta_4 (retention\,ratio)_{i,t} + \beta_5 (return\,on\,investments)_{i,t} + \varepsilon_i \quad \text{.....(ii)}$$

Table 5 presents the results of the both the lagged and unlagged regression, with market-to-book as the dependent variable. The Hausman test results indicate that while the fixed effects models are appropriate in the unlagged version of the model (equation i), the random effects model is appropriate in lagged version (equation ii). Findings given in the table indicate that the two most commonly used measures of firm growth, namely growth in total assets and growth in sales are insignificantly related to market-to-book ratio of firms. Capital expenditure to sales ratio is inversely related to market-to-book in both the fixed effects and the random effects model for both equation (i) and (ii); the variable however is insignificant in case of ordinary least square. The evidence on retention ratio is largely positive and significant in the unlagged version of the model, and largely negative and insignificant in the lagged version. Further our findings reveal that return on investment is inversely related to market-to-book ratio in equation (i) and directly related in equation (ii). The significant F-values indicates the validity of the model while the observed R-squared values indicate the inadequacy of the ordinary least square models in explaining the dependent variable, market-to-book ratio.

Our findings with regard to asset and sales growth in both versions of the model indicates that these two proxies of firm growth does not capture the same set of factors that market-to-book ratio as a measure of growth captures. Possibly the *ex ante* and *ex post* perspective of growth is the dominant underlying factor resulting in the statistical insignificance of our findings. The largely significant and inverse relationship between capital expenditure to sales ratio and market-to-book in both the unlagged and lagged version of the model is contrary to what empirical corporate finance literature has presumed while incorporating this alternative measure of firm growth. There can be alternative interpretations to this observation. One possibility suggests that in periods of high growth, expansion in sales is large enough to bring the ratio of cap-ex to sales down, while in periods of low growth (marked by lower sales) the ratio increases. And because market-to-book ratio might be more reflective of common conditions in the capital market (Booth et al (2001)) and real sectors of the economy, the observed relationship between the two is inverse. Alternatively, capital expenditure may be viewed as the dependent variable (influenced) and market-to-book as the independent variable (influencer) and the findings explained in line with what the option approach to capital investment suggests; lower market-to-book ratio reflective of macroeconomic uncertainty and depressed capital market condition triggers investment in capital expenditure (lower capital cost might be the primary factor motivating such expenditures). This coupled with declining sales in such period's results in the ratio of cap-ex to sales increasing with decline in market-to-book ratio. The statistical significance of the results only in the fixed and random effects model does indicate that the reasons behind its statistical significance are somewhere embedded in time and group dummies.

Table 5: Results of regression						
	Unlagged (equation (i))			Lagged (equation (ii))		
	OLS	FEFM	FEFTM	OLS	REFM	REFTM
Constant	2.4079(0.1479)**	_____	3.6759(0.1228)**	3.7888(0.1880)**	4.0557(0.2453)**	4.106(0.1490)**
Growth in total assets	0.2468(0.1437)	0.1468(0.1045)	0.1242(0.1025)	0.2737(0.1635)	0.1445(0.1157)	0.1243(0.1174)
Sales growth	(-)0.0487(0.040)	(-)0.0053(0.0280)	0.0174(0.0274)	(-)0.0146(0.0439)	0.0401(0.0302)	0.0467(0.0306)
Capital expenditure to sales ratio	(-)0.0337(0.0467)	(-)0.1217(0.0329)**	(-)0.1240(0.1025)**	(-)0.0474(0.0658)	(-)0.1332(0.0445)**	(-)0.1440(0.0449)**
Retention ratio	1.5251(0.1949)**	0.9226(0.1525)**	0.1956(0.1788)	(-)0.1988(0.2455)	(-)0.5164(0.1950)	(-)0.5795(0.2013)
Return on investment	(-)0.2441(0.0299)	(-)0.6193(0.0212)**	(-)0.4814(0.0244)**	0.6744(0.1939)**	0.5319(0.1357)**	0.5133(0.1375)**
F Statistic	F(5,3207)=34.65**	F(463,2749)=11.25**	F(470, 2742) = 12.01**	F(5, 2748) = 3.21**	F(463,2290) = 10.22**	F(469,2284)=10.30**
Estimated autocorrelation	_____	0.1612	0.1792	_____	0.2433	0.244
R-squared	0.049	0.596	0.616	0.004	0.6079	0.613
Hausman	_____	845.86**	248.96**	_____	6.82	6.67

Note:

i. OLS refers to ordinary least square, FEFM refers to fixed effects firm model, FEFTM refers to fixed effects firm and time model, REFM refers to random effects firm model and REFTM refers to random effects firm and time model
ii. Figures in parenthesis indicate standard error values

**, * represent significance at 1% and 5% respectively

Our findings with regard to retention ratio is in line with theoretical models in statistically significant cases; market-to-book ratio increases with earnings retention, possibly reflecting retention as a credible signal for future growth or an outcome of companies retaining higher proportion of earnings in periods when capital markets and macroeconomic performances are robust.

Another startling finding of this research is with regard to return on investment. Again our findings stand contrary to what theory suggests in the un-lagged version of our model; market-to-book ratio is inversely related to ROI, and the positive relation between market-to-book and retention ratio is valid only when the same is incorporated with lagged asset growth and lagged capital expenditure ratio. In such a model, however retention ratio is insignificant in determining market-to-book ratio.

Consequent to these findings we have a number of important observations to make with regard to the estimation of firm growth and its measurement. Based on our findings (from table 3 through to table 5) it appears that neither growth in total assets nor growth in sales captures the dimensions of firm growth in the same way as market-to-book ratio does. Empirical evidence on the use of alternative proxies in the Indian context supports this finding; Bhaduri (2002, 2002a) observed a positive relationship between long-term indebtedness and growth in total assets (a proxy for growth), while Mahakud (2006) and Manos, et al (2001) observed an inverse relation between long-term indebtedness and market-to-book ratio used as a proxy for growth.

Furthermore correlation tables (table 3 and table 4) reveal that the degree of correlation among the financial statements based measures are not particularly strong, and in certain cases lagging variables produce better correlations between financial statements based

measures especially between lagged capital expenditure ratio and sales growth. Regression results in table 5, with special reference to capital expenditure and its relation to market-to-book ratio lends credence to both the options perspective of capital investments as well as earlier research evidence on market-to-book ratio incorporating capital market and macroeconomic conditions and/or country factors as observed in Rapach (2001), Cassola and Morana (2004) and Bordo et al (2008). While there is little evidence to either support or refute (Myers's (1977) dissection of market value of a firm and the consequent use of) market-to-book ratio as a proxy for growth as either a superior or inferior measures, our evidence does suggest that the variable incorporates factors that are far from firm specific. This influence of external factors possibly explains the contradictory findings of Rajan and Zingales (1995) and Beevan and Danbolts (2002, 2004) on the influence of market-to-book ratio on long-term indebtedness, both in the context of UK firms.

Conclusion

Empirical tests of theoretical propositions necessitate quantitative estimation of qualitative firm level attribute. The challenges of such estimation are nowhere more pronounced than it is the context of estimating firm growth as evinced from the multiplicity of proxies used. However in using or theorizing about the validity of these alternative proxies in their quest to measure a common intangible called 'firm growth', the issue of inter-relationship between these variables and the dimensions of growth it is capable of capturing has never been explored. This research paper is an attempt to address this issue.

Findings of this research suggest that the alternative financial statements based measures of firm growth are not correlated to an extent that can warrant substitution or interchangeable use. And in certain cases correlations are stronger with time lags than without. Furthermore, it is also observed that financial statements based measures of growth have limited explanatory power when it comes to explaining variations in market-to-book ratio of firms. Findings of this paper coupled with studies on the linkage between macroeconomic and capital market conditions with equity prices, provides indirect evidence that market-to-book ratio factors in the forward looking perspective of growth that the other alternative measures are not capable enough to capture, given their historical nature. However, inspite of these advantages the variable has limited use owing to (i) its non-availability in case of unlisted firms, and (ii) the challenges involved in obtaining a point estimate of market value to be used in conjunction with financial statement based measures. The latter challenge also happens to be a point of contention for the current research; is 365 day average market capitalization a fair measure of market value? We do not know for sure, but in the absence of any other better measure of value, this seems to be the best one in sight. This research ignores certain qualitative indicators of firm growth, namely intellectual capital based measures like the number of patents generated, primarily because of non-availability of data. Incorporating similar variables in empirical models on determinants of growth may be a direction for further research. Similar extensions in the model are possible by incorporating macroeconomic variables that are known to have an impact on equity prices. However, to obtain meaningful results from these extensions, the period of study has to be sufficiently long. This paper also suffers from the limitations inherent in the use of secondary sources of information in

reaching its conclusion and hence would incorporate all errors that might have crept in while compiling such data in the data base.

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