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LEARNING-BY-EXPORTING: UMA AVALIAÇÃO DO CASO PORTUGUÊS

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Economia da Empresa, realizada sob a orientação científica do **Prof. Doutor Miguel Matos Torres**, Professor Auxiliar do Departamento de Economia, Gestão, Engenharia Industrial e Turismo da Universidade de Aveiro, e co – orientação científica da **Prof.ª Doutora Marta Ferreira Dias,** Professora Auxiliar do Departamento de Economia, Gestão, Engenharia Industrial e Turismo da Universidade de Aveiro.

Dedico este trabalho a todos aqueles que de perto me acompanharam nesta jornada, e em especial à minha mãe pela compreensão e apoio incondicionais.

O júri

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Palavras-chave Aprendizagem pela exportação, auto-seleção, inovação, exportação, produtividade, performance empresarial

Resumo Esta investigação examina a relação de causalidade entre exportação e performance empresarial. Recorrendo a um painel de dados no período temporal 1997 – 2007, é feito um teste à indústria transformadora portuguesa contrapondo a existência de aprendizagem pela exportação com a existência de auto-seleção das empresas em termos de comércio internacional. Este estudo fornece evidência da coexistência destas duas abordagens teóricas, em vez de apenas apoiar a existência de uma delas por exclusão da outra. Assim, esta investigação sugere que as empresas podem entrar por livre arbítrio no mercado de exportação, melhorando os seus níveis de produtividade antes do processo de exportação de forma a poderem competir adequadamente no mesmo, enquanto subsequentemente aprendem com o processo de exportar através das reservas de conhecimento a que vão acedendo, o que leva a uma melhoria do seu desempenho. Desta forma aponta-se claramente para a necessidade de se identificar um corpo teórico de nível superior ao existente presentemente.

Key words Learning-by-exporting, self-selection, innovation, exporting, productivity, firm performance

Abstract

This investigation work examines the causality link between exporting and firms' performance. Using a panel within the time span 1997 – 2007, it is done an assessment to the Portuguese manufacturing industry on the existence of the learning by exporting against the existence of self-selection in terms of international trade. This study provides therefore evidence of coexistence of these two streams, rather than supporting the existence of only one of them individually by excluding the other. This investigation thus suggests that firms can freely choose to enter in the exporting market, increasing their productivity levels ex-ante the exporting process in order to be able to properly compete on it, while subsequently learn from the exporting process through the knowledge stocks that it gives them access to which leads them to an improvement of their performance. This way it is pointed out the need be identify a theoretical framework that aim at a superior level than the existing one.

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EPO	European Patent Office
GDP	Gross Domestic Product
LEA	Learning by Exporting Approach
NACE	Statistique des Activités Économiques dans la Communauté Européenne, i.e. Statistical Classification of Economics Activities in the European Community
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
SME	Small and Medium Enterprise
SSA	Self-selection Approach
TFP	Total Factor Productivity
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development

1. Overview

Do Portuguese firms learn-by-exporting? Or, do they self-select into exporting? Are learning by exporting and self-selection, alternative or complementary approaches to understanding the exporting process of firm? This work delves into the causality link between three pillars of these approaches: exporting, innovation and productivity. This scientific work explores these two hypotheses upon empirical data of Portuguese transforming industry, adding to the literature a new perspective by thoroughly exploring the impact of internationalization, here measured through exporting, on both of the main strands of firm's performance: innovation and productivity.

Literature dealing with the drivers of exporting, namely through innovation and productivity, currently has two major approaches (Kneller and Pisu, 2010): (1) the stream advocating the existence learning-by-exporting as a major driver, through which exporting (as an exploratory activity) leads firms to innovate and consequently to improve their internal productivity levels, i.e., innovation is a link between exports and productivity (Vahter, 2011; Blalock and Gertler, 2004; Damijan, Kostevc and Polanec , 2010); and (2) the idea that firms self-select themselves into external markets according to their internal resources and capabilities; meaning that due to the inherent relatively high sunk entry costs on the international trade market, only more productive firms, the ones which have scale economies, are able to sustain an entry into the exporting market, playing according to its rules and competition requirements, i.e., productivity is a link between innovation and exporting (Clerides, Lach and Tybout, 1998; Delgado, Fariñas and Ruano, 2001; Eliasson, Hansson and Lindvert, 2009; Monreal-Pérez, Aragón-Sanchez and Sánchez-Marin, 2012).

Within the first approach, learning-by-exporting approach (LEA), extensive literature points that exporting is an activity with several advantages for firms. It can "feed" firms with valuable knowledge, which would be important to survive, particularly in more demanding markets like in foreign countries. By exploring international markets, either trading or doing other international activities, firms are exposed to rich environments to learn by interacting directly with foreign buyers and competitors (Wagner, 2007), which could grant them access to new technologies, new products and new processes that ultimately help to increase their productivity

levels (Bernard, Bradford, Redding and Schott, 2012).[1] Thus, according to the learning-by-exporting theory, the knowledge reservoirs obtained through the interaction with the international market players is used by firms through several different mechanisms to innovate, ultimately leading to their productivity improvement (Kafouros, Buckley and Clegg, 2012). By other words, this stream advocates that it is the skill-content of exports that influences the degree at which exports generate innovation to sustain economic growth (An and Iyigun, 2003).

On the other hand, the self-select approach (SSA), can be framed within a resource-based view (Barney, 1991), in which firms need to have strong capabilities, e.g. innovative capacity, to have higher levels of productivity, which give them a competitive advantage in foreign markets (Ray, Barney and Muhanna, 2004). Under these lines, the SSA supports that causality runs from undertaking innovation to exporting activity enhancement, i.e. in highly competitive markets, only the more efficient firms are able to bear the unrecoverable costs of exporting and can afford to innovate. Moreover, more innovative firms have clear incentives to expand their activities abroad once it will allow to get higher returns from business in more profitable markets (Monreal-Pérez et al., 2012). Clerides, Lach and Tybout (1998) argue that the relationship between exporting and firm efficiency results from SSA undertaken by more efficient firms.

The understandment on which are the main drivers behind firms' exporting processes, on why do firms export, whether following LEA or SSA, will ultimately derive into appropriate government policies that will contribute to properly foster economic growth. This understandment becomes even more crucial when considering the current economic scenario, where exports assume a leading role on any economy performance overview.

Recent data, published by UNCTAD statistics department, shows world record values on exports above the twenty-three trillion of US dollars (UNCTAD, 2013). According with EUROSTAT databases, Portugal has reached, during the year of 2013, a volume of exports close of 60 thousand millions of euros – this record despite the exports' growth rate has been decelerating because of economic and financial crisis[2]. The interesting point here is that the weight of exports on national Gross Domestic Product (GDP) has increased over the years, which provides a clear

[1] This positive impact is verified on business environment but also policy circles because favorable conditions for trade, especially on exports, is one of the most important ways promoting development through external markets (Balassa, 1985). Therefore, international trade benefits all its institutional players by contributing to their objectives.

[2] Between 1995 and 1996 the exports growth rate was around 7%. In 2001, its yearly increase was registered on 2% (EUROSTAT, 2014), keeping an analog trend along the following years. Between 2007 and 2008, Portugal had even record a decrease on its exports level.

perspective both on the openness of Portugal to foreign trade, and on the notable contribution of exports to economic growth of Portuguese Economy.

This investigation uses data that focus on the manufacturing industry (NACE Rev. 2) between 1997 and 2007 through three main sources. (1) The Structural Business Statistics Database of the Eurostat that provides data on the business demographics. (2) The Global Trade Atlas® that sources exports of the same firms identified in (1). (3) The European Patent Office (EPO) that provides data about innovation and patents of the same firms identified in (1). After some exploratory statistics, results show that empirical evidence obtained from the Portuguese case does not consistently support individually neither of the streams identified in literature, i.e. LEA or SSA, but rather leaves clear hints validating some of the basic assumptions underlying each one of them, supporting this way the non-mutually exclusive characteristic often associated (but scarcely empirically proofed) to both these streams in the current literature.

Along the next chapters the concept of learning-by-exporting will be analyzed and explored in detail against the self-selection approach. Furthermore, the data used on the empirical analysis will be described and analyzed. The detail on the employed econometric regression will be provided, as well as the main hypothesis and arguments, the empirical results and the robustness discussion. The final section concludes and leaves ground open for future researches.

2. Two Approaches On The Exporting Process

In theory, an exporting process begins when firms start selling their products abroad, i.e. outside their domestic market, being automatically subject to their implicit requirements and restrictions. The drivers that lead firms into the exporting process are a clear point of discussion in the current literature (Bernard and Jensen, 2004) being argued upon different plausible approaches. The current debate in academic, business and political circles, distinguishes therefore two major groups of opinion (ITO, 2011): the learning-by-exporting approach (LEA) and the self-selection approach (SSA). Learning by exporting refers to the mechanism whereby a firm's performance improves after entering export markets (Loecker, 2013). By exporting, a firm gains access to expertise, through the interaction with the international market players, which allows them to increase their efficiency levels (Clerides, 1998 and Loecker, 2007). On the other hand, self-selection happens in any situation in which individuals select themselves into a group, i.e., selection made by or for oneself, for example into being an exporter or not (Girma, 2004 and Serti, 2008).

2.1 Learning By Exporting

The learning by exporting approach (LEA) builds on the idea that through the interaction with the international market players, firms gain access to expertise, which allows them to increase their efficiency levels by applying it to their own products and processes (Aitken, Hanson & Harrison; Clerides, Lach, & Tybout, 1998; De Loecker, 2007). The existing empirical literature on international trade suggests that, taking the same industry, higher productivity levels are registered in exporting comparatively to the non-exporting firms. According to the learning-by-exporting theory, firms involved into international trade activities, are exposed to knowledge inputs not available at their home market, which allows them to accumulate market and technological information (Kafouros, Buckley and Clegg, 2012; Kafouros, Buckley and Clegg, 2010; Salomon and Shaver, 2005). International trade is a way to accumulate, to acquire, and to apply knowledge. The entrance on international markets exposes firms to more intense competition than in firms that only sell on their domestic markets (Eliasson, Hansson and Lindvert, 2009; De

Loecker, 2010), but also to increasing flows of knowledge which leads them to increase their performance namely in terms of productivity.

As a matter of fact, an exporter benefits from different kinds of knowledge generated abroad, namely in terms of technological expertise from the buyers, consumers' product preferences, competing products (Salomon and Shaver, 2005). Through these sources of knowledge firms can increase their capabilities to compete abroad. In addition, there are three types of effects associated with learning-by-exporting, often discussed in the current literature (Kneller and Pisu, 2010): (a) Technology transfer, when the interaction with the foreign agents provides information about processes and products' cost reduction and quality raising; (b) Economies of scale, when through the exporting process, firms increase their own production scale; (c) Competition, once exporting firms are subject of increased competition levels which force them to become more efficient (therefore more competitive), stimulating an increase of their innovation activity. Adding to this and following the purpose of this study in assessing how do Portuguese industry embodied the flows of knowledge obtained abroad, another question arises: does firms' exporting profile contributes to the choice between the two streams documented in the literature: i.e., existence of learning by exporting, or self-selection?

According to Bernard and Jensen (1997), the benefits that a firm obtains from exporting is not clear, not being able to determine whether "good firms" become exporters (SSA, see chapter 2.2) or if exporters become "good firms", thus having clear advantages by engaging in the exporting process (LEA). Bernard and Jensen (2004) provide a different approach on determine which firms' characteristics are related to export likelihood. They find stronger evidence in favor of firms' past success or entry costs on the international trade market, rather than the ones related with geographical spillovers or government export driven subsidies.

Despite the kind of effect triggered by learning by exporting, it might be significantly different depending on if it happens in a developed or developing country. The preponderance of the exports destination country dictates the magnitude of learning (Boermans, 2010). By other words, the interaction with international market players fosters both income growth and income convergence between the trading partners (Salomon and Jin, 2007). If a firm exports to a more technologically advanced country, it will experience greater learning than if they only trade with equally (or less) developed countries (Boermans, 2010). Thus, the skill-content of exports directly influences the degree by which they foster learning, helping to sustain higher economic growth rates (An and Iyigun, 2003). Regardless its proven potential, the empirical evidence of

learning-by-exporting is lacking some consistency in its findings. Current literature presents several case studies for developed countries such as United Kingdom (UK) high-tech Small and Medium Enterprises (SMEs) (Love and Ganotakis, 2010) and Spanish manufacturing firms (Delgado et al., 2001; Salomon and Shaver, 2005).

Nevertheless, the process of understanding learning by exporting effect that ultimately will reveal the role of international trade on firms growth, clearly assumes a greater importance within developing countries (Salomon and Jin, 2007), as the case of African Small and Medium Enterprises (SMEs) (Boermans, 2010), Indonesian firms (Blalock and Gertler, 2004), Estonian firms (Vahter, 2011) or Colombian firms (Trofimenko, 2005). The rationale behind this evidence is that the access to the market information that firms have access through the exporting process might help them to tailor products to meet specific needs and requirements of the foreign market and still have a negligible impact on productivity (Salomon and Shaver, 2005). But, the lack of empirical evidence may found its explanation on the learning timeline. Firms may not be able to appropriate returns from the technological flows they are exposed to. Even when they do so, it may take some time for this new technological information that firms get, to take part of its production function in order to result in performance improvements (Salomon and Shaver, 2005). Kafouros, Buckley, Sharp and Wang (2008) take this question further by arguing that firms may be unable to benefit from such innovation if their international activity is below a threshold level, i.e., a firm's degree of internationalization plays a moderator role regarding the innovation – performance relationship.

Fernandes and Isgut (2008) argue that for a better understanding of the reasons that explain why some firms seem to learn from exporting processes while others do not, settles on finding the parallelism between learning-by-exporting and a more traditional analog concept: learning-by-doing. The seminal work by Arrow (1962) argues that learning, as a product of experience, can only take place during activity, presenting significantly diminishing returns when this activity is based on repetition. Thus, Fernandes and Isgut (2008) associate these drivers with learning-by-exporting by advocating that firms will only be able to learn from exporting when for them it represents a new and challenging process. This can be pointed as the clear explanation for the higher evidence of learning-by-exporting on developing countries when compared with firms from developed countries.

2.2 Self - Selection

What if, given the existing barriers to entry the international trade market (Julian, 2009 and OECD, 2009), firms increase their productivity levels through innovation before entry the market in order to meet their competition requirements, rather than realize this efficiency improvement only *ex-post* the exporting process? Contrarily to the learning-by-exporting theory, once international markets imply relatively high entry sunk costs (Love and Ganotakis, 2010), only larger and more productive firms are able to profitably play within an international trade market (Blalock and Gertler, 2004). Following this theory, the link between exporting and firm performance is established in an opposite order than the one advocated through LEA, running therefore from innovation towards exporting potential improvement.

Accordingly to the SSA logic (Willis and Rosen, 1979 and Borjas, 1987), exporting is a result of an increased productivity built particularly upon innovation processes, rather than a cause (Blalock and Gertler, 2004). Self-selection establishes that only more productive firms are able to afford the higher cost of exporting, implying that the productivity on the future exporters is higher than non-exporters even before the exporting process starts – thus, firms learn to export rather than learn by exporting (Eliasson et al., 2009). In fact, self-selection is a plausible scenario once evidence have been showing that firms often need to be productive and successful at their home market before they enter on the international market (Vernon, 1966). Only by this way, firms will be able to amass the required knowledge and experience to sustainably play in the export markets (Vahter, 2011).

As a matter of fact, a plausible explanation for the self-selection phenomenon derives from the need of the firm to not only entry in the host market but also to keep playing on it within a sustainable framework. Eliasson et al., 2009 argue that firms consciously improve their performance indicators, namely their productivity levels, by investing in physical and human capital and new technology with the explicit intent of facing the competition levels associated with becoming exporters. This way, according with this approach, exporting does not necessarily leads to an improvement of productivity (De Loecker, 2010). Moreover, Blalock and Gertler (2004) argue that not only the productivity gains occur ex-ante de exporting process, but also that they do not disappear once this process stops.

Boermans, 2010 takes this SSA further by advocating that once only more efficient firms are able to afford internationalizing through exports and if firms which interact with external markets present higher competitive levels before selling abroad, then pushing them towards internationalization becomes at some levels, meaningless. They have a natural predisposition to become exporters which they will take advantage of, despite the supports they might benefit from.

Despite the likelihood highlighted by the literature for the existence of self-selection, rather than learning-by-exporting, these two different approaches are non-mutually exclusive explanations (Delgado et al., 2001) of a link between exporting, innovation and productivity: more efficient firms can self-select themselves into the export markets while subsequently learn by the process (Boermans, 2010). The mechanisms and sources of learning-by-exporting effects are still scarcely represented in the existing literature. Their clear understanding will ultimately derive appropriate policy recommendations to enhance the firm's growth (Keiko, 2011). Hence, here settles the backbone of this thesis. In the following chapters, the employed methodology and hypothesis to test the two approaches into account, and therefore reach a fuller understanding of this process will be thoroughly described.

3. Empirical Approach

3.1 Data

The data focus on the manufacturing industry (NACE Rev. 2) between 1997 and 2007 using three main sources. (1). The Structural Business Statistics Database of the Eurostat, which provides data on the business demographics. (2) The Global Trade Atlas®, which sources exports of the same firms identified in (1). (3) The European Patent Office (EPO) provides the data about innovation and patents of the same firms identified in (1).

In the absence of more detailed sources for Portuguese manufacturing industry, this investigation relies on a macro level analysis to highlight the potential of learning-by-exporting, following the work done for other scholars, e.g., An and Iyigun (2003), for a sample of 86 countries between 1970 and 1990. Despite lacking the detail level that a micro sample would provide, analyses at a macro level are supported in the current literature. According with De Loecker (2010), the recent evidence using micro level datasets must be compared against macro level results in order to properly extrapolate a conclusion on whether or not there is consistence evidence of learning by exporting.

An initial sample collects information on 11 subsectors for the years 1995-2012, providing a representative picture for 180 observations along the total period. However, the observations with missing data were removed. From this results an unbalanced panel of 121 observations along the total period, reflecting the performance pattern of 11 manufacturing subsectors in Portugal along a time span from 1997 until 2007.

The manufacturing industry is hereby classified according to the statistical classification of economic activities in the European Community (NACE Rev. 2). However, some adjustments are needed due to differences in terms of nomenclatures in the sources. Table 3.1.1 presents the industry breakdown for the first and last year of the sample.

TABLE 3.1.1.
INDUSTRY BREAKDOWN

Industry (by NACE REV. 2 applied to Portugal)	1997	Weight on total nr of firms 1997	2007	Weight on total nr of firms 2007	Growth rate (% firms)
CA. Manufacture of food products, beverages and tobacco products	10.206	12%	10.941	12%	7%
CB. Manufacture of textiles, apparel, leather and related products	20.823	25%	20.622	22%	-1%
CC. Manufacture of wood and paper products, and printing	14.185	17%	14.957	16%	5%
CD. Manufacture of coke, and refined petroleum products	1	0%	1	0%	0%
CE-CF. Manufacture of chemicals and chemical products & Manufacture of pharmaceuticals, medicinal chemical and botanical products	996	1%	1.042	1%	4%
CG. Manufacture of rubber and plastics products, and other non-metalic mineral products	5.562	7%	6.904	7%	19%
CH. Manufacture of basic metals and fabricated metal products, except machinery and equipment	14.684	18%	17.616	19%	17%
CI-CJ. Manufacture of electrical equipment & Manufacture of computer, electronic and optical products	1.936	2%	4.212	4%	54%
CK. Manufacture of machinery and equipment n.e.c.	3.597	4%	6.496	7%	45%
CL. Manufacture of transport equipment	901	1%	1.225	1%	26%
CM. Other manufacturing, and repair and installation of machinery and equipment	10.111	12%	10.623	11%	5%
TOTAL	**83.002**		**94.639**		**12%**

In overview, the number of firms in the Portuguese manufacturing industry between 1997 and 2007 has grown at a rate of 12%. The major contributions for this growth rate come from the manufacturing of electrical equipment, computer electronic and optical products, and machinery and equipment in which the number of firms doubled from 1997 to 2007. Another interesting remark is that the distribution of firms between the analyzed industries was nearly the same in the first and last years of the analysis.

3.2 Variables

The following subchapters focus on a clear separation and distinction between dependent, independent and control variables, introducing the discussion around their measurements and arguing about the drivers that more accurately justify them.

3.2.1 Dependent Variables

By definition, there is evidence of learning-by-exporting when an improvement on firms' performance is verified as result of the beginning of the exporting process. The conjecture of this theory is that newly exporting firms have access to different kinds of knowledge flows that ultimately will lead to a productivity increase (translated in a performance improvement). This is the argument used by several authors to support the choice of productivity measures to assess learning-by-exporting. Eliasson et al. (2009), for instance, uses labor productivity, instead of a 'theoretically more well-founded' TFP (Total Factor Productivity) measure, to empirically test the existence of learning-by-exporting. Fernandes and Isgut (2008), De Loecker (2010), Blalock and Gertler (2004) or An and Iyigun (2003) follow identical methodologies, whether by examining labor efficiency, average variable costs or total factor productivity.

On the other hand, once the information from the foreign markets that exporting firms gain access to through the exporting process facilitates innovation, Salomon and Shaver (2005) advocate that using innovative measures can be a more direct method to assess information exchange and therefore, learning-by-exporting. Salomon and Jin (2007) and Keiko (2011) share the same approach towards testing the occurrence of this phenomenon. In fact, accordingly also to what was mentioned before, it may take some time for the technological gains that firms have on the exporting process to be incorporated in their production function and consequently on their productivity measures. By other words, even though departing from the majority of the existing literature on the topic, using innovation measures to proxy learning-by-exporting might indeed be a more accurate method. For this reason, this investigation work will test the existence of learning-by-exporting in the Portuguese manufacturing industry, using both typologies of proxy measures for this phenomenon, guaranteeing a wider approach and a thorough analysis.

As argued above, this analysis focuses on two dependent variables: patent application counts and apparent labor productivity. Assessing both measures of learning-by-exporting allows this investigation to more accurately test the existence of this phenomenon at the Portuguese manufacturing case, mitigating some of the limitations of each approach individually.

3.2.1.1 Patent Application Counts

Patent application is a direct and expected result of the flow of knowledge that can be associated to the exporting process. It is this (newly) generated knowledge, i.e. innovation, that firms feel the need to protect from competition through patents emission. The variable labeled as **PATENTS** captures the patent applications to the European Patents Office (EPO) filed for protection in Portugal by priority year.

Patent data on the analysis of learning-y-exporting has been used through the years by several authors (Salomon and Jin, 2007). This variable departs from the approach taken by most scholars once it captures the total number of patent applications whether they are granted or not at a later stage, which can lead to some bias on the results. Salomon and Shaver (2005), argue that a potential problem on assessing learning-by-exporting through patent applications instead of granted patents relies on the possibility of capturing spurious applications filed by the exporting firm. Nevertheless, once this application process is not free of costs, there is the strong belief that this variable captures the innovation of which firms believe is worthwhile of protection, even though they may be a clear overstatement of the innovation actually achieved by the firms.

3.2.1.2 Productivity

As previously described, learning-by-exporting can also be captured by perceptible increases on productivity as a result of the increased flow of knowledge from the exporting process, clearly affecting this way firms' performance behavior. By other words, learning by exporting authors advocate that once firms participate in the export market, they gain access to specific sources of knowledge that will ultimately stimulate them towards higher performance levels through perceptible increases in their productivity indicators.

Most scholars apply total factor productivity (TFP) (Delgado et al., 2001; Vahter, 2011; Trofimenko, 2005; Damijan et al., 2010) or even labor productivity (Eliasson et al., 2009; Boermans, 2010; Monreal-Pérez et al., 2011) to assess the existence of learning-by-exporting. Following these approaches, the variable here labeled as **PRODUCTIVITY** captures the apparent

labor productivity for the manufacturing industry over the period 1997-2007, measuring the relation between the gross value added and the number of persons employed.

3.2.2 Independent Variables

3.2.2.1 Export

Export is the central variable of this investigation work once it is upon its performance that the phenomenon of learning-by-exporting is assessed. Being this a macro level analysis, the recurrent variable "export status" often used in the existing literature, does not apply. Grossman and Helpman (1991) suggested that the volume of trade is related with the intensity of interaction with the destination markets, consubstantiating therefore the use of export volume as a valid proxy variable for the direct unilateral interaction of firms with the external market. Similarly to what already have been done by Salomon and Shaver (2005), the variable labeled as **EXPORT VOLUME** is defined as the natural logarithm of total foreign sales in Euros.

Moreover, keeping in perspective that the benefits captured through the exporting process might not be immediate and only be realized in future periods, the export variable must be lagged. Giving the dimension of this panel and the existing literature, the lags used for this variable are 1, 2 and 3 years (Salomon and Shaver, 2005; Bernard and Jensen, 1998).

3.2.3 Control Variables

Despite the needed focus on the determinant variables of this investigation, the ones described above, there is the need to control for some key variables in order to guarantee the coherence of the reached results.

Following the work done by other scholars (Love and Ganotakis (2010), Damijan et al., 2010 and Monreal-Pérez et al., 2011) the variable labeled as **SIZE** is defined by the natural logarithm of the total number of employees and it is used as a control variable in event that the

size of firms might be related to their innovation activity, namely through patents application. This means that through this variable, scale economies are being controlled once their number of employees is a proxy for their scale in terms of both their production level and their human capital capacity, which are, within this investigation framework, plausible inputs for firms' innovative activity.

Similarly, once there is an explored association between R&D and innovative productivity (Love and Ganotakis, 2010; Salomon and Jin, 2007; Monreal-Pérez et al., 2011), R&D current expenditures are here controlled through the variable **R&D INTENSITY** defined as the share of R&D expenditures in the production value (output). R&D expenditures are thus herby identified as a clear input for innovative activity. Moreover, an intensity measure is used as a control because, even though previously controlling for firm size, in theory R&D expenditure is highly correlated with size (Kneller and Pisu, 2010).

Following this argument, meaning once that exporting can also be strongly related with size (see chapter 2.2 regarding the self-selection theory), this investigation work adds the export intensity as a control variable. Hence, following the same logic than the intensity variable described above, the variable here labeled as **EXPORT INTENSITY** is defined as the share of exports in the production value (output), thus capturing the intensity of the direct unilateral interaction of firms with the external market.

Finally, this investigation work controls for the dimension of openness to foreign trade by including the variable labeled as **OPEN**. It is measured by the ratio of international trade (imports plus exports) to output (An and Iyigun, 2003), i.e. the weight of the bilateral relationship with foreign markets in firms' production level.

3.2.4 Variables Framework

Table 3.2.4.1 puts the different phenomenon under study, the ones that allow the assessment of the causality link between performance, exporting and innovation, into perspective by consolidating the above described variables in the framework used in this investigation work in order to accomplish the empirical methodology described on chapter 3.4.

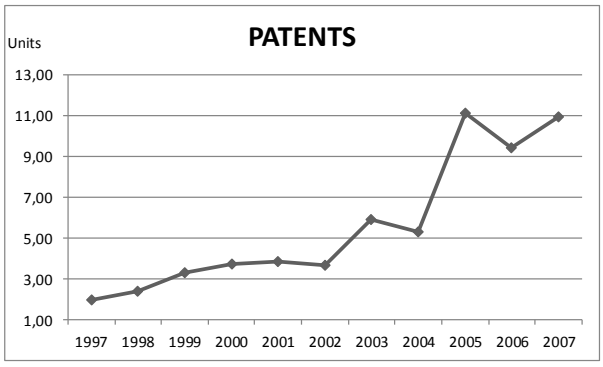
TABLE 3.2.4.1.

VARIABLES FRAMEWORK

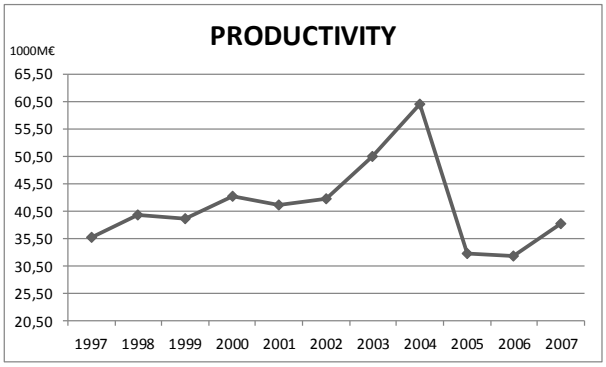
Phenomenon Under Study	Variable	Description	Measurement	Database source	Domain	Reference(s)
Innovation	PATENTS	Patents are a direct and expected result of the flow of knowledge that a firm is subject to, being an effective way of firms to protect the (newly) generated knowledge (innovation) from competition.	Number of Patent applications to the (EPO) filed for protection in Portugal by priority year.	EPO	PATENTS ϵ R0+	Salomon & Jin (2007), Salomon & Shaver (2005)
	R&D INTENSITY	R&D expenditures (in intensity terms) as an innovative activity input.	Share of R&D expenditures in the production value	SBS EUROSTAT	R&D_INTENSITY ϵ R0+	Love and Ganotakis (2010), Salomon and Jin (2007), Monreal-Pérez et al. (2011)
Performance	PRODUCTIVITY	Labor productivity as a clear indicator/output for a firm performance assessment. The better the productivity levels of a firm, the better its performance level.	Ratio between the gross value added and the number of persons employed.	SBS EUROSTAT	PRODUCTIVITY ϵ R0+	Delgado et al. (2001), Vahter (2011), Trofimenko (2005) Damijan et al. (2010)
External Market Relation	EXPORT_VOLUME	Export volume, i.e. the volume of sales to foreign markets as the output of the direct (unilateral) interaction activity of firms with the external market.	Natural logarithm of total foreign sales	Global Trade Atlas ®	EXPORT VOLUME ϵ R0+	Grossman and Helpman (1991), Salomon and Shaver (2005)
	EXPORT_INTENSITY	Exports' share on firms' output level as a direct reflection of the intensity of interaction with foreign markets.	Share of exports in the production value	Global Trade Atlas ®	EXPORT_INTENSITY ϵ R0+	n/a (calculated variable, own interpretation)
	OPEN	External market relation captured in a bilateral perspective considering not only the sales to, but also the purchases from external markets.	Ratio of international trade (imports plus exports) to output	Global Trade Atlas ®	OPEN ϵ R0+	An and Iyigun, 2003
Scale Economies	SIZE	Firms' average size / number of employees, as a proportional reflection of their scale in terms of both their production level, and their human capital capacity (as a knowledge/innovative input).	Natural logarithm of the total number of employees	SBS EUROSTAT	SIZE ϵ R0+	Love and Ganotakis (2010), Damijan et al. (2010) and Monreal-Pérez et al. (2011)

3.3 Descriptive Results

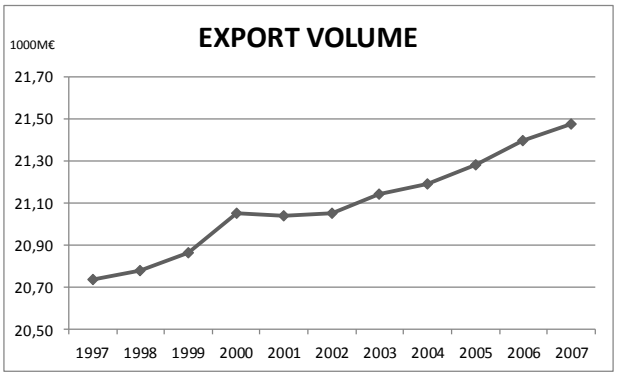
Accordingly to what was mentioned above, this investigation work tests the learning-by-exporting theory applied to the Portuguese manufacturing industry, using two possible approaches: productivity measures against innovative measures (see chapter 3.2.1). Graphs 3.3.1, 3.3.2 and 3.3.3 present the average performance of the manufacturing industry over the years. Even though productivity had a more irregular pattern over the analyzed years, both dependent variables show an upward trend from the first to the last year of the sample. The independent variable exports volume follows an analog behavior, albeit more in line with the innovation proxy variable (patents). Only a more thorough statistical (econometric) analysis will provide the possibility to establish the causality link between these dependent variables and the exporting related ones, assessing this way whether or not there is evidence of learning-by-exporting in the Portuguese manufacturing industry (see chapter 4).



GRAPH 3.3.1 PATENTS COUNT EVOLUTION.



GRAPH 3.3.2 PRODUCTIVITY EVOLUTION.



GRAPH 3.3.3 EXPORT VOLUME EVOLUTION.

Table 3.3.1 presents the summary statistics and correlation analysis for the full sample. Despite most of the correlations are as expected, there are some that deserve a closer attention. First, it was found a negative correlation between the lagged export volume and the dependent variables (patent counts and productivity) which is, in a certain way, inconsistent with the hypothesis of learning-by-exporting. Nevertheless, this hypothesis cannot be rejected right from this point once this investigation work is not able to test the export status variable. By other words, as mentioned above, there is evidence of learning-by-exporting when an improvement on firms' performance is verified as result of the beginning of the exporting process. In the absence of the export status variable, learning-by-exporting should be tested based on a link with each industry's exporting experience. Therefore, once the export volume variable is not directly linked to exporting experience of the industry, it isn't possible at this point to take strong conclusions about whether or not there is evidence of learning-by-exporting in the Portuguese manufacturing industry.

Finally, the correlation analysis of the full sample also indicates that:

a. Larger firms are more productive;
b. Larger firms are more innovative;
c. Export intensity is positively correlated with innovation;
d. R&D intensity is positively correlated with innovation;
e. Openness to foreign trade is positively correlated with innovation.

To a better understand the nature of these relationships between variables, this investigation work follows a multivariate analysis which is carefully described in the next chapter.

TABLE 3.3.1.

DESCRIPTIVE STATISTICS AND CORRELATIONS ANALYSIS

	PRODUCTIVITY $_{(t)}$	PATENTS$_{(t)}$	EXPORT_VOLUME$_{(t-1)}$	EXPORT_VOLUME$_{(t-2)}$	EXPORT_VOLUME$_{(t-3)}$	RD_INTENSITY$_{(t)}$	EXP_INTENSITY$_{(t)}$	SIZE$_{(t)}$	OPEN$_{(t)}$
PRODUCTIVITY $_{(t)}$	1								
PATENTS$_{(t)}$	-0.11	1							
EXPORT_VOLUME$_{(t-1)}$	-0.04	-0.12	1						
EXPORT_VOLUME$_{(t-2)}$	-0.05	-0.05	0.995	1					
EXPORT_VOLUME$_{(t-3)}$	-0.04	-0.04	0.992	0.996	1				
R&D_INTENSITY$_{(t)}$	-0.14	0.231	-0.31	-0.32	-0.31	1			
EXPORT_INTENSITY$_{(t)}$	-0.23	0.119	0.782	0.786	0.785	-0.04	1		
SIZE$_{(t)}$	0.012	0.129	-0.02	-0.02	-0.01	0.014	-0.05	1	
OPEN$_{(t)}$	-0.05	0.234	0.675	0.673	0.666	-0.04	0.905	0.022	1
Mean	41.21	6.86	21.06	20.99	20.92	2.56E-07	0.0004	1.45E+13	1.06
Standard Error	44.51	8.7	1.40	1.39	1.40	5.25E-07	0.0003	1.14E+14	0.70
Maximum	284.40	39.00	22.65	22.65	22.62	3.10E-06	0.0010	9.98E+14	2.38
Minimum	11.70	0.20	17.25	17.24	17.08	0.00	9.91E-06	7.66	0.02

3.4 Methodology And Statistical Approach

The approaches here taken to assess if there is learning-by-exporting in the Portuguese manufacturing industry consist in regressing the dependent variables of innovation and productivity separately, on lagged values of export variable, plus the control variables mentioned in the previous chapters. This approach follows therefore the work of Salomon and Shaver (2005) considering the needed fitting adjustments to the sample framework.

In overview, the empirical assessment of the existence of learning by exporting will be obtained by estimating the following equation:

$$\text{DEPENDENT VARIABLE}_{j,t} = \beta_1 + \beta_2 \text{EXPORT VOLUME}_{j,t-1} + \beta_3 \text{EXPORT VOLUME}_{j,t-2} + \beta_4 \text{EXPORT VOLUME}_{j,t-3} + \beta_5 \text{SIZE}_{j,t} + \beta_6 \text{R\&D INTENSITY}_{j,t} + \beta_7 \text{EXPORT INTENSITY}_{j,t} + \beta_8 \text{OPEN}_{j,t} + u_{it} \quad (3.4.1)$$

The variables defined in equation (3.4.1) are defined as described in chapters 3.2 and 3.3. The **DEPENDENT VARIABLE** can assume either the **PATENTS** variable (chapter 3.2.1.1) or the **PRODUCTIVITY** variable (chapter 3.2.1.2), depending on whether it is taken the innovation or the productivity approach (respectively) to assess the existence of learning by exporting. Furthermore, *(j)* denotes the individuality of each analyzed industry (cross-section dimension) and *(t)* denotes the corresponding year of the sample (time-series dimension). Finally, u_i determines the error component of the analyzed model.

Given the nature of the collected data and the purpose of the analysis itself, the most appropriate estimation procedure is a panel data regression. In general terms, panel data accounts for individual heterogeneity of the analyzed industries, allowing the control for variables that cannot be observed or measured such as cultural factors, variables that change over time but not across individuals, business practices, etc. Baltagi (2005) enunciates several benefits from using this type of regression that justify by themselves the own purpose of this econometric regression methodology: (1) Controlling for individual heterogeneity; (2) giving more informative

data, more variability, less colinearity between variables, more degrees of freedom and more efficiency; (3) being able to better study the dynamics of adjustments; and (4) being able to better identify and measure effects that are not detectable in simple cross-section or time-series data.

A panel data analysis can be developed using different methods: the Pooled OLS Regression Model; the Fixed Effect Model; and the Random Effect Model. Each methodology presents its own advantages and limitations. The choice of which is the most appropriate methodology relies not only on its own objectives but also in some specific tests to the dataset in order to validate their suitability to the analyzed sample. The following chapters will thoroughly explore each one of these panel regression methods, testing their applicability to the analyzed sample. Therefore, both mentioned approaches (innovative vs. productivity measures) will be separately analyzed at first. In chapter 4, the regression results will be tested according to the econometric approach taken, and properly discussed given the theoretical framework of this study. In the chapter 5 (Conclusions), a comparative analysis between these two approaches – innovation and productivity – will be taken into account to the final assessment of whether or not there is evidence of learning by exporting in the Portuguese manufacturing industry within the analyzed time frame.

3.4.1 Innovation Approach

The Pooled OLS (Ordinary Least Squares) Regression consists in regressing the dependent variable on the analyzed independent and control variables. This approach is often dismissed giving its own limitations, namely: to neglect the cross section and time series nature of the data, not distinguishing the various analyzed individuals (industries). Even though recognizing this method as a valid panel regression, it will not be accounted for this analysis once it clearly misses the aim of this investigation by denying the heterogeneity or individuality that may exist among the different analyzed industries.

In econometric theory, Fixed Effects model should be used when the purpose is to analyze the impact of variables that vary over time, removing the effect of those time invariant characteristic from the independent variables in order to assess their net effect (Torres-Reyna, Oscar). On the other hand, with Random Effects model the variation across entities is assumed to

be random and uncorrelated with the independent variables included in the model (Torres-Reyna, Oscar). As such, this model should be used if there is reason to believe that the individuality among the analyzed industries has some influence on the dependent variable. Following Baltagi (2005), the Random Effects model here estimated will take the Amemiya (1971) procedure which is named Wansbeek and Kapteyn in E-views, once the latter paper generalizes the Amemiya method to work with unbalanced panels.

To properly choose between Fixed Effects or Random Effects, it should be tested if the errors (u_i) are correlated with the regressors. For that purpose, it is used the Hausman test that determines in its null hypothesis that the errors are not correlated with the regressors. By other words, Hausman's null hypothesis assumes that Random Effects model is appropriate for the intended regression, while the alternative hypothesis establishes that Fixed Effects model is the appropriate one.

The results of the Hausman test for the here taken innovation approach are presented at table 7.1.1 (chapter 7. Appendix). Testing the above mentioned null hypothesis, the resulting p-value leads to its acceptance, meaning that the Random Effects model is the most appropriate one to explore the relationship between the innovation and the export related variables described in the previous chapters.

Table 3.4.1.1. reports the results from regressing patent counts on the export related variables described above plus the enunciated control variables. In columns A to C are presented the results from models including random effects with the predetermined regressors. In columns D to F is included a linear feedback (Salomon and Shaver, 2005) on the innovation variable.

Accordingly to the variables framework made on chapter 3.2.4, table 3.2.1 highlights that in the phenomenon of 'external market relation' this investigation work is using three proxy variables of it in order to assess the existence of learning by exporting in the Portuguese manufacturing industry. The empirical approach from table 3.4.1.1. is therefore taken further by including different combinations of these three variables in the regression work. Thus, tables 7.1.2 to 7.1.4 report the results from regressing the patents variable on the plausible combinations of the external market relation proxy variables, following the methodology from the basis analysis on table 3.4.1.1.

TABLE 3.4.1.1.

INNOVATION APPROACH RESULTS

	A	B	C	D	E	F
C	-47,022	-92,469	-135,299**	-20,579	.63,097*	-84,796**
	(-0,769)	(-1,434)	(-1,899)	(-0,616)	(-1,519)	(-1,699)
$PATENTS_{(t-1)}$				0,821***	0,801***	0,747***
				(8,228)	(7,932)	(6,531)
$EXPORT\_VOLUME_{(t-1)}$	2,142			1,111		
	(-0,695)			(0,656)		
$EXPORT\_VOLUME_{(t-2)}$		4,353			3,241*	
		(1,349)			(1,547)	
$EXPORT\_VOLUME_{(t-3)}$			6,366**			4,309**
			(1.799)			(1,719)
$R\&D\_INTENSITY_{(t)}$	-3.256.515***	-2.892.097**	-2.666.316**	-584.250,1	-453.322,1	-518.653,5
	(-2,256)	(-1,989)	(-1,809)	(-0,508)	(-0,387)	(-0,412)
$EXPORT\_INTENSITY_{(t)}$	-9.251,507	-15.594	-28.812,23*	-9.530,669	-14.789,02	-21.873,18*
	(-0,657)	(-1,043)	(-1,542)	(-0,963)	(-1,364)	(-1,542)
$SIZE_{(t)}$	$-3,66^{E-15}$	$-3,91^{E-15}$	$-5,52^{E-15}$	$-3,05^{E-15}$	$-3,38^{E-15}$	$-4,35^{E-15}$
	(-0,651)	(-0,706)	(-0,976)	(-0,693)	(-0,783)	(-0,932)
$OPEN_{(t)}$	12,212*	13,652**	19,720***	3,086	3,124	5,789
	(1,662)	(1,813)	(2,137)	(0,761)	(0,635)	(0,896)
n	88	88	77	88	88	77
R^2	13,46%	15,62%	18,92%	51,86%	51,38%	47,82%
R^2 Adjusted	8,18%	10,48%	13,20%	48,29%	47,78%	43,35%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

3.4.2 Productivity Approach

Similarly to the work done following the innovation approach (see chapter 3.5.1), the econometric methodology here applied was chosen based on the same econometric validation tests. Hence, table 7.2.1 presents the Hausman test for the productivity approach regression, which led to the choice of the random effects model as the most appropriate one to explore the relationship between productivity and the export variables described in the previous chapters.

Table 3.4.2.1. reports the results from regressing productivity on the export related variables described above plus the enunciated control variables. In columns A to F are presented the results from models including random effects with the predetermined regressors. In columns J to L is included a linear feedback (Salomon and Shaver, 2005) on the productivity variable.

Similarly to the work done for the innovation approach regarding the external market relation proxy variables, tables 7.2.2 to 7.2.4 report the results from regressing the productivity variable on the plausible combinations of the external market relation proxy variables, following the methodology from the basis analysis on table 3.4.2.1.

In the following chapters the obtained statistical evidence results will be thoroughly analyzed and discussed in light of the previously presented theoretical framework.

TABLE 3.4.2.1.

PRODUCTIVITY APPROACH RESULTS

	A	B	C	D	E	F
C	-287,4054**	-88,594	-291.552*	-2,928	-1,964	-126,766
	(-1,678)	(-0,509)	(-1.635)	(-0,099)	(-0,065)	(-1,291)
$PRODUCTIVITY_{(t-1)}$				1,089***	1,090***	1,109***
				(33,249)	-33.161	(11,945)
$EXPORT\_VOLUME_{(t-1)}$	15,903**			0,083		
	(1,845)			(0,055)		
$EXPORT\_VOLUME_{(t-2)}$		5,866			0,033	
		(8,715)			(0,021)	
$EXPORT\_VOLUME_{(t-3)}$			16,675**			6,307
			(1,878)			(1,269)
$R\&D\_INTENSITY_{(t)}$	-1.871.085	-1.240.896	-40.365,50	95.785,64	61.938,40	630.734,9
	(-0,499)	(-0,306)	(-0,011)	(0,038)	(0,024)	(0,222)
$EXPORT\_INTENSITY_{(t)}$	-63.499,75	-46.165,81	-27.813,22	-6.453,675	-6.164,240	-9.822,560
	(-1,644)	(-1,141)	(-0,587)	(-0,453)	(-0,423)	(-0,318)
$SIZE_{(t)}$	$-1,14^{E-15}$	$-4,47^{E-16}$	$-2,83^{E-15}$	$-9,53^{E-16}$	$-9,20^{E-16}$	$-3,00^{E-16}$
	('0,078)	('0,030)	('0,030)	(0,089)	(0,086)	(0,026)
$OPEN_{(t)}$	23,935	29,430	1,445	2,188	2,156	-2,935
	(1.160)	(1,447)	(0,063)	(0,519)	(0,507)	(-0,237)
n	88	88	77	86	86	75
R^2	6,95%	3,57%	5,25%	95,27%	95,27%	70,63%
R^2 Adjusted	1,27%	-2,31%	-1,43%	94,91%	94,91%	68,04%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

4. Results

4.1. Statistical Evidence

Regarding the **innovation approach**, table 3.4.1.1 reports the regression findings. Accordingly to the obtained results, the goodness of fit (R^2) for models D to E, i.e., the ones including the linear feedback on the innovation variable (patent counts), is significantly higher than for models A to C, confirming that past innovations will effect present innovation performance. Although R^2 is relatively low, it increases around 34 percentage points (p.p.) from one specification model to another.

In column A, it is presented a model specification with the 1-year lagged export volume variable[3]. Even though presenting a positive impact on innovation, the coefficient estimate of EXPORT VOLUME in this specification is not statistically significant. The same occurs in the 2-year lagged export volume specification (column B). Column C, replaces the 2-year lag with a 3-year lag of export volume and suffers a further reduction in sample size due to the increased lagged structure. At this specification, the coefficient estimate of EXPORT VOLUME remains positive in magnitude and becomes statistically significant (albeit at the 10% level). Another noteworthy result is the one that reflects the increase of the magnitude of the impact of EXPORT VOLUME on innovation along the lag structure.

Some interesting results were also obtained for the included control variables: (1) R&D INTENSITY remains negative in magnitude and statistically significant across the three specifications, albeit decreasing on both of them along the increased lag structure, (2) OPEN, i.e., the degree of openness to foreign trade, increases both its positive magnitude and its level of significance from specification A to C, and (3) EXPORT INTENSITY, albeit statistically insignificant on the first two lag structures, increases its negative magnitude, becoming statistically significant in the 3-year lag specification (even though at a 15% level of significance).

[3] Once the knowledge obtained from the exporting process is not instantaneous and will most probably take time to filter back to the main firm (Salomon and Shaver, 2005). 2 and 3 –year lags on this variable will be subsequently tested, following this perspective.

Columns D to F, re-estimate columns A to C respectively, by including the linear feedback (1-year lag structure) on the dependent variable that in this case measures innovative activity. On the 1-year lag specification (column D) all variables albeit maintaining the magnitude of impact (positive or negative) on the dependent variable, they all lose their statistical significance. On the 2-year lag specification (column E), the coefficient estimate for EXPORT VOLUME remains positive in magnitude (even though at a smaller level) and becomes statistically significant (albeit at a 15% level), comparing with the previous specification on column B. On the other hand, column F repeats the results from the previous specification in column C in terms of the coefficient estimate for EXPORT VOLUME, i.e. it remains statistically significant (at the same level of significance) and with a positive impact on the dependent variable (albeit at a lower level).

Moreover, repeating the behavior registered in the first set of regressions (columns A to C), the inclusion of linear feedback of the dependent variable on the regression (columns D to F) results in an increasing of the magnitude of impact of the EXPORT VOLUME on innovation along with the increased lag structure of this explanatory variable: the coefficient estimate of EXPORT VOLUME in column F is approximately four times bigger than in column D.

Regarding the remaining variables, with the lag structure of the dependent variable included, the results differ from the one previously obtained: (1) R&D INTENSITIY even though maintaining its positive magnitude, looses statistical significance, (2) OPEN, i.e. the degree of openness to the foreign market becomes statistically insignificant as well even though maintaining its impact magnitude on the dependent variable, and (3) EXPORT INTENSITY, even though keeping a negative impact on the innovation variable, it becomes statistically significant only in the 3-year lag structure of the EXPORT VOLUME variable.

Accordingly to what was previously argued on chapter 3.4.1, when considering the plausible combinations of the three different proxy approaches on firms' foreign interaction, the results above suffer a few noteworthy changes. Table 7.1.1 replicates the results from regressing the patents variable on the export variable plus the remaining control variables, excluding 'OPEN'. By removing this latter from the simple regression, i.e. the one that does not include an autoregressive perspective on the dependent variable (columns G to I), the main differences to register are: (1) about export intensity which, albeit statistically insignificant, becomes positively related to the innovation dependent variable hereby taken into account, and (2) about the fact that none of the lag structures considered along the specifications G to I show statistical significance, even though presenting a positive impact on patents variable. Columns J to L, the

specifications in which there is considered the linear feedback on the innovation dependent variable, present regression results in line with the ones achieve in the original regressions (columns A to C, table 3.4.1.1).

Table 7.1.3 replicates the original regression (table 3.4.1.1) considering the combination of the external market relation proxy variables in which only the variable 'EXPORT INTENSITY' is excluded from the specification. Taking this scenario into account, the obtained results follow the ones got from the first regression, presenting only a few differences: (1) the export independent variable, albeit remaining statistically insignificant in the 1 and 2 year lag structures, becomes statistically insignificant in the 3 year lag structure, (2) the analog behavior is shown with both the variable 'OPEN' in the 3 year lag structure in the simple regression (column O), and (3) with the export volume variable on the three specifications that, following this scenario, include also de linear feedback on the dependent variable (columns P to R).

Finally, within the innovation approach, this investigation work considers a last plausible combination among the external market relation proxy variables in which there is only considered for the specification the export volume variable, i.e. excluding the two export related control variables ('OPEN' and 'EXPORT INTENSITY'). This is the scenario in which the obtained results departs the most from the original regression (table 3.4.1.1): the export volume variable becomes statistically significant in all the considered lag structures, remaining positively related with the innovation dependent variable (columns S to U, table 7.1.4). On the other hand, when including in this specification the autoregressive component of the dependent variable (columns V to X), all the considered independent and control variables become statistical insignificant across the different lag structures.

Across the previous three additional sets of specifications taken into account in the innovation approach (tables 7.1.2 to 7.1.4), the goodness of the model (R^2) decreases when comparing with the original regression (table 3.4.1.1) around eight percentual points.

Referring to the **productivity approach**, table 3.4.2.1 reports the regression findings. Accordingly to the obtained results, the goodness of fit (R^2) for models D to F, i.e. the ones including the linear feedback on the productivity variable, is significantly higher than for models A to C, implying on the other hand the lost of statistical significance for the focus variable of this study, the EXPORT VOLUME. This variable assumes a positive magnitude and statistical

significance for both 1 and 3-year lag structures (columns A and C), being statistical insignificant to the 2-year lag structure on the EXPORT VOLUME variable. Similarly to the findings from the innovation approach, this coefficient estimate also increases from the 1 year to the 3 – year lag structure.

Regarding the rest of the (control) variables considered in both specification models – with and without the linear feedback on the dependent variable – contrarily to the previous approach, they lack statistical significance. Nevertheless there some noteworthy remarks: (1) R&D INTENSITY assumes a negative impact on the productivity along the first specification group (columns A to C), changing this behavioral pattern with the inclusion of the 1-year lag structure of the productivity variable (columns D to F); (2) both export intensity and openness to foreign trade present (albeit statistical insignificant) present a similar behavior that the one registered in the innovation approach, with a negative impact on the dependent (productivity) variable; and (3) finally the size of the firms assumes also in these specifications a negative impact on the productivity variable.

Following the previous work done for the innovation approach around the proxy variables for the external market relation, tables 7.2.2 to 7.2.4 are replicates of the original (productivity approach) regression taken on table 3.4.2.1., considering respectively the same different combinations of those proxy variables: (1) excluding only 'OPEN'; (2) excluding only 'EXPORT INTENSITY' and (3) excluding both 'OPEN' and 'EXPORT INTENSITY'. In case (1) (table 7.2.2), the central variable of this investigation work registers the same behavioral pattern than the one verified in the original regression, maintaining the statistical significance and positive impact on the patents variable in the 1 and 3 year lag structure. When including in the linear feedback on the patents variable (columns J to L), the export volume variable not only becomes statistically insignificant (following what was verified on the original regression, columns D to F) but also presents a negative impact on the dependent patents variable.

On the other hand, in case (2), i.e. the one that excludes from the specification the variable 'EXPORT INTENSITY' (table 7.2.3), the results obtained differ from the original regression (table 3.4.2.1) once the independent variable on the external market relation (export volume) becomes statistically insignificant regardless both the lag structure taken into account and the inclusion or not of the linear feedback on the dependent variable on firm performance (productivity).

Finally, case (3) which excludes from the specification both the external market relation variables alternated in (1) and (2), i.e. 'OPEN' and 'EXPORT INTENSITY' (table 7.2.4), replicates the results obtained from the original regression, presenting the same behavioral pattern for all the considered variables.

4.2. Discussion

Despite the empirical results given above lack the needed robustness to properly and strongly support either the learning-by-exporting or the self-selection propositions[4], they allow us to warily validate most of the basic assumptions behind the learning-by-exporting stream. The analysis demonstrates that exports volume is positively related with innovation activity, registering an increased magnitude of impact and becoming statistically significant, the greater its lag structure. It thus confirms the existing theoretical proposition on the fact the knowledge gained through the exporting process is not immediate, taking time to filter back to the main firm (Salomon and Shaver, 2005). The results on the productivity approach, albeit more inconsistent than the ones obtained from the innovation approach, give their own contribution by reinforcing the evidence behind this proposition about time difference between the exporting process and the time when its effects show perceptible effects on both innovation and productivity.

In addition, the variable 'OPEN', proxy for the external market bilateral interaction, has a positive impact on the innovation variable, following the theoretical framework argued by Kafouros et al. (2008). By other words, the coefficient estimate of this variable supports the argument of internationalization having a moderating role on the innovation-performance relationship, i.e. firms without any international background will experience greater difficulties in properly appropriating the benefits from innovation resulting from the increase of their knowledge stocks through the exporting process.

Another noteworthy result is the one that shows that export intensity is negatively related to innovation, contradicting in one hand the assumption that external market relation directly

[4] The first three regressions on each approach, i.e., the specification that does not include the linear feedback on the dependent variable whether it was innovation or productivity, were submitted to the Durbin-Watson test, indicating positive autocorrelation in the sample residuals. This test is not applicable to auto-regressive models, i.e. in this case of the specifications that included the 1-year lag structure as an explanatory variable.

fosters innovative activity (Eliasson et al ., 2009; De Loecker, 2010) but reinforcing on the other hand the convergence effect in the appropriation of the knowledge returns between entities in different stages of development (Salomon and Jin, 2007; Boermans, 2010; Blalock and Gertler, 2004; Vahter, 2011; Trofimenko, 2005; Love and Ganotakis, 2010; Delgado et al., 2001; Salomon an Shaver, 2005). Firms that present higher export intensity have fewer propensity to innovate as a consequence of the exporting process, comparing to the ones that are at the early stages of this process and that for this reason will be more eager to learn from it.

Even though clearly consistent with the theoretical framework behind the LEA, the findings described above are not enough to state the existence of this phenomenon per se. On the other hand, the lack of significance of the size variable included in this study, is not a solid foundation to exclude à priori the existence of self-selection also. By other words, even though contrarily to what this stream argues, the size of the company that will ultimately be a plausible proxy to its natural predisposition to export[5], is not (positively) correlated with firm's innovative activity, which per se is not enough to lead us to disregard this stream as well. Taking this analysis further, by doing the exercise of regressing the size variable on innovation activity (see table 7.3.1, chapter Appendix) it is possible to find a positive impact of firm's size on innovation. This result is complemented by the correlation matrix previously analyzed (see table 3.4.1), giving a clear reinforcement on supporting the self selection hypothesis, strongly advocated by Clerides, Lach and Tybout (1998).

The findings hereby achieved do not exclude per se the existence of either one of the two theoretical streams discussed above. They rather provide some clear trace evidences of both the learning-by-exporting and self-selection theories, with a greater predominance of the statistics supporting the first stream. Additionally, a noteworthy remark is that there is no evidence that excludes the existence of a two-way link between firm performance, measured through innovation, and internationalization, consistent with the technology accumulation view argued by Castellani and Zanfei (2007). By other words, a firm will certainly invest in innovation and R&D to gain the competitive edge necessary to compete in the international markets, while benefitting from its internationalization strategy and structure to access privilege knowledge that will ultimately foster an increased performance level.

[5] Once international markets imply relatively high entry sunk costs (Love and Ganotakis, 2010), only larger, more productive firms are able to profitably play in the international trade market (Blalock and Gertler, 2004).

Against the major results presented in current literature on the topic, that either support one stream or the other individually, this investigation work provides therefore clear signs of the coexistence of both argued streams in the same industry. Even though some authors had, along the past recent years, put this question in their theoretical approach (Delgado et al., 2001), there is no empirical evidence supporting the non-mutuality of learning by exporting and self-selection that this study is able to state given its wider approach on assessing the causality link between exporting and firm performance. Thus, considering the hereby taken sample on the Portuguese manufacturing industry, a firm can indeed self-select itself into the foreign market given its own natural predisposition to export while subsequently learn from the exporting process in a way that allows it to improve (increase) their performance indicators such as innovation and productivity.

This study presents however a number of limitations. Firstly, it is a macro analysis that for that reason misses some perspectives than can only be capture to a micro level approach, such as export status or export experience. Despite the needed contrast of the results obtained using aggregate data versus firm level data (De Loecker, 2010), working with a macro level sample might capture the learning-by-exporting effect as a (partial) result of foreign direct investment (FDI). Secondly, our sample contains some missing data that ends up compromising the analysis to its fully extent. Finally, the fact that data was collected from different sources provides the sample a greater risk of error in the work done regarding the harmonization of nomenclatures and aggregates.[6]

On the other hand, as a clear sign of practical potential, this investigation work provides a theoretical framework none existing in the currently literature so far. Moreover, by using a macro level sample it is not subject to the eventual subjectivity presented in most of the micro econometric studies existing in the current literature, which have their dataset based on firm-level surveys.

[6] For instance, giving the unavailability of the exports data per manufacturing subsector for the analyzed period in Eurostat, we collected this information from the Global Trade Atlas®, which implied that transformation of the original collected data available in 2 digits Harmonized System Codes for NACE REV.2 subsectors. This ultimately raises the risk level of some inaccuracies.

Taking our findings and limitations into account, we suggest future researchers to re-estimate the model using a micro level sample[7], thus reaching a more detailed level of analysis, taking it one step forward by clearly exploring the role of variables like export status or export experience in both strands of firm's performance in parallel, as well as by being able to clearly distinguish the typical behavior of exporters comparing with non-exporters. Hence, future researchers may take the present analysis to a level in which firms' profile can be weighted on such wider extent, in order to clear assess the causality link between exporting and firm performance, considered in its both main strands: innovation and productivity.

In terms of practical applicability, considering that the mechanisms and sources of learning-by-exporting effects are still scarcely represented in the existing literature, their clear understanding through this and future researches will ultimately derive appropriate policy recommendations to enhance firm's growth (Keiko, 2011). Taking this into account, one other question may arise from the methodology developed by this investigation work, as well as the one taken by most of the current scholars on the topic, regarding the performance proxy level per se. The productivity component is often taken into account in the innovation and exporting theory (Castellani et al., 2007, Delgado et al., 2001, De Loecker, 2007) but does productivity really make sense on the approach of learning by exporting? Performance (productivity) improvements are what allows firms to remain competitive on the markets they are playing, improving their market share. They will thus always have the incentive to work towards productivity increases despite the exporting process. In real economic framework, firms do not see the export decision as a mean to reach higher productivity levels. This is not a determinant factor in their decision on where to produce, where to export. On the other hand, this decision may be in great part influenced by government promoting policies. According to the learning by exporting theory, exporting will ultimately foster innovation. In its most pure concept innovation aims to uniqueness in the market, to a rupture within the existing competition towards a monopoly position. Thus, are the current export promotion policies ultimately fostering monopoly positions? Imperfect competition? This study intents to provide further insights that will

[7] Love and Ganotakis (2010) argue that despite the closer attention to detail, firm level analysis are not without limitations. Firm performance is subject to several other influences regardless exporting, which can bias the analysis. In addition, they may also learn from internal sources unrelated with exporting that per se foster some learning. At such, the greater majority of current literature on the effects of export on performance, often have mixed results.

ultimately contribute to guide policy makers into designing more assertive export driven policies, by giving them a clear perspective on the potential benefits of the exporting process on firms in particular, and on economic activity when considering a wider perspective.

5. Conclusions

Prior studies often isolate either innovation or productivity roles to assess the impacts of internationalization in firm's performance. This study contributes to the internationalization and learning-by-exporting literature by considering and analyzing both strands in parallel, in order to more thoroughly assess whether or not there is evidence of learning-by-exporting in the Portuguese manufacturing industry.

This investigation work has its genesis in two key questions: Do Portuguese firms learn-by-exporting? Or, given the difficulties of entry in external markets, do they self-select into the exporting market? By exploring a panel dataset referring to the Portuguese manufacturing industry between the time span 1997 – 2007, this study provides empirical evidence not supporting neither of the previous streams individually, but rather leaving clear signs of the coexistence of both of them. Given the challenges that the international markets presents to its players both in terms of barriers to entry or in terms of barriers to competitively play on it, there is evidence that firms might not only self-select themselves into the international trade market but also they are able to learn from the process in such way that allows them to improve their performance.

The exporting process grants firms the access to specific knowledge reservoirs, either in terms of new processes or new products, that they do not have access to in their own market. This is what will allow them to re-think and re-shape their own methods in order to properly play in the international market. This is the rationale behind the learning by exporting theory. It is this need to catch up into the international set competitive levels that fosters the innovation verified as a result of the exporting process. However, this does not exclude the self-selection theory. Given the competitive edge currently associated to the international trade market, firms may feel the need to become more competitive ex-ante the exporting process in order to properly and sustainably entry and play in such markets. Moreover, even doing so, they still have space to learn and to grow as a result of the greater contact to foreign players provided by the exporting process.

A firm will certainly invest in innovation and R&D to gain the competitive edge necessary to compete in the international markets, while benefitting from its internationalization strategy and structure to access privilege knowledge that will ultimately foster an increased performance level.

All hypothesis and results from this investigation work considered, the causality link between exporting and firm performance that it aimed to assess, works more as a two way link that relies on the interaction between the three analyzed strands (exporting, innovation and productivity), than as a causality (one way) relationship. This investigation work, ultimately points out the need to identify and explore theoretical framework on the topic that aims at a superior level than the existing one, clearly specifying the relationship between exporting, innovation and productivity, by accurately determining which are the drivers followed by firms into the exporting process.

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7. Appendix

7.1 Innovation Approach

TABLE 7.1.1

INNOVATION APPROACH - HAUSMAN TEST RESULTS

Regression	A	B	C	D	E	F
p-value	0,2273	0,2233	0,2354	0,5053	0,4682	0,5053

Regression	G	H	I	J	K	L
p-value	0,1391	0,134	0,1396	0,4025	0,354	0,3631

Regression	M	N	O	P	Q	R
p-value	0,1251	0,126	0,1426	0,2768	0,3189	0,3374

Regression	S	T	U	V	W	X
p-value	0,0641	0,0634	0,071	0,2806	0,2966	0,3121

TABLE 7.1.2.

INNOVATION APPROACH RESULTS

	G	H	I	J	K	L
C	-44,960	-69,987	-75,585	-29,953	-64,719*	-65,931
	-0,767	-1,138	-1,143	-0,834	-1,564	-1,438
$PATENTS_{(t-1)}$				0,823***	0,813***	0,78***
				8,304	8,206	6,991
$EXPORT\_VOLUME_{(t-1)}$	2,350			1,639		
	0,801			0,905		
$EXPORT\_VOLUME_{(t-2)}$		3,597			3,391*	
		1,170			1,632	
$EXPORT\_VOLUME_{(t-3)}$			3,901			3,488*
			1,176			1,508
$R\&D\_INTENSITY_{(t)}$	-3241071***	-2924901**	-2764227**	-648.437,600	-419.446,800	-449.428,600
	-2,209	-1,964	-1,796	-0,564	-0,359	-0,356
$EXPORT\_INTENSITY_{(t)}$	6.260,661	3.595,320	2.844,699	-5.845,255	-10.576,340	-11.367,560
	0,544	0,311	0,218	-0,727	-1,241	-1,144
$SIZE_{(t)}$	-3,17E-15	-3,29E-15	-4,60E-15	-3,03E-15	-3,27E-15	-3,97E-15
	-0,554	-0,580	-0,778	-0,694	-0,761	-0,848
$OPEN_{(t)}$						
n	88	88	77	88	88	77
R^2	9,64%	10,68%	10,76%	50,92%	51,13%	47,18%
R^2 Adjusted	5,29%	6,38%	5,80%	47,93%	48,15%	43,46%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

TABLE 7.1.3.

INNOVATION APPROACH RESULTS

	M	N	O	P	Q	R
C	-15,398	-38,514	-49,874	5,324	-11,674	-12,083
	-0,304	-0,742	-0,872	0,240	-0,415	-0,377
$PATENTS_{(t-1)}$				0,847***	0,819***	0,783***
				8,862	8,300	7,030
$EXPORT\_VOLUME_{(t-1)}$	0,617			-0,211		
	0,240			-0,188		
$EXPORT\_VOLUME_{(t-2)}$		1,753			0,656	
		0,669			0,461	
$EXPORT\_VOLUME_{(t-3)}$			2,290			0,682
			0,796			0,421
$R\&D\_INTENSITY_{(t)}$	-3193395**	-3068890**	-2943487**	-409.065,700	-551.579,800	-618.219,300
	-2,207	-2,104	-1,960	-0,363	-0,474	-0,491
$EXPORT\_INTENSITY_{(t)}$						
$SIZE_{(t)}$	-3,34E-15	-3,45E-15	-4,48E-15	-2,39E-15	-2,80E-15	-3,14E-15
	-0,592	-0,617	-0,773	-0,543	-0,639	-0,662
$OPEN_{(t)}$	9,003**	8,302*	8,690	1,080	0,106	0,279
	1,645	1,524	1,448	0,457	0,035	0,081
n	88	88	77	88	88	77
R^2	12,03%	12,93%	13,72%	54,42%	51,59%	47,64%
R^2 Adjusted	7,79%	8,74%	8,92%	51,64%	48,64%	43,95%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

TABLE 7.1.4.

INNOVATION APPROACH RESULTS

	S	T	U	V	W	X
C	-67,081*	-81,147**	-84,357**	-4,007	-16,325	-20,756
	-1,591	-1,843	-1,710	-0,196	-0,656	-0,691
$PATENTS_{(t-1)}$				0,835***	0,808***	0,767***
				8,963	8,495	7,118
$EXPORT\_VOLUME_{(t-1)}$	3,521**			0,290		
	1,767			0,300		
$EXPORT\_VOLUME_{(t-2)}$		4,197***			0,886	
		2,014			0,749	
$EXPORT\_VOLUME_{(t-3)}$			4,375**			1,116
			1,869			0,781
$R\&D\_INTENSITY_{(t)}$	-3233490**	-2850362**	-2709529**	-523.007,900	-609.262,100	-692.605,200
	-2,218	-1,950	-1,796	-0,462	-0,531	-0,558
$EXPORT\_INTENSITY_{(t)}$						
$SIZE_{(t)}$	-3,25E-15	-3,31E-15	-4,69E-15	-2,64E-15	-2,91E-15	-3,37E-15
	-0,573	-0,587	-0,802	-0,601	-0,667	-0,714
$OPEN_{(t)}$						
n	88	88	77	88	88	77
R^2	9,32%	10,41%	10,64%	52,37%	51,00%	46,72%
R^2 Adjusted	6,08%	7,21%	6,97%	50,08%	48,64%	43,76%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

7.2 Productivity Approach

TABLE 7.2.1

PRODUCTIVITY APPROACH - HAUSMAN TEST RESULTS

Regression	A	B	C	D	E	F
p-value	0,1893	0,1967	0,0807	0,9121	0,9095	0,5576

Regression	G	H	I	J	K	L
p-value	0,3331	0,4375	0,2494	0,9948	0,9981	0,476

Regression	M	N	O	P	Q	R
p-value	0,2903	0,3997	0,2157	0,9655	0,9652	0,4333

Regression	S	T	U	V	W	X
p-value	0,2151	0,3314	0,1601	0,9915	0,9951	0,3898

TABLE 7.2.2.

PRODUCTIVITY APPROACH RESULTS

	G	H	I	J	K	L
C	-310,039**	-89,086	-298,595**	0,595	2,041	-155,669**
	-1,835	-0,520	-1,676	0,021	0,069	-1,467
$PATENTS_{(t-1)}$				0,821***	0,801***	0,747***
				35,774	35,738	11,128
$EXPORT\_VOLUME_{(t-1)}$	17,664***			-0,108		
	2,100			-0,073		
$EXPORT\_VOLUME_{(t-2)}$		6,676			-0,183	
		0,780			-0,121	
$EXPORT\_VOLUME_{(t-3)}$			17,033**			7,703
			1,915			1,437
$R\&D\_INTENSITY_{(t)}$	-1.981.009,000	-1.279.087,000	-10.805,940	19.567,050	-42.912,640	704.379,300
	-0,527	-0,322	-0,003	0,008	-0,017	0,250
$EXPORT\_INTENSITY_{(t)}$	-36.947,910	-10.506,810	-25.184,740	-203,329	108,736	-17.124,620
	-1,189	-0,335	-0,758	-0,027	0,014	-0,764
$SIZE_{(t)}$	-5,01E-16	4,79E-16	-2,85E-15	1,06E-16	1,26E-16	-8,10E-16
	-0,034	0,032	-0,198	0,010	0,012	-0,071
$OPEN_{(t)}$						
n	88	88	77	86	86	75
R^2	5,35%	1,09%	5,48%	95,25%	95,25%	66,94%
R^2 Adjusted	0,79%	-3,68%	0,23%	94,95%	94,95%	64,54%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

TABLE 7.2.3.

PRODUCTIVITY APPROACH RESULTS

	M	N	O	P	Q	R
C	-146,688	15,692	-241,945	4,983	5,935	-95,625
	-0,971	0,105	-1,578	0,211	0,249	-1,225
$PATENTS_{(t-1)}$				0,821***	0,801***	0,747***
				37,164	37,160	13,139
$EXPORT\_VOLUME_{(t-1)}$	9,016			-0,347		
	1,179			-0,294		
$EXPORT\_VOLUME_{(t-2)}$		0,764			-0,395	
		0,102			-0,332	
$EXPORT\_VOLUME_{(t-3)}$			14,256			4,713
			1,854			1,199
$R\&D\_INTENSITY_{(t)}$	-1.933.843,000	-1.778.251,000	-296.207,900	-145.693,700	-201.855,300	483.175,900
	-0,510	-0,455	-0,079	-0,059	-0,081	0,173
$EXPORT\_INTENSITY_{(t)}$						
$SIZE_{(t)}$	-2,30E-17	3,32E-16	-2,18E-15	-1,12E-18	-2,75E-17	1,92E-16
	-0,002	0,022	-0,151	0,000	-0,003	0,017
$OPEN_{(t)}$	3,647	14,504	-8,194	0,571	0,628	-5,030
	0,221	0,926	-0,508	0,254	0,279	-0,626
n	88	88	77	86	86	75
R^2	3,70%	2,02%	4,91%	95,25%	95,25%	73,11%
R^2 Adjusted	-0,94%	-2,70%	-0,37%	94,96%	94,96%	71,16%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

TABLE 7.2.4.

PRODUCTIVITY APPROACH RESULTS

	S	T	U	V	W	X
C	-170,367	-52,434	-214,885*	1,183	1,720	-89,958
	-1,386	-0,420	-1,576	0,065	0,093	-1,210
$PATENTS_{(t-1)}$				0,821***	0,801***	0,747***
				37,235	37,209	11,805
$EXPORT\_VOLUME_{(t-1)}$	10,323**			-0,140		
	1,783			-0,165		
$EXPORT\_VOLUME_{(t-2)}$		4,731			-0,166	
		0,801			-0,193	
$EXPORT\_VOLUME_{(t-3)}$			12,55**			4,210
			1,944			1,197
$R\&D\_INTENSITY_{(t)}$	-1.949.907,000	-1.464.654,000	-453.675,800	-957,423	-30.918,430	324.484,200
	-0,517	-0,375	-0,123	0,000	-0,013	0,117
$EXPORT\_INTENSITY_{(t)}$						
$SIZE_{(t)}$	-2,73E-18	5,87E-16	-1,98E-15	1,24E-16	1,17E-16	-8,91E-17
	0,000	0,039	-0,138	0,012	0,011	-0,008
$OPEN_{(t)}$						
n	88	88	77	86	86	75
R^2	3,75%	0,99%	4,86%	95,25%	95,25%	68,65%
R^2 Adjusted	0,32%	-2,54%	0,95%	95,01%	95,01%	66,85%

t-values in parenthesis bellow coeficient estimates.

*** p-value < 0,05.

** p-value < 0,10.

* p-value < 0,15.

7.3 Other Appendixes

TABLE 7.3.1 POOLED OLS REGRESSION

(dependent variable: PATENTS)

	Coefficient
SIZE	$1{,}73^{E-14**}$
	(1,848)

** p-value < 0,10.