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**The effect of innovative activity in firm performance and development:
Analysing data from eurozone**

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Abstract

Purpose – The purpose of this paper is to examine the effect of Innovative Activity on firm performance and growth. Active Research and Development is considered to be directly related with development, prosperity and growth, in micro and macro level and a key factor in hindering economic recession.

Design/methodology/approach – We analyse economic data from listed firms of selected eurozone country-members in order to associate Research and Development with performance indicators in firm and country level. For that purpose, several firm data were collected from WorldScope data base and macroeconomic data from Worldbank database. The period examined is between 2002 and 2012, with a special focus on current financial crisis (after 2007). The empirical process includes, descriptive statistics and logistic regression analysis.

Findings – Findings indicate the crucial effect of innovative process in economic performance and development in firm and country level. The latter highlights the urgent need for public support in order to spur innovative activity and high-tech exports, especially in countries that were heavily affected by recession.

Research limitations/implications – Some research limitations are the large number of missing cases in WordScope database, as many firms after the beginning of current crisis exit stock market. Furthermore, the other part of the economy, the Small and Medium Enterprises does not exist in the analysis, as listed firms are mainly large and mature companies.

Originality/value – The results tend to highlight the need for common policy measures in eurozone, in regard to such issues, instead of imposing horizontal budgetary constraints in specific countries (like Southern Europe), hindering the vicious recessionary circle.

Keywords: Innovative Activity, Development, Firm Performance, Eurozone

JEL Classification: M2110, O390, O470

1. Introduction

In this work, we attempt to examine the role of innovative activity in hindering the impact of economic crisis. Characteristics of firms performing Research and Development are compared with those of non-innovative firms, from selected countries of two different groups of Eurozone: The southern European countries (Greece, Italy, Portugal and Spain), that were (and still are) heavily affected by current crisis, and the most representative countries of central Europe (also called as “European North” or the “core of eurozone”), Germany and France, which ‘manage’ recession in a much different way. Our main scope is first to identify possible differences between innovative and non-innovative firms and then to attempt to disclose similar differences between innovative firms (only) from different countries. The main scope is not only to confirm the (prospected) significant effect of innovation in development but also to highlight the different impact (if any) of macroeconomic performance and infrastructure, in R&D outcome. Before the empirical process will be analysed, two main questions should be answered: i) why we are interested in innovative

activity and ii) why we analyse group of countries of eurozone.

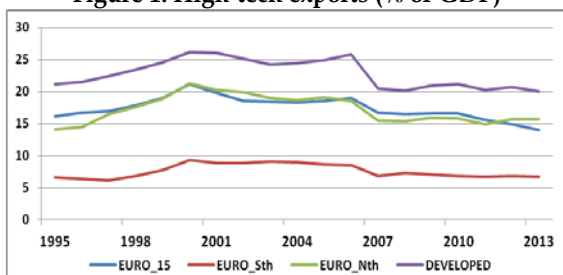
Innovative activity is considered to be a crucial factor for prosperity and growth. It seems to affect economic process directly (improving turnover and profitability) or indirectly (increasing employment, diffusing new technologies etc. (OECD 2013). Thus, Research and Development appears in various surveys to be the major factor of spurring technological and economic progress (for a short literature review, see Makris, 2015; Ferguson and Olafson, 2007; Tselekidis et al., 2003; Makris, 2008). Hashi and Stojcicc (2013), find that investment in innovation activities result in better productivity, while Koelinger (2008) claims that R&D increases the level of sectoral and national economic performance, diffusing innovative products (p.990), Furthermore, Kafouros (2005) finds that R&D process is positively correlated with productivity growth and sales, especially in high-tech sectors (p.492). In their research, Autio and Parhankangas (1998) highlight the ability of those firms to survive and grow even during economic crises. In regard to European firms, Koellinger (2008) concludes that the innovators are

more likely to grow than non-innovative firms. Apart from financial performance, innovative activity seems also to affect positively firms' competitiveness, increasing exporting activity (see indicatively Bleaney and Wakelin, 2002; Filatotchev et al., 2009; Hashi and Stojcic, 2013).

Adversely to the importance of innovative activity, in European Union, no common strategy seems to exist concerning R and D activity and technological infrastructure. Especially in the core of EU, the Eurozone, a clear segregation appears. From the one hand, the countries of European south (euro-periphery), after a period of prosperity and growth (until 2005), present poor performance, decreasing the (already low) R&D expenditures and the high-tech exports (two of them, Portugal and Greece, are in the last place). Due to the dramatic cuts in public spending, the austerity measures and the lack of FDI (as a result of the unstable economic conditions), those countries suffer from various economic restrictions in liquidity, exports, imports of intermediary goods, etc.

On the other hand, countries of the core of Eurozone (like Germany and France), continue to increase investment in R&D, establishing a national system of innovation that is focused on technologically intensive sectors, while at the same time, they highly support even during the economic distress, production of high-tech products and services. As a result, the existed gap in technological intensity between the two groups of countries (of the same union), seem to become larger after current financial crisis. It is interesting enough, that fifteen years after the ambitious project of economic union, no real integration between countries-members that have joined it (for further analysis see also Makris and Nikolaidis, 2015) seem to exist. Adversely, the gap between prospering "North" and the struggling "South" is highlighted. The latter is clearly presented in figures 1 and 2. Figure 1 presents the average percentage of high-tech exports, and Figure 2 the R&D expenses the last 20 years in EURO-15 countries¹, in the two groups of countries analysed and in selected representative large developed economies (Germany, US, China and Japan).

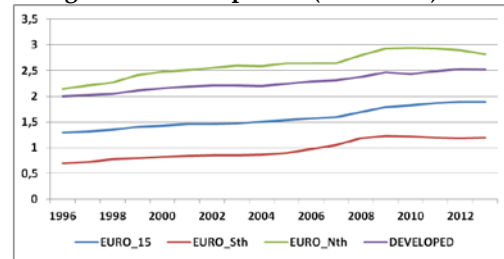
Figure 1: High-tech exports (% of GDP)



Source: World data bank, Eurostat and personal calculations

¹ We excluded countries that joined eurozone after the beginning of economic crisis

Figure 2: R&D expenses (% of GDP)



Source: World data bank, Eurostat and personal calculations

As it is clear, from both figures, innovative activity is rather low in countries of European South, while the stability or even slight increase in R&D expenses or high-tech exports after 2007, is actually a huge reduction (in absolute values), because they are expressed as a percentage of GDP which has been dramatically reduced in those countries. Adverse is the picture in countries of European North where GDP increases

2. R&D Performance in Eurozone²

After a period of slight convergence in the field of innovation and R&D intensity in the beginning of common currency project (2002-2005), expenditure in R&D differs significantly after 2007 across economies and sectors, resulting in different policy measures, performance and development, both in firm and macroeconomic level.

More specific, in euro periphery, the basic characteristic of firms is the small or medium size along with the low and medium technologically intensive production processes and products. Those countries, at the beginning of euro project (2002-2005), significantly improved their scientific quality, increasing public funding in supporting innovative process and achieving higher private investment in Research and Technology. After 2008 however, all targets concerning R&D intensity (to be achieved by 2020) were cancelled. Countries of southern Europe were heavily affected by the global financial crisis, mainly due to their inability to manage sovereign debt. The result of debt crisis was the implication of harsh austerity measures and dramatic cuts in public spending resulting in a large reduction in GDP and in a violent burst in unemployment. The vicious circle of recession is generally admitted to be the most crucial problem for those economies and specific policy measures and reforms are necessary in order to spur development and growth. The overall economic condition affects investment in R&D, impairing recession. On the other hand, totally different is the picture concerning the two countries of Eurozone North, which were not affected seriously by financial crisis (especially Germany), and they were not obliged to apply cuts in budgets and high taxes in companies. The countries of the core of Eurozone, are research intensive, and innovation has a strong impact in performance, in Micro and Macro level. Private sector's R&D expenditures progressed

² Sources: European Commission 2013, OECD 2013, European Union 2014

during the economic crisis (2007-2011) in those countries, while public funding in R&D has also grown substantially, helping them to maintain a strong exporting performance. As a result, those countries succeed a strong positive contribution of high and medium-tech products to the trade balance (2002-2012), adversely to the negative trend of total trade.

3. Sample and Methodology

In this work, we attempt to analyse the effects of innovative activity in development and growth in firm level. Our sample consists of firm data from listed data from seven eurozone countries-members, Germany and France ('core' of eurozone'), Italy, Spain, Greece, Portugal and Ireland (euro periphery). From an initial sample of 650 listed firms, data from 441 (after excluding missing and extreme values) were collected and classified in two different groups that will next be compared to each other:

- Firms that present continuous and high level of R&D expenditure and introduce new patents in products and services (taking value 1).
- Firms that do not perform any innovative activity (R&D expenses and patents) during the period examined (taking value 0).

The number of firms included from each country in the final data set, was attempted to be in accordance with the average number of the listed firms of each one in the period examined, as recorded by Worldscope databank. Some country-specific data that were included in the analysis, were collected from World Bank databank.

In order to analyse the differences between firms performing innovative activities, we select several widely used characteristics, indicating performance and growth. For most of those indicators (apart from categoricals), percentage change between the period examined were calculated. The main question that we attempt to analyze, is whether significant differences between innovative and non-innovative firms exist, relative to several performance indicators and firm characteristics. In the rest of the section, all the variables included in the analysis, are described, along with a brief theoretical justification and some descriptive statistics.

i) Firm size and Investment Activity (Investment-SIZE) is one of the most commonly used measures of growth. However, it is a rather ambiguous factor in regard to its contribution to economic performance. Empirical findings conclude that SMEs and mainly NTBFs, are important drivers of growth and innovation, affecting positively employment (Majumdar, 1997, Makris, 2008). On the other hand, larger businesses typically have the competitive advantage due to economies of scale, cheaper credit and direct access to global value chains. Concerning Europe, innovators are more likely to grow than non-innovative firms (Koellinger, 2008) and because of that, a positive relation between rates of growth and innovation is prospected. Various measures have been used in literature in order to quantify firm size (number of employees, profitability, total assets etc.) (Coad, 2007).

In this work, employment, economic growth (profitability) and Total Assets are directly or indirectly included in the analysis and because of that, net Fixed Assets' growth is used as a measure of firm size (implying that the more a company invest, the larger it became). Investment activity is a major factor of economic development. SMEs increase employment, while larger firms appeared also to affect positively growth and employment (it depends on the sample used). In order to calculate that measure, the natural logarithm of the average change in investment in Fixed Assets is used. Figures 3 and 4 present investment performance for two sub periods: 2002-2012 (the whole period examined) and 2007-2012 (current financial crisis).

Figure 3: Investment Activity (2002-2012)

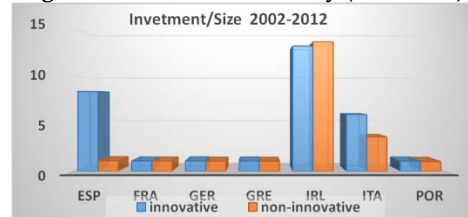
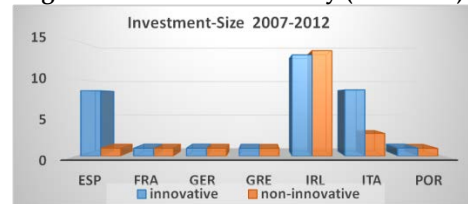


Figure 4: Investment Activity (2007-2012)



Findings confirm the ambiguous findings literature highlights. For both periods examined, little differences appear in investment activity, among innovative and non-innovative firms for the vast majority of the firms analysed. Thus, no clear relation between size and innovative activity seem to exist.

ii) Financial Performance is a crucial factor of growth and prosperity. Firms with strong economic performance could resist in recession, retaining or increasing employment and enjoying less financial and commercial constraints indoor and outdoor. Innovative firms due to the competitive advantage of innovative products and processes, are expected to affect positive firms' financial outlook. In order to test that hypothesis, three widely used indicators of financial performance are included in the analysis: *Profitability, Debt Accumulation and Liquidity*.

Profitability (PROF) is a crucial factor in regard to firm growth. As a measure of profitability, EBIT-to-Total Assets ratio was selected (also called as Basic Earning Power), as it has been included in various similar researches (see indicatively Wang et al. 2009 and Makris 2015). Due to their competitive advantage, innovative firms are expected to present higher profitability than non-innovative. Thus, a significant effect relation with R&D is expected. Figures 5 and 6 highlight that assumptions for most of the countries examined and for both periods analyzed.

Figure 5: Profitability (2007-2012)



Figure 6: Profitability (2007-2012)



iii) **Debt Accumulation (DRBR)** indicates firms' financial health. It is crucial for a firm to manage successfully and reduce (if possible) liabilities, especially during economic distress. A high debt ratio may restrain economic performance, generating worries for firm's ability to make interest and loan payments (see for example Wang et al 2009). As an indicator of debt accumulation, the financial leverage ratio is used (Total Debt to Total Assets). The fast growth that (according to literature) innovative firms usually enjoy, may affect positively market share and turnover, resulting in a better financial performance and thus a lower debt ratio. A negative relation with R and D activity is thus, prospected, however a positive relation could also be possible, due to fast growth and high investment rates that innovative firms may follow.

Figure 7: Debt ratio (2007-2012)

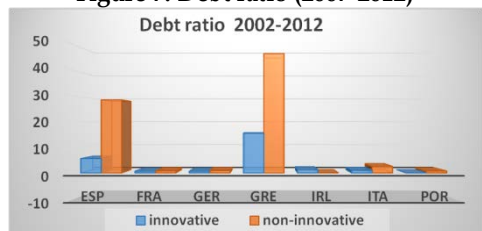
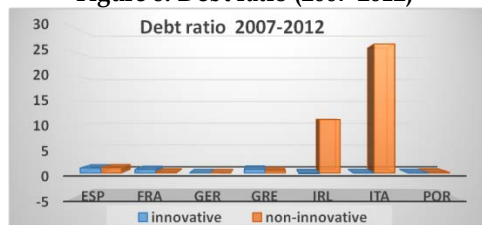


Figure 8: Debt ratio (2007-2012)



Descriptive statistics do not present a clear picture, with most countries to appear similar percentages of debt accumulation during the periods examined. However, in countries affected most by recession, innovative firms seem to perform much better, with lower debt ratio than non-innovative.

iv) **Liquidity** is a measure of viability and financial health. Firms presenting high liquidity ratio, are able to reduce liabilities (debt). Furthermore, adequate liquidity during a distress period provides firms with a strong competitive advantage in national and mainly in global market, diminishing constraints from suppliers, financial institutions and creditors. One of the various indicator implying ability of a firm to repay its short-term liabilities is Net working Capital ratio (=Current Assets - Current Liabilities). A positive relation with innovation is prospected as innovative firms are expected to be more profitable and fast growing as already discussed. However, a negative effect could also be possible, as due to higher growth rates, those firms could present new investments and asset's growth and as a result, shortage of cash.

Figure 9: Liquidity ratio (2002-2012)

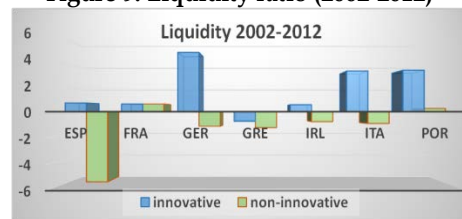
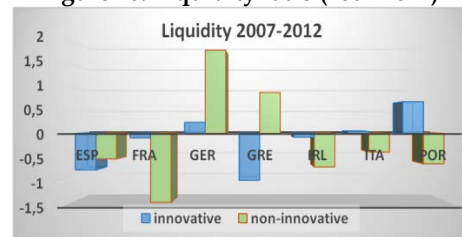


Figure 10: Liquidity ratio (2007-2012)



As findings indicate, innovators seem to perform better for the whole period examined (2002-2012). During current crisis however, results are not so clear, with non-innovative firms to present better liquidity ratios in some countries.

v) **Employment growth (EMPL)**. A crucial factor concerning development, growth and social cohesion is employment growth. As already mentioned, many research works conclude in a strong positive effect of innovative performance in employment (Makris et al. 2014-IJBG), even during recessionary periods (Autio and Parhankangas, 1988). Thus, several policy measures have been established in order to spur job creation. Innovative firms that follow faster growth rates could support such policies, as long as public support to R&D is also established and grow. A positive effect of innovation in employment is expected.

Figure 11: Employment ratio (2002-2012)

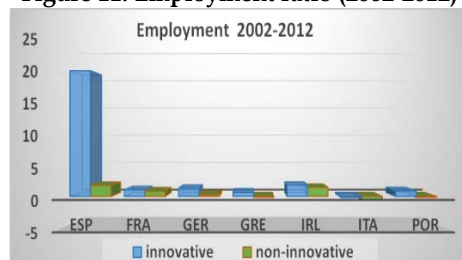
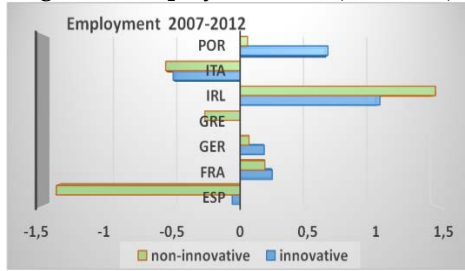


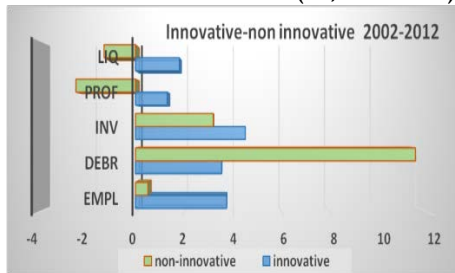
Figure 12: Employment ratio (2007-2012)



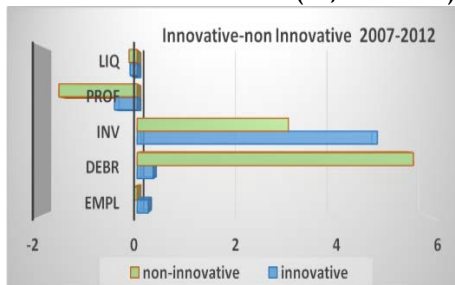
In almost all countries, for both periods examined, innovative firms present higher rates of employment growth, confirming literature. Especially in the years after 2007, findings (apart from Ireland) are even more clear. Thus, R and D activity is positively related to employment and budgetary constraints should not affect investment in that.

Summarizing findings, Figure 13 and 14 present innovative and non-innovative firms from all countries and variables used, highlighting the better performance of innovators in all indexes.

Figures 13: Performance of Innovative and non-Innovative firms (all, 2002-2012)



Figures 14: Performance of Innovative and non-Innovative firms (all, 2007-2012)



Those descriptive findings will then be tested through an empirical analysis in order to be statistically confirmed (or not). For the econometric analysis that will follow, IBM SPSS statistics v.19 will be used and a logistic regression model will be used, appropriate for binary dependent variables (0=non innovative, 1=innovative firms). As data from different countries (with different characteristics) of eurozone are analysed, a segregation is necessary, in order to disclose possible differences. Thus, a categorical country-specific interpreter will be included in the model (COUNT), consist of six classes (taking values from 1=poor performance to 7=best performance). That indicator is a weighted result of performance, in several macroeconomic indicators (debt accumulation, R&D

intensity, GDP growth and unemployment rate). Country's economic conditions and innovation system (public funds, infrastructure, debt etc.) is expected to affect strongly innovative activity and performance. Thus, a positive relation is expected.

Table 1 presents the summarized results of logistic regression process.

Table 1: Regression Results

Regression's Results			
Explanatory	Model Results		
	B	Sig.	Exp(B)
Country	.150	.008	1.162
Liquidity	.052	.008	1.053
Investment-Size	.054	.058	1.055
Debt Ratio	-.001	.518	.999
Profitability	.061	.040	1.063
Employment	.106	.071	1.112
* Model Performance			
Chi-square=44,842. df=6 , sig. = .000			
Cox & Snell R Square: .197, Nagelkerke R Square: .229			
Predicted cases: 0=56.2, 1=73.2, overall=64.9			

Findings strongly confirm descriptive statistics, with innovative activity to be positively related to most indicators already discussed, while model's performance seem to be quite adequate. Thus, the direct relation of innovative activity with performance, growth and development (investment, employment etc) is more than obvious.

4. Conclusions

In this work we attempted to associate firm performance and development with innovative process. Findings indicate that innovators appear to increase profitability, assets and employment, even during a severe economic crisis (after 2007). Thus, specific policy measures should be applied, in order to support innovative activity, especially in countries that are heavily affected by economic distress.

However, a clear differentiation between countries seems also to exist (which is also confirmed by the empirical analysis), with most of the euro periphery countries to impose budgetary cut-offs in public spending, even in sectors that could alleviate the consequences of the crisis (like innovation), impairing thus, the vicious recessionary circle. At the same time, countries of northern Europe foster innovative activity establishing supporting mechanisms and public funding, increasing thus the gap between the two parts of the same union.

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