Drivers of Competitiveness in the Manufacturing Industry: The Case of Technology Sectors in Greece

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Abstract

This paper investigates empirically the main determinants of firm competitiveness under conditions of economic turmoil, with the use of panel data techniques. The study is based on firm-level financial data of 693 firms from the high and medium technology manufacturing sectors in Greece, and covers the time period 1996-2011, distinguishing between the pre-crisis (1996-2007) and the post-crisis (2008-2011) period. The results show that the key factors determining firm competitiveness are size, age, leverage, capital intensity and new fixed assets formation. Also, economic crisis has been found to change significantly, and in some cases dramatically, the pattern of the tested relationship.

Keywords: Determinants, firm competitiveness, economic crisis, manufacturing, panel data.

Introduction

Technology sectors in manufacturing are considered to be among the most progressive and important potential drivers of competitiveness and growth of a developing economy. This is based on the competitive advantages that those sectors can create for their economy through their products and the availability and use of its intellectual capital. The purpose of this paper is to study the drivers of competitiveness in the technology sectors of the Greek manufacturing industry, both in the pro and post economic crisis era, based on firm level financial data and try to find critical determinants.

Literature Review

According to Fischer and Schornberg (2007) profitability is a key variable for assessing sector competitiveness and value added as a percentage of turnover is a kind of profit margin that one often has to rely. They argued that market share is a useful competitiveness indicator at the company level even when analyzing aggregates, market shares may be problematic.

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Competitiveness is adopted as a management or economics idea that is superior to the traditional economic indicators such as profitability, productivity or market share, which are seen as being insufficient to enable continuous improvement of performance (Lu,2006). As declared by Buckley et al. (1988), the concept not only reflects past performance, but also allows the perception of potential and the improvement of managerial processes. Traditional indicators can only reflect the historic quantitative facts.

There is a great deal of controversy over the definition of industry'. Porter (1980) defines an industry as a group of firms producing products that are close substitutes for each other. An industry is an arbitrary boundary within which firms compete with each other to produce related or similar products (Langford and Male, 2001).

For providing customers with greater value and satisfaction than their competitors, firms must be operationally efficient, cost effective, and quality conscious (Johnson, 1992; Hammer and Champy, 1993). Also related to this condition are a number of studies focusing on particular aspects like marketing (Corbett and Wassenhove, 1993), information technology (Ross et al, 1996), quality of products (Swann and Tahhavi, 1994), and innovative capability of firms (Grupp et al, 1997). Some research, partly supported by Porter's (1990) argument that productivity is the true source of competitive advantage, defines competitiveness by using productivity. Porter defined competitiveness at the organisational level as productivity growth that is reflected in either lower costs or differentiated products that command premium prices.

The limitations of measuring productivity include lack of availability and reliability of data; failure to measure more important things (e.g. the effectiveness of project management, the quality level achieved, and the innovations); the difficulty of productivity comparisons between industries, etc. (Cattell et al., 2004).

Kraft (1989) analyzes the relation between market structure, firm structure and innovation for a sample of 57 German metal working firms. According to his results firm size has no significant impact on the share of new products in total sales. They also confirm that firm characteristics, as well as market characteristics, influence innovative performance. Veugelers and Vanden Houte (1990) examine R&D spending per dollar of sales for a cross-section time series sample describing 47 Belgian firms. Neither firm size nor market concentration has very significant effects on R&D intensity. Lee (2005) uses a data set of Korean manufacturing industries for the year 1983 and proves that the concentration of R&D relationship differs depending on the strength of the link or simply the appropriability of R&D in terms of market share: a positive relationship is found in case of low-appropriability industries, where market concentration characterizes low R&D appropriability, while a negative or inverted U-shaped relationship characterizes high-appropriability industries.

However, only few works tried to investigate the relationship between firm R&D intensity and other firm level variables such as growth, profitability and also financial status of the firm, using data of Greek manufacturing firms, in which the technological performance of the industry is limited but growing. Vlachvei, A. et al. (2006), examine the factors that determine the variation of R&D activity across a sample of 150 Greek manufacturing firms for the period 1996-2000. Alternative methods (Fixed effects and 2SLS fixed effects) have been applied to test the effects of a number of firm level variables on firm R&D intensity, by taking into consideration the conditions, the initiatives and the status of technological performance in Greece. The results show that when the Greek firms are profitable and fast growing, there is limited motivation to invest in R&D. Also, Notta's et al. (2010) empirical work is based on financial data of 300 food manufacturing firms. The financial data set covers the period 2003-2007. The Fixed Effects method is used to estimate the coefficients of the specified empirical model using time series cross-section panel data.

They find that the main significant determinants of growth are size, profitability and age. Also, there is a U shaped relationship between size and growth which implies that size affect growth positively only when firm reaches a certain level of sales. Profitability is found to affect growth negatively which shows that in order to achieve high growth firm sacrifices profits.

Design and Methodology

The research is based on financial data of 693 firms from the sectors of metallurgy products, machinery, electrical and electronic products, electrical appliances and transportation vehicles, for the period 1996-2011, separating the period into two sub periods, i.e. pre economic crisis period (years 1997-2007) and after the crisis period (years 2008-2011), in order to detect differences in performance and the factors affecting it.

The sectors are based on 2 digit NACE codes and are characterized as medium to high technology sectors for Greece. Financial data for those firms were collected from the ICAP Hellas data base.

We used two measures as proxies of competitiveness, i.e. a) sales of firm **i** over Total Sales of the 4-digit industry sector where the firm belongs and b) market share growth. The reasoning behind this is that, if a firm acquires a large market share, the firm is able to withstand competition.

We use two empirical models, one for each dependent variable above. Based on theory and literature, we selected five independent variables, assuming that they might affect significantly the firms' competitiveness:

1. Size: It is measured as natural logarithm of Total Assets and is expected to correlate positively with market share and market share growth.
2. Age: This is measured as year t minus year of establishment and is expected to correlate negatively with market share.
3. Leverage: Measured as Total Debt / Total Liabilities, leverage shows the level of firm indebtedness, both in short term and long term funds.
4. Capitalization: This is measured as Fixed Assets over Total Assets and shows the capital intensiveness of the firm
5. Investment: Measured as change in Net Fixed Assets from year t-1 to year t,
6. Crisis Dummy: a dummy variable taking the value of 1 for the period 2008-2011 and 0 for the pro crisis period, years 1996-2007. This variable is included in order to capture the effect of the current economic crisis on the above indices of competitiveness.

From descriptive statistics (Table 1), we see that market share has increased in the crisis period, i.e. 2008-2011, due to the fact that many firms closed down and consequently the remaining ones gained their market share.

Table 1: Descriptive statistics

	AGE	Capitalization	MSHARE growth	Investment	Leverage	MSHARE	SIZE
Pre crisis period (1996-2007)							
Mean	12,61	0,32	0,02	0,49	0,55	0,09	14,83
Std.Dev	15,22	0,23	1,04	11,61	0,24	0,19	1,43
Post crisis period (2008-2011)							
Mean	20,61	0,32	0,05	0,13	0,60	0,11	14,73
Std.Dev	14,87	0,20	0,51	1,54	0,30	0,20	1,36

This gave a momentum to those firms to demonstrate a higher growth rate in market share during that period.

Age shows a significant increase, again due to the fact that the surviving firms are older firms benefiting from economies of scale and reputation effects.

Although capital intensity remained unchanged, investment in fixed assets showed a substantial decrease during the crisis period, due to limited funds both from retained earnings and borrowing. Capital intensity, size and leverage remained at approximately the same levels.

Table 2: Variables used and expected signs

Variable	Meaning	Expected sign (Dependent Variable: Market share)	Expected sign (Dependent Variable: Market share growth)
Size	The natural logarithm of Total Assets	(+)	(+)
Age	Age of establishment of the firm	(-)	(-)
Lev	The financial ratio Total Debt / Total Liabilities	(-)	(-)
Capit	The financial ratio Fixed Assets / Total Assets	(-)	(-)
Inv	Change in Net Fixed Assets from year t-1 to year t	(+)	(+)
CD	Crisis dummy equals to 0 for the pre economic crisis period (years 1997-2007) and 1 for the crisis period (2008-2011)	Unspecified sign	Unspecified sign

Based on the above variables we used the following model:

$$\text{[Market Share] or [Market Share Growth]} =$$
$$= a_0 + a_1 Size + a_2 Age + a_3 Lev + a_4 Capit + a_5 Inv + a_6 CD + \varepsilon$$

We run the above two regression models on panel data for a) the total period 1997-2011, b) the pre-crisis period 1997-2008 and c) the post crisis period 2008-2011.

The empirical analysis was performed using the Panel EGLS method with diagonal correction of standard errors for heteroscedasticity and autocorrelation (according to the White methodology).

Specifications with both fixed and random effects were tried, but their performance was relatively inferior based on the usual statistical / econometric criteria. Also, there is no indication that the data structure is characterized by period specific heteroscedasticity, contemporaneous covariances, and between-period covariances.

Empirical Results

For the Market Share model the results are shown in Table 3.

Table 3: Determinants of MSHARE

Variables	Time Period 1997 - 2011	Time Period 1997 - 2007	Time Period 2008 - 2011
	(a)	(b)	(c)
Size	0.057***	0.057***	0.051***
	(8.288)	(5.813)	(4.723)
Age	-0.007***	-0.008***	0.004***
	(11.376)	(9.423)	(3.893)
Leverage	-0.054***	-0.062***	-0.034**
	(4.886)	(3.430)	(2.177)
Capitalization	-0.047***	-0.055***	-0.039
	(3.989)	(4.136)	(1.564)
Investment	2×10^{-6}	5×10^{-6}	6×10^{-6}***
	(0.925)	(1.115)	(3.471)
Crisis Dummy	0.012***	-	-
	(3.909)	-	-
Adj. R-squared	0.919	0.925	0.969

*(1) * Significant at the 10% level (two-tailed test), ** Significant at the 5% level (two-tailed test) *** Significant at the 1% level (two-tailed test).*

(2) t ratios are in parentheses. All equations include 2-digit industry dummies. Standard errors are White heteroskedasticity consistent.

Where:

MSHARE = market share of the firm in the relevant 4-digit industry
Size = natural logarithm of Total Assets
Age = year t minus year of establishment
Leverage = Total Debt over Total Liabilities
Investment = Rate of growth in Net Fixed Assets from year t-1 to year t

The results show that size is positively and significantly correlated to market share. This is in line with our hypothesis and indicates that larger firms have the required resources to achieve economies of scale, produce more and promote their products at lower prices thus attaining a larger market share. Therefore H1 Hypotheses cannot be rejected.

Age was also found significant but with a negative correlation as expected (H2), indicating that young firms are more aggressive and use modern management procedures to achieve a higher market share.

This result is supported by the negative correlation found in the capitalization ratio [Fixed Assets (FA) over Total Assets (TA)] accepting H3. Large investments in FA are expected to correlate with older firms through the years.

However, the findings on the investment variable imply that firms that make new investments have larger market shares. We expect that young firms in the technology sectors are the ones that will use their funds to invest in new technology in order to be competitive. This variable came out as significant only in the crisis period in the market share growth model. Therefore hypothesis H5 is supported by the findings.

Leverage came out as significant but with a negative sign, as expected (H3). The reason for this is that over leveraged firms are deprived of enough retained earnings needed to support production and promotion activities, because of debt repayment obligations.It is important to note that for the post crisis period only capitalization variable came as non-significant in the market share model, implying that only firms that make new investments in tangible long term assets with or without capital intensity can remain leaders in the market during an economic crisis period.

All other variables remained unchanged for the pro and post crisis period. The concluding remark for this is that relatively large size young firms in Greece with low to medium level borrowed capital, investment in new technology and innovation, are the market leaders during an economic crisis period. The crisis dummy shows that crisis affects market share positively and significantly for the firms that remain in the market after the crisis. Due to the fact that many firms closed down after 2008, the surviving ones enjoy a higher market share and oligopolistic market conditions.

For the model of market share growth the results are shown in Table 4.

Table 4: Determinants of Growth in Mshare

Variables	Time Period 1997 - 2011	Time Period 1997 - 2007	Time Period 2008 - 2011
	(a)	(b)	(c)
Size	0.085	0.090*	0.111
	(1.118)	(1.798)	(1.132)
Age	-0.015***	-0.021***	0.042***
	(2.768)	(3.660)	(3.681)
Leverage	0.118*	0.109**	0.052
	(1.684)	(1.995)	(0.302)
Capitalization	-0.592***	-0.522***	-1.435***
	(3.718)	(3.202)	(3.973)
Investment	0.070***	0.067***	0.258***
	(15.996)	(16.347)	(9.482)
Crisis Dummy	0.482	-	-
	(0.874)	-	-
Adj. R-squared	0.480	0.646	0.602

*(1)   * Significant at the 10% level (two-tailed test),** Significant at the 5% level
        (two-tailed test) *** Significant at the 1% l*
(2)   Level (two-tailed test).
(3)   t ratios are in parentheses. All equations include 2-digit industry dummies. Standard
errors are White heteroskedasticity consistent.

In this model the variable is the change in market share, as a measurement of stronger competiveness than market share. If a firm can increase its market share, especially in periods of severe economic depression, then it will be able to survive and grow in any other circumstances. Investigating the critical factors which affect positively this competitiveness measure will help managers and policy makers to take actions towards this direction.

The findings of the research presented in table 3 above, indicate that age is a critical factor, but it is interesting that in periods of normal economic activity, young firms are the winners of the market, while in periods of recessionary conditions, older firms are the ones that increase their market share.

A possible explanation for this is that older firms have the knowhow, the brand name plus the resources required to overcome the difficulties and additional effort required in bad economic conditions. Furthermore, they can possibly benefit from dynamic economies of scale by learning from experience and reputation effects (Notta et al., 2010).

Other implications from the findings of this model are:

- The impact of leverage is positive since lower leverage indicates greater financial security, necessary to seek an aggressive marketing strategy. The higher the borrowing the higher the growth in market share, meaning that availability of foreign funds and access to financing can help firms to invest in new technology and beat the market. However, it did not come out as a significant factor in the post crisis period, suggesting that firms are financing their growth through own funds, because of lack or difficulty in obtaining loans.
- Increase in Net Fixed Assets is significant and positive at 1% level determinant, supporting the explanation given above. During economic depression growth should be financed through own funds.
- The capital intensity affects significantly but negatively the market share increase in both non crisis and crisis conditions. This means that flexibility and new technology are the critical factors for firms in the technology sectors, in order to be dynamic in increasing their market share.
- Finally, economic crisis does not seem to affect market share growth.

The present research incorporates an analytical framework that contains a comprehensive set of connections between competitiveness measures and its drivers. The competitiveness measurement model we developed serves as a useful strategic tool for firms of technology sectors in assisting them in the analysis of their financial performance. Therefore, this approach can be used as an additional tool for managers in the formulation of strategies to improve their competitiveness.

Further research could include the investigation of firm's competitiveness critical factors in other sectors of the economy, for comparison reasons.

Concluding Remarks

In our research, we presented a model of critical determinants of firm competitiveness with reference to the technology sectors of the Greek manufacturing industry. Competitiveness was measured with market share and market share growth and included separately normal and recessionary economic conditions. With the help of panel data econometric analysis, we investigated the effect of size, age, leverage, capital intensity and investments in fixed assets, on competitiveness, on a firm level basis, taking into account the heterogeneity among firms.

The results of empirical research indicate that the main significant determinants of market share and market share growth are size, age, leverage, capital intensity and new fixed assets formation.

Economic crisis increases market share for the firms surviving the crisis, because of prevailing oligopoly conditions formulation.

In summary, we can conclude that competitiveness increases with size and decreases with age of the firm. Young firms of considerable size tend to become more competitive.

Borrowing helps firms to increase their market share, but the dominants of the market show low levels of debt.

Low capitalization with continuous investing in new technology increases a firm's competitiveness, especially under recessionary economic conditions.

Therefore, large size young firms with low level of tangible assets, which follow the market by investing in new technology, are the ones which can beat the market in both good and bad economic conditions. Our findings could guide executives in formulating their strategy if firms focus on increasing their market share.

The State policy makers should give incentives to young firms to borrow and make investments, to keep up with the new technology. Lenders should focus in financing large size firms of lower financial risk, supporting the expansion of technology manufacture in Greece.

Acknowledgments

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