GEE Papers

Number 110

setembro de 2018

Assessing the Competitiveness of the Portuguese Chemical Sector

Ana Rita Marques
Cátia Silva

Assessing the Competitiveness of the Portuguese Chemical Sector

Ana Rita Marques[1] and Cátia Silva[2]

Abstract:

The aim of this paper is to examine the set of variables that determine competitiveness in the Portuguese Chemical sector. By performing a micro-econometrics analysis, whose temporal gap ranges between 2010 and 2016, and using data from the Portuguese firms' population, two models were constructed: the first aims to identify what features influence the export-status of a firm while the second one, a Fixed-effect regression, has the goal of spotting the characteristics associated with higher exports' volume. It was possible to conclude that the only variables that are associated with a positive impact on both dependent variables are the Export Persistency and the Share of Investment in Innovation. Interesting and unusual results were found regarding the statistical significance and impact of firms' age and size on their competitiveness.

JEL Classification: D22

Keywords: Chemical, Exports, Competitiveness, Firm-level data.

Note: This article is sole responsibility of the authors and do not necessarily reflect the positions of GEE or the Portuguese Ministry of Economy

[1] Strategy and Research Office, Ministry for the Economy. Nova School of Business and Economics, Universidade Nova de Lisboa.
[2] Strategy and Research Office, Ministry for the Economy. Nova School of Business and Economics, Universidade Nova de Lisboa.

Acknowledgements: The authors would like to thank Ricardo Pinheiro Alves, Rita Bessone Basto and Catarina Nunes for their direction, Ana Martins, Eva Pereira, Gabriel Osório de Barros, Nuno Tavares and Tiago Domingues for their guidance and Guida Nogueira and Vanda Dores for assistance in the present study. They would also like to recognize the helpful comments and suggestions from Professor Judite Gonçalves, their colleagues at GEE and APQuímica. All errors and omissions are naturally from the authors' responsibility.

1. Introduction

The Chemical sector is characterized by the importance it has on both industrial and consumer chemical products. Although it is not among the main Portuguese exporters, its relevance in terms of turnover created and development of new products is significant. At the European Union (EU) level, it is the leading manufacturing sector in terms of value added per worker[3]. Contrasting with the majority of Portuguese industries, the Chemical sector competitiveness' is based on investment in innovation (research and development) and capital instead of labour costs. According to the annual report elabourated by Cefic "The European chemical industry delivers products to all sectors of the economy, providing innovative and sustainable solutions to today's economic and environmental challenges".

The present paper will follow previous studies that have been conducted to identify the main determinants of competitiveness of other Portuguese industries, such as the Footwear and the Metalworking sector. A broader study was conduted by Correia and Gouveia (2016) for the Portuguese economy. The present paper uses firm-level data to present two econometric models which have the purpose of revealing the main drivers of the sector's competitiveness.

In line with the literature, the study found that exporting in the previous year is pretty much associated not only with an increasing likelyhood of exporting in the year of analysis but also with greatest quantities exported. The same reasoning can be attributed to the variable "share of investment in innovation". Moreover, while financial pressure seems to be associated with a decrease in the probability of exporting, it turned out to have no significance in what concerns export intensities. More detailed information is provided in the 6th and 7th sections (Empirical Results and Conclusions).

The paper is structured as follows. Chapter 2 presents an overview of the industry, adressing international and national trends. In Chapter 3 one may find the literature review that made it possible to establish the results. Chapter 4 describes the data set used.The two next chapters, Chapter 5 and 6, embody respectively the methodology and empirical results. The paper ends with the conclusions and recommendations for improvements in what concerns the sector's competitiveness. Contents for further researches will also be suggested.

[3] According to Cefic (The European Chemical Industry Council)

2. The Chemical Sector

This chapter contains a brief overview of the Chemical industry. It will start by presenting an international broader vision and then it will focus specifically on the Portuguese case.

2.1. International Overview

2.1.1. World Chemical Sales

In 2016, the world Chemical turnover reached 3360 billion of euros, being the sales growth rate considerably lower when comparing with previous years. Nonetheless, this was also a year marked by a sharply recovery, mostly due to China's sales.

During the period between 2006 and 2016, the European Union (EU) lost part of its market share. China held the top ranking position in sales followed by the United States which ranked second, along with the EU Chemical industry, in total sales. Germany, France, Italy and the Netherlands displayed a crucial role, accounting for the 61.7 per cent of EU's transactions. As the following graph depicts, Asian sales more than doubled those from the EU in 2016.

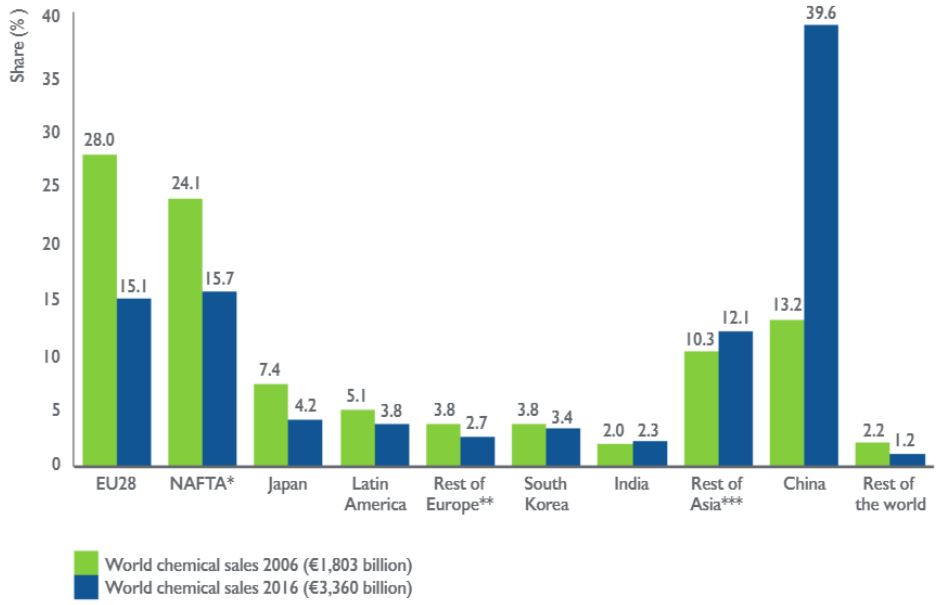


Figure 1: World chemical sales in 2006 and 2016 (Source: Facts & Figures 2017, The European Chemical Industry)

2.1.2. Production

According to the European Chemical Industry Council (Cefic), the industry's production can be fragmented into three areas: Base Chemicals, Specialty Chemicals and Consumer Chemicals. Petrochemicals (which belong to the Base Chemicals) and Specialty Chemicals accounted for half of EU Chemicals sales. At the EU level, such industry (excluding pharmaceuticals) was the fifth largest one, contributing to about 7 per cent of the total manufacturing value added. Nearly two-thirds of the EU Chemicals were supplied to the industrial sector which includes activities such as construction. The former part was attributed to other economic activities such as agriculture, services and other business activities.

2.1.3. Intra-EU Sales

The internal market embraced over 500 million consumers. Total EU Chemicals sales were worth €507 billion in the year of analysis (2016) being such value the lowest ever reached since 2010. On one hand, intra-EU sales followed an increasing trend. On the other hand, about 30 per cent of these Chemicals were sold outside EU.

The three primary markets for EU Chemicals exports were the EU's neighbour countries, the North American Free Trade Agreement countries (NAFTA trade bloc) and Asia.

During the 11-year period that goes from 2006 to 2016, this industry in the European Union had a negative weak average production growth rate. Despite the recovery trend that was observed since 2010, production remained below its pre-crisis level. It was also notorious the fact that emerging economies were outpacing the production of industrial countries.

2.1.4. International Trade

As previously stated, the European Union Chemical industry was negatively affected by the 2008 Economic crisis and so, trade agreements with key partners enabled to reach further enhances in what concerned efficiency gains. Note that these agreements are still beneficial nowadays.

In 2016, a trade surplus of €47.3 billion was reached, being the US the main trading partner. Specialty Chemicals were the major components in exports while Petrochemicals hold the greatest share on imports.

2.1.5. Energy Dependence

The chemical industry is an energy-intensive one. Energy costs have always been a constraint in what concerns production. Moreover, in Europe these costs have a major impact on competitiveness. Ethylene, which is globally used in the industry, was three times more expensive in Europe than in the US, in 2013. Despite its improvement (the difference diminished), in 2016 this was still a clear disadvantage for European producers.

In order to improve the industry's performance, better access to affordable energy and raw materials is required.

2.2. Portuguese Overview

The Chemical sector is characterized by the production of organic and inorganic Chemical products whose range contains from origin, fertilizers, pharmaceutical products, ink, varnish and clean and beauty products. Nevertheless, it is important to consider the wholesale of these products due to the fact that it represents a small but significant part of the overall economic activity.

The industry belongs to the Class 20 (Manufacture of chemicals and chemical products), such classification is attributed by NACE Rev.2 – Statistical Classification of economic activities in the European community. This division includes the transformation of organic and inorganic raw materials by a chemical process and the transformation of products. It distinguishes the production of basic and end goods by further processing of Basic Chemicals that make up the remaining industry classes.

According to the classification of INE (*Instituto Nacional de Estatística*)[4], the economic activities analysed in this paper belong to the following CAE's division: CAE-19201, CAE-19202, CAE-20, CAE-211 and CAE-46750. The subsequent statistics will be based on these CAE's, which means that some discrepancies can be found if different classifications/categories are used.

The main areas of the Chemical industry can be synthesized as follows:

- Manufacture of refined petroleum products from origin and from solid waste;
- Manufacture of chemicals and synthetic or artificial fibbers;
- Manufacture of basic pharmaceutical products from origin;
- Wholesale.

The overview of the sector concerns the time-period comprised between 2008 and 2015 because, for the year of 2016, some data is hidden since for divisions in which only one firm existed, its financial indicators must be preserved as confidential.

2.2.1. General Statistics

In 2015, 1634 firms were active; this represented 2.4% of the total manufacturing industry. The majority of enterprises were classified as small and micro companies, mostly operating in the area of Consumption products. Some larger companies were involved in Basic Chemicals, Fertilizers, Petrochemicals, Polymers, Fibbers and Specialties. There was also a small but dynamic group of companies in the Fine Chemicals area with its own know-how and a significant contribution to exports.

As presented in the following graph, it is clear that the number of total firms decreased overtime. With a fall of 11% between 2008 and 2015, the wholesale subsector embodied the greatest share in what concerns the number of total firms (with a decrease of 12%).

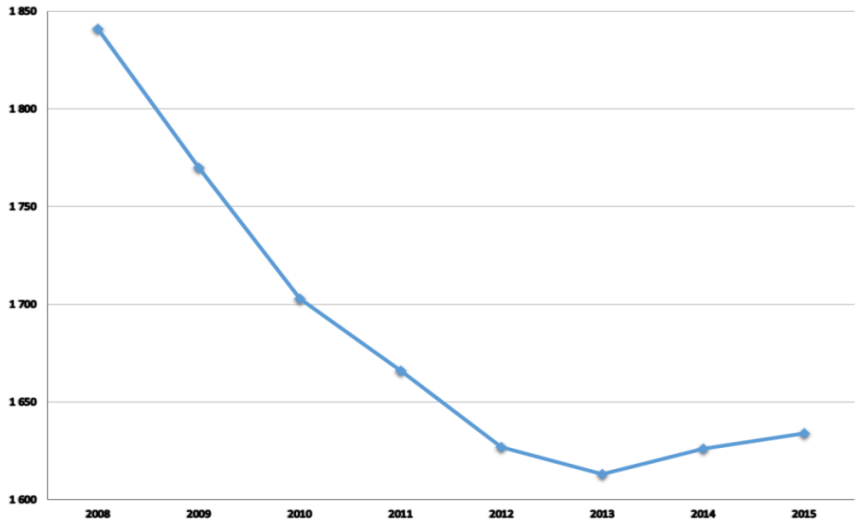


Figure 2: Evolution of the number of firms in the chemical sector (Source: SCIE)

In 2015, the turnover created by the Chemical sector was equal to 13440 million of euros. This variable decreased 0,35% between 2008 and 2015 and the main contributor for this tendency was the manufacture of refined petroleum products.

[4] which is named CAE-Rev.3 (*Classificação das Atividades Económicas*)

A decreasing trend may also be found in the number of employees decreased 8% between 2008 and 2015. In 2015 there were 19837 people employed. The manufacture of refined petroleum products was the activity that more significantly contributed to this indicator.

The Gross Value Added (GVA) generated by the Chemical industry reached 1707 million of euros in 2015, which depicted an improvement in comparison with, for example, the value achieved in 2008 (0,47% increase). In fact, the sector represented, in 2015, 9% of the total GVA produced by the Manufacturing Industry. The manufacture of Basic Pharmaceuticals contributed mostly for this result with an increase of 28% during this period.

2.2.2 International Trade

In terms of international trade, the Chemical sector has kept a good position in the ranking of Portuguese exporters: representing 11% of international sales in 2016. Exports, which play a major role on production, increased by 27% between 2008 and 2016. The principal destinations of chemical exports are Spain, the United States and The Netherlands.

Petroleum oils and oils obtained from bituminous minerals represented the biggest share of exported products, reaching in 2016, 5,2% of the total Portuguese exports.

Imports were relatively steady between 2008 and 2016 (decreased only 1%) and the increasing trend on exports made it possible to achieve significant improvements in terms of the trade balance. Nevertheless, this sector continued highly dependent on foreign countries. The Portuguese imports come primarily from Spain, Germany and from the Netherlands.

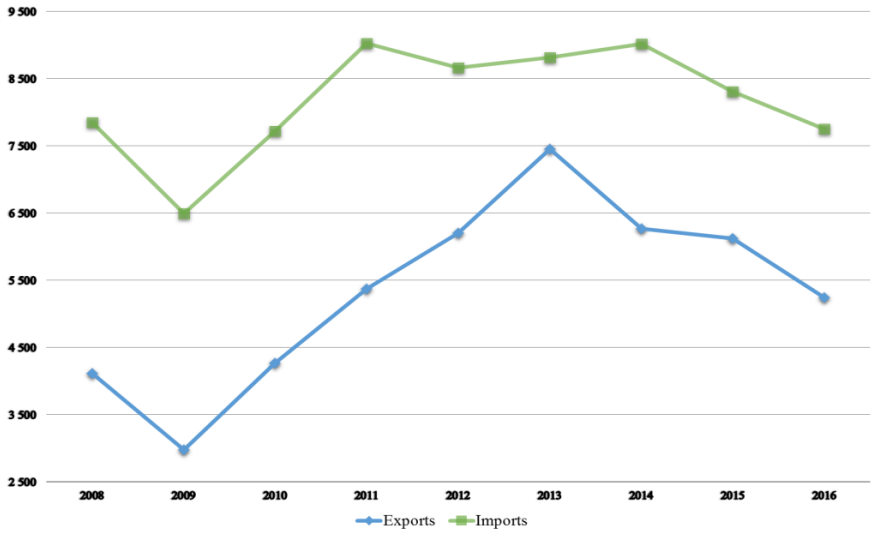


Figure 3: International trade of the Portuguese chemical industry (Source: *SCIE*)

2.2.2. Weaknesses

Although the sector is well-established in terms of employment and production, its value chain has significant breaks, mostly in the field of intermediate products. Such issue creates a lapse in the production process thus sometimes it is not completely unified. This might appear as one of the reasons why Portugal is not in the leading exporting countries in Chemical industry.

Another weakness that can be pointed out is the fact that Portuguese firms face high electricity costs, and as electricity is an input massively used in the production chain, it is a huge drawback. According to Eurostat, the price to pay for the consumption of this source of energy (for non-households consumers), before taxes and levies, faced by Portuguese firms is higher than the average of the European Union from 2012 onwards.

The graphs bellow depict prices in two different bundles of electricity consumption: The first ranges between 500MWh and 2000MWh while the second between 70000MWh and 150000MWh, which are the minimum and maximum costs Chemical firms can face, respectively. When comparing the ones from in Portugal with the ones faced in the European country that mostly contribute to global Chemical sales (Germany), one can understand that Portuguese companies face much higher costs which may, for obvious reasons, result in decreases in competitiveness.

Electricity prices

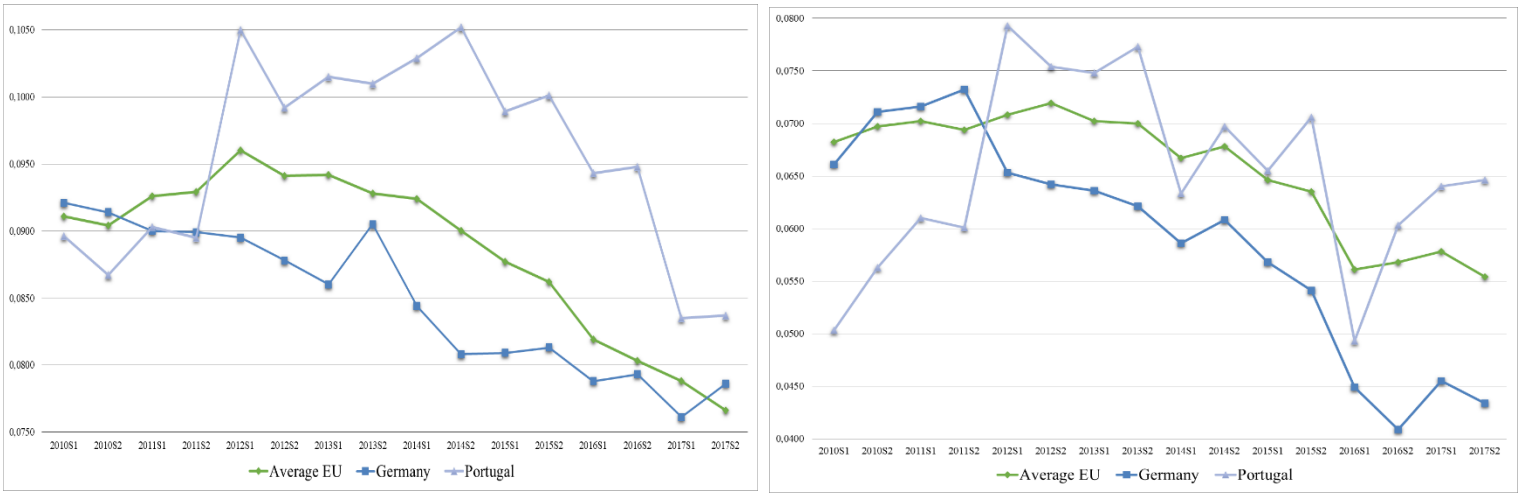


Figure 4: Electricity prices for non-households' consumers, in euros, excluding taxes and levies for consumption between 500MWh and 2000MWH, on the left, and between 70000MWh and 150000MWh, on the right (Source: Eurostat)

One of the explanations on behalf of this difference may be found in the "Landscape of the European Chemical Industry" for the year of 2018 which defends that electric power connections between Iberia and the rest of Europe are poor, making it difficult to develop of a real competitive market in Portugal and Spain.

This sector is also very intensive in the use of natural gas and oil. In the following graphs it is shown that, during some time, Portugal was facing higher natural gas' costs when compared to the top exporters in Europe. Although after 2016 these two countries switched positions, Portugal has always been in a worse condition when compared to the EU average.

Natural gas prices

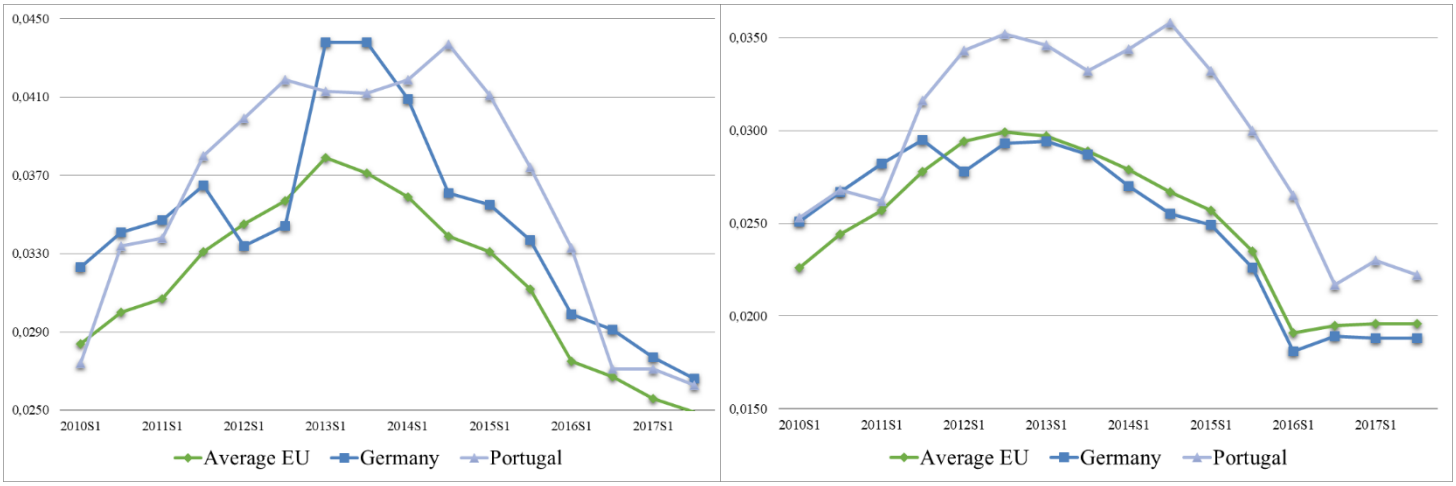


Figure 5: Natural gas prices for non-households consumers, in euros, excluding taxes and levies for consumption between 10000GJ and 100000GJ, on the left side, and for consumptions between 1000000GJ and 4000000GJ, on the right side (Source: Eurostat)

The figures above provide a clear vision of, on the left side, the costs of natural gas for consumptions between 10000GJ and 100000GJ and, on the right side, for consumptions between 1000000GJ and 4000000GJ. As it was explained for electricity, following the suggestion of *APQuímica*, once more these concern the sorts of consumptions that denote the minimum and the maximum costs Chemical firms face, respectively.

In this study, the authors decided to compare the cost of energy without the attachment of taxes and levies because it makes the comparison between countries easier and more intuitive. However, the role of the Government in the cost of energy influences straight the competitiveness of the Chemical firms. In this field, if an analysis was conducted it would be found that Portuguese firms are in a worse position than their competitors from abroad.

According to data collected from the U.S Energy Information Administration, it is clear that the price of oil per barrel has not been following a clear trend in the European Markets, being its journey marked by ups and downs.

Prices reached their pick in the year of 2008 which was a benchmark because, afterwards, they dropped considerably. After a steady period, from 2013 on, the pattern followed is one of declining. Note that since 2016, the values started increasing again.

Moreover, in comparison with the 90's, it can be said that there was an overall shift so, generally speaking, over this last decade oil got way more expensive.

3. Literature Review

The main goal of this paper is to evaluate the competitiveness of Chemical sector on a firm-level basis. The idea that economic success of a country depends on its international competitiveness is present since the late 1970s[5], as Krugman (1996) stated. Since the pioneer works of Bernard & Jensen (1995), most of the studies consistently show that in specific situations, exporting firms are larger, with higher levels of productivity, more capital-intensive, pay higher wages and invest more in Research and Development (R&D).

The relation between productivity and exports is a frequently discussed topic. While some authors believe that high levels of productivity influence the export status, the other way around is often also verified in the literature. The first view was followed by Altomonte et al (2012). According to him, firm's competitiveness is best captured by the Total Factor Productivity (TFP) because only the most productive firms are able to compete internationally. The same view was defended in the work of Greenaway & Kneller (2004). Authors believed that there exists self-selection into any export-promotion policies because only the "large enough or productive enough" firms are able to attain the costs to enter in the export market.

Years before, a relation between productivity and exports was already introduced by Van Biesebroeck (2003) but this author stated that "exporters increase their productivity advantage after they start exporting". The argument presented by him was the one of economies of scale: while firms that engage in this type of economic activities are producing at the lower cost, the ones that do not export are producing at a point with increasing returns to scale.

A consensus can be reached in what regards the fact that greater degrees of trade openness are beneficial for long-term growth of countries and, for Ortega et al (2014), this is possible through increases in competitiveness due to investment in R&D and by exporting to other countries ("learning by exporting"). The relation between investments in R&D lasts since 1993 where Ito & Pucik (1993) found a significant effect of this variable on the export status. This way, R&D intensity offers a significant explanation as it was found in the study by Guner et al (2010). However, less robust results were found for labour productivity, capital intensity, and concentration ratio.

The study conducted by Haque & Kemal (2007) makes a first attempt to evaluate subsidies policies in a new perspective by estimating the impact of two export subsidy schemes on international trade performance, which lead to insignificant effects of subsidies on export status. Their limited role was also found in the work of Panagariya (2011), arguing that more effective policy to boost exports can be achieved. Safi (2010) claimed that positive effects in the presence of imperfect competition may exist in two cases: economies of scale and externalities.

The study conducted by Caloff (1994) does not corroborate previous findings in which size was said to be positively related to a firm's propensity to export. The author identified a positive and significant relationship between size and the number of markets to which the firm actually exports. Nonetheless, evidences point out lack of explanatory power in what concerns exporting behaviour of the firm. Following this thought-line, the author suggests that size should not be considered a major barrier when undertaking

[5] Since the World Economic Forum used as major criterion for competitiveness the international trade.

export accomplishments – Smaller firms do have the required skills to engage successfully in these activities. Other authors, such as Moen (1999), found as main conclusions that smaller firms are just as successful in international markets as larger ones. Note that, it is crucial to have a clear definition for size in order to reach plausible results.

One of the main determinants of the export performance identified in 1995 by Bernard and Jensen (1995) was the effect of firms paying higher wages and a more detailed discussion on the topic can be found in Schank et al (2008). Taking the fact that exporting firms pay higher wages as given, the authors demonstrated that the exporter wage premium does already exist in the years before firms start to export, and that it does not increase in the years after exporting started. It suggests the existence of self-selection into exporting firms because only the more productive firms pay higher wages (hypothesis) and sell to international markets as defended by Bernard and Jensen. These findings deviate from the idea that firms increase the wages payed to employees after start exporting.

According to Sinani and Hobdari (2008), a firm's exporting history is statistically significant and affects the likelihood of remaining in the export market. The average predicted probability of exporting is higher for firms with past experience and, the authors state that it is more than 50% for firms that have exported in the last 2 years. Facts like the presence of sunk costs and the own firm's characteristics take a place in the decision making process towards whether firms should export or not. Last but not least, negative effects can be attributed to the role of spillovers in the export market. Operating in an export-oriented industry increases the likelihood of engaging in this activity.

A study conducted by Mariasole et al (2013) on SME (Small and Medium enterprises) Italian firms confirms that experience in external markets enables to share knowledge in global value chains thus, it leads to increases in competitiveness. On the other hand, according to Boehea & Jiménez (2016) export intensity changes the economics of export diversification: low export intensity reduces and high export intensity amplifies the benefits derived from this geographic diversification (S-curved relationship and inverted U-shaped, respectively).

Fabling & Sanderson (2013) nail down that firms which are about to enrol in export activities incorporate, on average, higher labour productivity and capital intensity. Furthermore, employment and capital intensity are expected to keep on the rise as firms expand to additional markets. However, the authors claim that while new exporters engage in international trade by increasing labour inputs with capital deepening occurring only after entry, experienced exporters make capital investments prior to market expansion.

The literature is assertive in saying that financial pressure impacts negatively firms' performances. Bellone et al (2009) confirm that a firm's financial pressure can limit its performance: it can work as a barrier when acquiring more debt constraining the possibility of improving competitiveness.

An additional source of heterogeneity that can help to account for different export behaviours across firms is financial health. There exists evidence that firms facing better financial health are more likely to start exporting in the work of Bellone et al (2009). In previous research by Greenaway et al (2007), conflicting results were found which display that export participation improves firm financial health but not that exporting firms show any ex-ante financial advantage.

According to Bruderl & Schussler (1990) young firms face disadvantages in the international markets because the relations with clients are not yet established and those with clients from previous periods

dominate in the process of internationalization. This idea was also defended in the work of Wagner (2015), which shows that export participation and the share of exports in total sales are both larger for older firms. When younger firms invest in innovation strategies, those firms may overcome their liabilities and be successful in foreign markets.

The literature found that there are significant and robust higher markups for exporting firms. Furthermore, this variable differs dramatically between exporters and non-exporters. Nevertheless, the impact it pursuits on productivity cannot be discarded. Lastly, according to the authors, markups are also impacted every time firms enter new export markets.

Variable	Authors	Effect
Dimension	Bernard & Jensen (1995) Caloff (1994) Moen (1999) Wagner (2015)	**+** **0** **0** **+**
Productivity	Bernard & Jensen (1995) Altomonte et al (2012) Greenaway & Kneller (2004) Van Biesebroeck (2003)	**+** **+** **+** **Reverse causality**
Capital intensity	Bernard & Jensen (1995) Gunguner et al (2010) Fabling & Sanderson (2013)	**+** **+ / 0** **+**
Wages	Bernard & Jensen (1995) Schank et al (2008)	**+** **0**
Investment in R&D and Innovation	Bernard & Jensen (1995) Ortega et al (2014) Ito & Pucik (1993) Guner et al (2010) Correia & Gouveia (2016)	**+** **+** **+** **+** **+**
Labour productivity	Guner et al (2010) Fabling & Sanderson (2013)	**+ / 0** **+**
Concentration	Guner et al (2010)	**+ / 0**
Subsidies	Haque & Kemal (2007) Panagariya (2011) Safi (2010)	**0** **0** **+**
Export Persistency	Sinani and Hobdari (2008)	**+**
Exports Diversification	Mariasole et al (2013) Boehea & Jiménez (2016)	**+** **+/-**
Financial Pressure	Bellone et all (2009)	**-**
Financial Health	Bellone et al (2009) Greenaway et al (2007)	**+** **Reverse causality**
Age	Bruderl & Schussler (1990) Wagner (2015)	**+** **+**
Markup	Jan De Loecker & Frederic Warzynski (2012)	**+**

Figure 6: Literature review summary

4. Database description

4.1. The Dataset

The dataset used comes from SCIE (*Sistema de Contas Integradas das Empresas*) which was provided by the National Statistical Institute (INE). The data, whose time-period of analysis ranges between 2010 and 2016, concerns accounting information from the Portuguese chemical firms.

The selection of data was based on the CAE's that address the Chemical sector (those were specified earlier in Chapter 2), the final number of observations is 11606 being the annual average of firms equal to 1934. As it was previously discussed, this sector is characterized by its export intensity. Between 2010 and 2016 the participation of firms in international markets has been increasing at a low rate.

Year	Number of firms	Number of exporters	Non-exporters
2010	1709	782	927
2011	1674	813	861
2012	1641	800	841
2013	1627	806	821
2014	1639	836	803
2015	1649	833	816
2016	1667	843	824

Figure 7: Export dynamics of firms in the chemical sector (Source: *SCIE*)

In terms of size, it is mainly composed by Micro and Small firms. Their decrease in absolute number was already mentioned in Chapter 2 and can now be seen in the table below. This trend was not followed by Medium firms which increased their number.

Year	Micro	Small	Medium	Large
2010	491	215	63	13
2011	513	222	63	15
2012	499	222	63	16
2013	511	217	62	16
2014	516	237	68	15
2015	493	253	73	14
2016	500	249	79	15

Figure 8: Dimension of firms in the chemical sector according to European Commission (Source: *SCIE*)

Within firms that export, the sector is also composed mainly by Small and Micro companies. It is easy and straight forward to interpret in figure 9 that large firms are, in majority, present in international markets.

Year	Micro[6]	Small[7]	Medium[8]	Large[9]
2010	1296	327	71	15
2011	1260	327	72	15
2012	1246	312	67	16
2013	1242	299	69	17
2014	1231	319	73	16
2015	1224	331	79	15
2016	1245	321	86	15

Figure 9: Dimension of exporting firms in the chemical sector according to European Commission (Source: *SCIE*)

4.2. Choice of variables

As recommended in the literature, this study will use international performance as a proxy for a firm's competitiveness. In this reasoning, the authors decided to use as dependent variables the export status of a firm and its total exports. The use of export status is justified by the presence of some firms that do not display this type of behaviour. This may provide enough information in order to determine why some firms export and others do not. A more direct "thought-line" can be attributed to the reasoning behind the choice of total exports: it is interesting to infer and conclude about what influences the decision of firms regarding how much to export.

The database used, SCIE, provides vast information about financial accounts of Portuguese firms therefore, it was possible to approximate most of the variables identified as determinants in the literature review.

Firms' size was calculated within the rules of European Commission. Export persistency occurs when the firm exported in the previous period but also at the current one. Export diversification denotes a situation where firms export not only within the European Union but also outside of it. The capital intensity ratio, which seems to influence firms' performance due to the characteristics of Chemical sector, was computed as the division between the sum of both fixed tangible and intangible assets by the Turnover.

Some financial pressure and financial health measures were included in our study, for example, the Debt-to-Equity ratio which was computed as the ratio between total liabilities and total equity. Financial pressure is given by the division between interest expenses and EBITDA (Earnings Before Interest, Tax, Depreciations and Amortizations). Internal financing is the ratio between EBITDA and total assets.

Another driver of competitiveness, often pointed on literature is innovation. In this paper, the proxy for innovation includes the sum of investment in R&D, goodwill, industrial property and intangible assets. Unfortunately, no subsidies to innovation were included in the study.

[6] According to European Commission: less than 10 employees and turnover or total assets less than 2000000
[7] According to European Commission: less than 50 employees and turnover or total assets less than 10000000
[8] According to European Commission: less than 250 employees and turnover less than 43000000 or total assets less than 50000000
[9] According to European Commission: more than 250 employees or turnover and assets more than 50000000

Lastly, it is important to emphasize that some variables were divided by the turnover so that their interpretation were not scale-dependent. This works out as an induced normalization.

Labour Cost – Personnel costs (total wage bill)
Tangible Assets (*Tang_assets*) – Fixed Tangible Assets
Share Investment in Innovation (*Share_inv_innovation)* – Ratio of Innovation (sum of investment in Intangible assets, goodwill, R&D and in industrial property) to Turnover
Debt-to-Equity – Ratio of total liabilities to total equity
Internal Financing – Ratio of EBITDA to Total assets
Financial Pressure– Ratio of interest expenses to EBITDA
Capital Intensity (*K_intensity*) – Ratio of Capital (sum of fixed tangible and intangible assets) to Turnover
Size (*Micro, Medium or Large)* – Four categories: Micro, Small, Medium and Large enterprises
Age – Defined as the years that passed between the year of creation of the firm and the last year in consideration in the analysis
Export Diversification (*X_diversification*) – Dummy variable equal to one if the company exports within and outside the EU
Persistency - Dummy variable equal to one if the company exported in the previous year and in the year of analysis
Total Factor Productivity (*TFP*) – Productivity computed by the Levinsohn and Petrin's method
Export propensity (*X_prop*) - Dummy variable equal to one if the company exports in the year of analysis
Turnover – Sum of total assets and services of the company
Investment – Gross formation of fixed capital
Markup – Commercial margins
Birth - Dummy variable equal to one if the company was created in the year of analysis

Figure 10: Variables description

4.3. Descriptive Statistics

As it was previously mentioned, the Chemical sector can be mainly classified in four groups and the subsector that holds the most significant share of participation in international markets is the "manufacture of chemicals and synthetic or artificial fibbers", as it is shown in figure 11.

Subsector	% Exporting Firm – Average
Manufacture of refined petroleum products from origin and from solid waste	41,76%
Manufacture of chemicals and synthetic or artificial fibers	54,53%
Manufacture of basic pharmaceutical products from origin	42,86%
Wholesale	48,02%

Figure 11: Percentage of exporting firms by subsector (Source: *SCIE*)

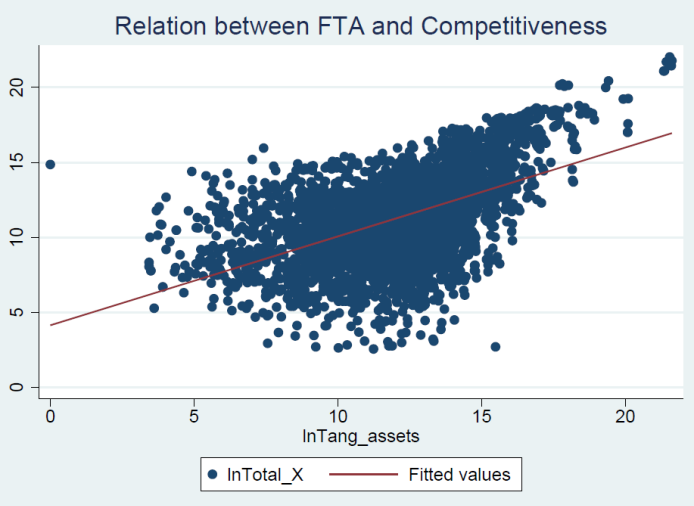
The decision of whether to enter in international markets or not, is associated with different behaviours of firms in key determinant variables. These correlations are crucial and so, they will be tested in our models (in section 5 and 6). However, some general differences between the two groups can be spotted *a priori*.

Mean differences	Exporting firms	Non-exporting firms
Share of investment in innovation	1,780737	0,0106708
Capital intensity	3,549479	8,485876
Productivity	22,76235	21,65423
Labour cost	688956,2	59281,21
Fixed tangible assets	6570813	444811,9
Financial pressure	-2,957471	-0,0341163
Debt-to-equity	4,009847	2,660884
Markup	493345,1	105705,9

Figure 12: Mean differences between exporting and non-exporting firms

As figure 12 depicts, firms differ in some key indicators according to their export-status. Exploring those differences, one may find the determinants that are critical to this decision.

Illustrations of the relationship between some key variables and competitiveness can be found below. It is shown that labour cost expenses, innovation and level of fixed tangible assets (FTA) are positively correlated with total exports of a firm. This suggests that firms whose desire is to compete internationally should probably invest in those variables. Analysing the case for innovation, companies with higher levels of investment in it, generally have higher levels of exports.



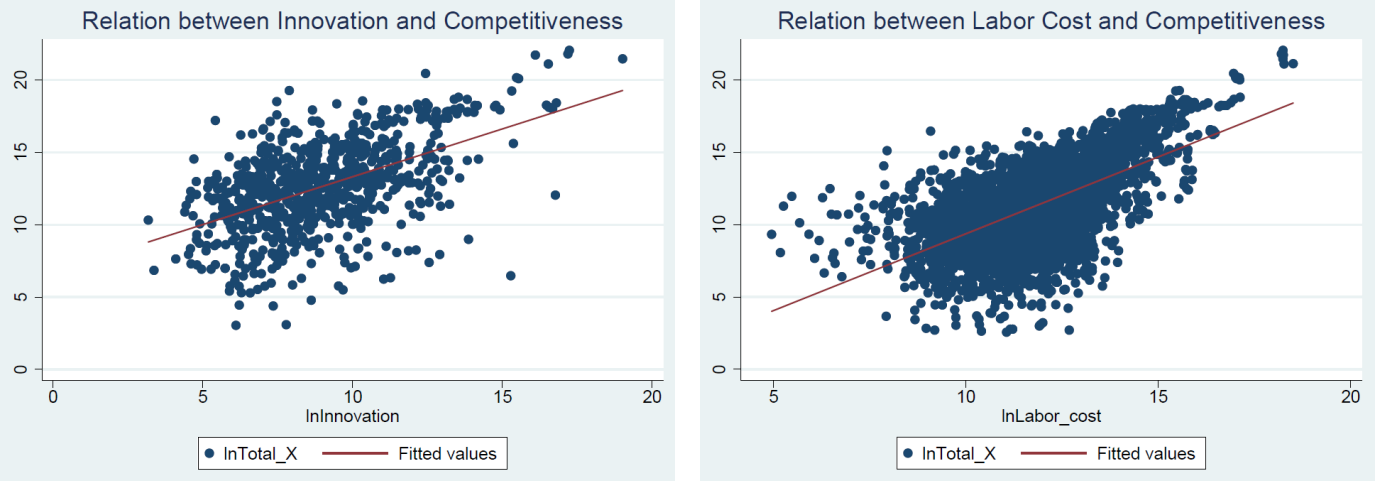


Figure 13: Correlation between variables and competitiveness (Source: *SCIE*)

5. Methodology

The aim of this paper is to investigate the determinants of competitiveness of the Chemical sector. In order to conduct such study, firm-level data of Portuguese Chemical industries, ranging between the time period of 2010-2016, was collected. According to the literature review and as mentioned in that section, the level of internationalization will be used as proxy for a firm's competitiveness.

To begin with, a Linear Probability Model (LPM) was computed aiming to analyse whether a firm would export, or not. Secondly, through a Panel OLS model, Fixed Effects (FE) were estimated so that, conclusions concerning the quantity exported could be drawn out. Both models will be presented later on.

The LPM will allow inferring which features actually have explanatory power regarding a firm's probability of becoming an exporter in the next year (t). Hence, the dependent variable chosen is the export propensity (X_prop). Since a lagged dependent variable is included, this is a typical linear dynamic panel-data model and so, by construction, the unobserved individual-level effects are correlated with the lagged dependent variable, making standard estimators inconsistent. The model used, which is described below, includes Blundell and Bond[10] system estimator in order to correct for such issue. Note that, all explanatory variables are *ex ante* determinants.

[10] Blundell and Bond system estimator relies on Arellano and Bond estimator – a consistent generalized method of moments (GMM) – and it is build up on the work of Arellano and Bover (1995)

$$X\_prop_{i,t} = \beta_0 + \beta_1 X\_prop_{i,t-1} + \beta_2 lnTurnover_{i,t-1} + \beta_3 Investment_{i,t-1} + \beta_4 Markup_{i,t-1} + \beta_5 Labour\_cost_{i,t-1} + \beta_6 Share\_inv\_innovation_{i,t-1} + \beta_7 lnK\_intensity_{i,t-1} + \beta_8 Financial\_pressure_{i,t-1} + \beta_9 EBITDA_{i,t-1} + \beta_{10} Debt\_to\_equity_{i,t-1} + \beta_{11} Equity_{i,t-1} + \beta_{12} Birth_{i,t-1} + \mu_{i,t}$$

Moving to the second regression, it looks forward to explain what variables impact on the quantity exported by each firm. The specification of the model, whose dependent variable is the total exports (Total_X) can be found below. Furthermore, a Hausman test was performed in order to choose between Random (RE) and Fixed (FE) effects. The Null-hypothesis of having individual specific effects not correlated with the explanatory variables was rejected and so, the study was conducted with FE.

$$Total\_X_{i,t} = \beta_0 + \beta_1 lnLabour\_cost_{i,t} + \beta_2 lnTang\_assets_{i,t} + \beta_3 Share\_inv\_innovation_{i,t} + \beta_4 Share\_inv\_innovation_{i,t-1} + \beta_5 Internal\_financing_{i,t} + \beta_6 Debt\_to\_equity_{i,t} + \beta_7 Debt\_to\_equity_{i,t}^{\ 2} + \beta_8 K\_intensity_{i,t} + \beta_9 K\_intensity_{i,t}^{\ 2} + \delta_{10} Micro_{i,t} + \delta_{11} Medium_{i,t} + \delta_{12} Large_{i,t} + \beta_{13} Age_{i,t} + \beta_{14} X\_diversification_{i,t} + \beta_{15} Persistency_{i,t} + \beta_{16} tpf_{i,t} + \beta_{17} Year_{i,t} + \omega_i + \varepsilon_{i,t}$$

In order to provide clear insights on the choice of the binary dependent variable model, an intensive research was done and so, a conclusion was reached and will be presented below. Note that, this choice is closely related with the goal of the study.

5.1. Choice of the model - LPM vs Probit/Logit

The Linear Probability Model was found to perform as well as the other two alternatives. Given the non-occurrence of many predicted probabilities above 1 or below 0, this model fits the purpose of the paper.

According to Suneel Chatla and Galit Shmueli (2016), for classification, in terms of class separation and ranking, the LPM performance is as good as that the other two available options. Furthermore, when the predicted probabilities are not directly of interest, Logit and Probit do not perform better than the model in question. Many other reasons where found in what concerns situations in which LPM is the best choice.

As stated by Wooldridge (2010), if the main purpose of the study is to "estimate the partial effect of explanatory variables on the response probability, averaged across the distribution of the covariates, then the fact that some predicted values are outside the unit interval may not be very important". Nonetheless, the LPM need not provide very good estimates of partial effects at extreme values of independent variables.

5.2. Commodities vs Specialties

Since the Chemical sector is characterized by its heterogeneity, in consensus with *APQuímica*, a study aiming to dig deeper in the differentiation between the two main groups of Chemicals produced in Portugal was considered.

Theoretically, it was possible to distinguished between Commodities and other Specialties. The first group is integrated in very competitive markets where different firms are producing similar products. The second group is included in a segment of the Chemical sector where innovation is the crucial factor because there is room for new and different product. In this segment, the price/cost of the product may not be the determinant for international competitiveness.

Nonetheless, in practice it was not easy to establish a clear cut off that could enable to divide the observations in two. In addition, the results obtained did not corroborate with the reality in the sense that the characteristics verified were not statistically significant in the respective groups.

Figure 14: Segmentation of the Chemical sector

Group 1 – Commodities	Group 2 - Specialties
Lower markup	Higher markup
Lower Value Added	Higher Value Added
Great importance of the Turnover	Perform in advanced of the Chain Value
Already integrated in Global Value Chains	Already integrated in Global Value Chains
Verifies Economies of Scale	Smaller firms
Investment in Fixed Tangible assets leads to breaks in production	New borns
Requirement of high levels of efficiency	Strongly connected to R&D

6. Empirical Results

Output 1 depicts the results from the Linear Probability Model regression of the export propensity on a set of explanatory variables. The Fixed Effects panel regression of the total exports of the firm is presented in Output 2.

Output 1: Linear Probability Model (Model 1)

```
Fixed-effects (within) regression               Number of obs      =         2973
Group variable: ID                              Number of groups   =          761

R-sq:  within  =  0.0999                        Obs per group: min =            1
       between =  0.5020                                       avg =          3.9
       overall =  0.4843                                       max =            6

                                                F(17,760)          =       205.44
corr(u_i, Xb)  =  0.4260                        Prob > F           =       0.0000

                                               (Std. Err. adjusted for     761 clusters in ID)
```

lnTotal_X	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnLabor_cost	.2717323	.0864843	3.14	0.002	.1019558	.4415087
lnTang assets	.1353684	.040646	3.33	0.001	.0555765	.2151602
Share inv innovation	.1064194	.0185651	5.73	0.000	.0699745	.1428643
l1Share inv innovation	-.0008634	.0006833	-1.26	0.207	-.0022047	.0004779
Internal_financing	.6417275	.2464204	2.60	0.009	.157982	1.125473
Debt to equity	-.0009248	.000543	-1.70	0.089	-.0019908	.0001411
Financial pressure	-.0000121	.0000298	-0.41	0.683	-.0000705	.0000463
K intensity	-.0250342	.0136536	-1.83	0.067	-.0518373	.001769
K_intensity2	.0000204	.000012	1.69	0.091	-3.27e-06	.000044
Micro	0	(omitted)				
Small	.3019387	.1572211	1.92	0.055	-.0067004	.6105778
Medium	.2673572	.2767805	0.97	0.334	-.2759879	.8107024
Large	.8635751	.6671267	1.29	0.196	-.4460549	2.173205
Age	.0094844	.0263517	0.36	0.719	-.0422464	.0612153
X diversification	.6926505	.0928486	7.46	0.000	.5103803	.8749208
Persistency	.1919007	.1097555	1.75	0.081	-.0235593	.4073607
tfp	.0149555	.0036247	4.13	0.000	.0078399	.0220712
Year	.0223577	.0167564	1.33	0.183	-.0105367	.0552521
_cons	-39.55746	33.55377	-1.18	0.239	-105.4265	26.31163
sigma_u	2.233583					
sigma_e	.99986404					
rho	.83306206	(fraction of variance due to u_i)				

Output 2: Fixed-effects model (Model 2)

System dynamic panel-data estimation — Number of obs = 5476
Group variable: **ID** — Number of groups = 1225
Time variable: **year**

Obs per group: min = 1
avg = 4.470204
max = 6

Number of instruments = 33 — Wald chi2(11) = 836.75
Prob > chi2 = 0.0000

One-step results

X_prop	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
X prop L1.	.2290796	.0369469	6.20	0.000	.156665	.3014943
lnl1Turnover	.0432582	.0214216	2.02	0.043	.0012726	.0852437
l1Investment	-9.17e-11	1.39e-10	-0.66	0.511	-3.65e-10	1.82e-10
l1Markup	2.08e-09	3.95e-09	0.53	0.598	-5.66e-09	9.83e-09
lnl1Labor_cost	.0111696	.0150374	0.74	0.458	-.0183031	.0406423
l1Share_inv_innovation	.0001416	.0000118	11.97	0.000	.0001184	.0001648
lnl1K_intensity	.0022564	.0107892	0.21	0.834	-.0188901	.0234029
l1Financial_pressure	-.0000174	4.77e-06	-3.64	0.000	-.0000267	-8.00e-06
l1Debt_to_equity	.0000183	.0000199	0.92	0.358	-.0000207	.0000572
l1Internal_financing	-.0400549	.0273066	-1.47	0.142	-.0935748	.0134651
l1Equity	-7.01e-09	2.46e-09	-2.85	0.004	-1.18e-08	-2.19e-09
l1Birth	.1358067	.0667917	2.03	0.042	.0048974	.2667159
l1EBITDA	1.41e-11	2.31e-11	0.61	0.543	-3.12e-11	5.94e-11
_cons	-.2983402	.2799282	-1.07	0.287	-.8469894	.2503089

6.1. Export Persistency

According to the models, this variable seems to be associated with a positive impact on the quantity exported by a firm. Moreover and as predictable, it is also connected with the probability of exporting in the

period that follows. These results are in line with Sinani and Hobdari (2008) findings in which "past exporting experience" plays a great role in the decision of giving continuity to this economic activity. Moreover, operating in an export-oriented industry increases the likelihood of competing in international markets and, as described in the general statistics, the Chemical sector exports' are about 11% of the Portuguese total.

This way, one must conclude that all else equal, a firm that exported in the previous year has, on average, an associated probability of exporting 22.8% higher than those who did not export before. Regarding the second model, on average, and keeping all else constant, a firm that exported in the previous year is associated with more 19.16% of total exports than those who did not display this type of past behaviour.

6.2. Share of Investment in Innovation

In what concerns this variable, results go in line with the literature found. Indeed, firms that invest on innovation not only depict higher probability of exporting in the following period but also export more.

The variable "Innovation" was generated as the sum of the investment made in R&D, intangible assets, goodwill and of industrial property. The share aimed to eliminate any scale-dependence. Bearing in mind that this industry has, in massive weight, multinational companies plus the fact that no great investments have been done during the period of analysis, it was expectable for this indicator not to have a huge coefficient. Differences between the results obtained and the expectations can be justified due to heterogeneity in the sample.

6.3. Capital Intensity

Although the sector under analysis is very capital intensive, this variable is only statistically significant in what concerns the decision of how much to export. Unlike the results of most of the literature this variable displays an inverted U shape meaning that, capital intensity only starts being associated with an increase in the likelihood of exporting after a certain threshold. Guner et al (2010) also found less robust results concerning the positive impact of this variable.

6.4. Productivity

Following the reasoning presented by Altomonte et al (2012), this study opted to use the Total Factor Productivity (TFP), calculated according to the method of Levinsohn and Petrin, to capture a firm's productivity. The TFP variable is said to be, in agreement with the results found, positively linked to total exports. However, bearing in mind the output table, it is also notorious that it does not seem to have any explanatory power in what concerns the decision of exporting. These incongruous results are consistent with the reality of the Chemical sector.

In the Linear Probability Model, since the independent variable is a dummy, the results are mainly driven by firms in advanced phases of the chain value because the majority of the sample collected is composed by companies that produce Specialties. This way and due to the presence of Specialties (Group 2 described in Chapter 5), it is natural for them not to invest in techniques to improve productivity since they are already integrated in phases of the chain value in which there is a wide range of variety and diversity of products. Due to this fact, other critical dimensions apart from productivity emerge in order to explain the exporting status.

In the second model, which explains quantity exported, productivity improvements may be more relevant, as firms holding larger values of exports produce commodities (Group 1), where competitiveness is more intensive (the same product is produced worldwide).

According to literature productivity is a central trigger of competitiveness and exports. However the previous regressions' results do not support that statement.

One must note that, there is a huge limitation coming from this variable. As found by other authors, a relation of reverse causality can be attributed to productivity and total export. This is seen as a huge drawback in the sense that it brings endogeneity issues that interfere with the causality attributed to the models.

6.5. Labour Cost

As stated in the Literature Review section (Chapter 3) there is a positive correlation between the wage level payed firms and export performance. Such statement was corroborated with this study. Indeed, on average and keeping everything constant, an increase of 1% in the labour cost is associated with an increase of 27.17% of the total exports. Once more, it must be noticed that causality may be reversed or even may flow in both directions indicating a possible deviation from the departing point at which firms would increase the wages paid after start exporting.

As described previously, Labour Cost refers to total wage bill and therefore an increase in labour expenses may happen either due to higher wages per employee or higher number of employees. Consequently, one may be careful when interpreting the effect of wages in the Chemical sector.

6.6. Fixed Tangible Assets

As the Chemical sector is strongly dependent on capital and machinery plays a crucial role, tangible assets are of great importance. According to Hur et al (2004) countries with relatively well developed financial sector have a comparative advantage in industries characterized by intangible assets while countries with poorer financial development have comparative advantage in industries characterized by tangible assets.

Empirically, an increase of 1% in the tangible assets is associated with 13.53% more of total exports. Regarding the literature, this suggests that Portugal could eventually be seen as country with lack of financial development.

6.7. Financial Indicators

The literature is assertive in saying that financial pressure impacts negatively firms' performances. Bellone et al (2009) confirm that a firm's financial pressure can limit its performance: it can work as a barrier when acquiring more debt constraining the possibility of improving competitiveness.

In the models presented above, the indicator Financial Pressure only presents a significant coefficient in the model that studies the decision to export. Here, it was found a negative effect, which is supported by literature.

Another alternative financial indicators included in the analysis were Internal Financing and Debt-to-Equity. These two indicators only had statistical relevance in the model that shows the behaviour of total exports. The negative effect of Debt-to-Equity shows that a firm facing worse financial health is more likely to export less. The other indicator illustrates that with increases in its Internal Financing performance, a firm is more likely to pay its debts without incurring to external financial support, increasing this way the total quantity of exports. This is also supported by literature which states that firms in better financial health are more competitive.

These results are consistent with the reality of the Portuguese Chemical sector because, as it was previously stated, the second model is largely influenced by firms that produce commodities. Those need to have a good performance on internal financing due to the fact that, usually there is only a short time-period comprised between the production of the goods and their payments. So, it is necessary for them to produce large quantities of products only using firms' assets.

In the first model, whose reality concerns mainly the one faced by Specialties' producers, this might not appear that significant in explaining firms' competitiveness. However, financial pressure plays a role in this model. If those firms face a financial pressure too costly, they might not be able to produce and develop new products which are the core of their activity.

6.8. Diversification

The diversification proxy used acts in accordance with Mariasole findings in which it was concluded that this variable would impact competitiveness in a positive manner. Following Boehea & Jiménez (2016) thought-line, one could say that the Chemical sector would belong to the high export intensity group (which is totally plausible for the case). In fact, all else constant, exporting to several markets is linked to an abrupt increase in the percentage of total exports of a firm, when comparing with firms that do not pursuit any type of diversification. Moreover, this measure is highly statistically significant.

Diversifying is a preventive measure since it allows to spread any possible risks through several markets and so, it enables to mitigate (or even eliminate) their idiosyncratic components. Due to the fact that it is a post-export indicator, it was not taken into consideration for the Linear Probability Model because including it would be counterintuitive.

6.9. Age and Size

The variable "Age" was created to support the belief that older firms would hold greater quantities of exports than younger ones. This was a pretty straightforward expectation since all literature analysed supported such information.

Surprisingly, it turned out that there is no statistical significance in what concerns firms' age and both their export status and their total quantity exported. According to information provided by *APQuímica* the majority number of companies was, more or less, created at the same time and so, it is not that difficult for this indicator not to have any influence on the dependent variable of the models. Moreover, the period of analysis may be too short to validate such statement (it ranges between 2010 and 2016), such issue may present itself as a possible constraint.

Nonetheless, attention must be paid to the fact that the variable “Birth”, a dummy that takes value one if the firm was born in that year, turned out to be relevant in the LPM model suggesting that, firms engage in this type of activities since their early stages. This is in line with reality because the segment characterized by Specialties’ producers, covers new firms, for example start-ups, that by introducing innovative products are competing internationally.

Moving on to the next variable, the literature is controversial regarding the relationship between a firm’s dimension and competitiveness. Conclusions taken from the models are in line with Caloff (1994) and Moen (1999) findings in the sense that size should not be considered a major barrier when undertaking export activities.

Overall, the feedback obtained from *APQuímica* is that such results are not a surprise since no matter how old firms are or if they are either large or small, firms operating in this sector are, at a large scale, insert on Global Value Chains since the very beginning.

7. Conclusions, Policy Recommendations and Further Research

The aim of this paper was to investigate the determinants of competitiveness in the Portuguese Chemical sector. A two-step approach was taken. The first consist of a regression aiming to study what features affect firms’ decisions about their export status. Secondly, a Fixed Effect model was designed to explain what influences the total quantity exported.

The authors findings depart slightly from the literature results.. While, according to the most studies competitiveness’ determinants vary across firms depending on dimension and age, in the Chemical industry results are scale-invariant and do not depend on firms’ age either. However, the fact that firms engage in export activities since the very beginning (new born companies who are already classified as exporters) was found to be significant in explaining export performance.

As predictable, variables such as persistency and share of investment in innovation, are associated with both an increase in the likelihood of exporting and a positive impact in total exports. Other regressors like capital intensity, TFP, the cost of labour and export diversification were only determinants for the total quantity exported.

The analysis performed allowed deriving set of recommendations that might be useful to improve the competitiveness of the sector. Regarding investment on innovation it could be beneficial to strengthen the relationships between firms and universities or engage in more programs that could provide/finance or subsidies to innovation. As stated before, since the sector is capital intensive and depends a lot on machinery to conduct its activities, acquiring new and more efficient equipment (for example, in order to use less electricity) could also boost its performance. Furthermore, firms should take advantage of international trade agreements, establish new trading partners and integrate in new global value chains. Diversifying the destination of exports is associated with positive impacts and risk diversification.

The analysis presented must be interpreted in a careful way since, just like in any other study, limitations can be outlined. The first constraint that needs to be highlighted is the short-coming period of analysis. If only the time period was wider, the robustness of the results would increase considerably. Likewise, part of the time-range studied namely from 2010 to 2013, covers the Economic crisis which could have implications on the conclusions of the models.

Another limitation is the fact that no data was available for the variable “Subsidies”. Based on the literature review, the authors believe that such variable would impact positively the competitiveness of the industry.

Last but not least, it is crucial to emphasize that correlation is not causality. Due to the possible presence of endogeneity, explicitly as a result of variables such as productivity (as mention on Chapter 6) in which there is evidence of simultaneity, no causality can be inferred from the estimated coefficients.

Further research can be done on this topic, namely, to infer causality between the regressors and the dependent variables. In addition, it would be interesting to compare the Portuguese performance with that of the top ranked European countries in the world Chemical sales. Moreover, research that benefit from databases with more information/variables available would be interesting to conduct.

References

Altomonte, Carlo, Aquilante, Tommaso, and Ottaviano, Gianmarco. "The triggers of competitiveness: The EFIGE cross-country report". Bruegel Blueprint series, Volume XVII (2012).

Alvarez, Roberto, and Ricardo A. Lopez. "Is Exporting a Source of Productivity Spillovers?" SSRN Electronic Journal, 2006.

Bannò, Mariasole, Lucia Piscitello, and Celeste Amorim Varum. "The Impact of Public Support on SMEs Outward FDI: Evidence from Italy." Journal of Small Business Management 52, no. 1 (2013): 22-38.

Batista, Fábio, Matos, José, and Matos, Miguel. "Assessing the Competitiveness of the Portuguese Footwear Sector". 2017.

Bellone, Flora, Patrick Musso, Lionel Nesta, and Stefano Schiavo. "Financial Constraints and Firm Export Behavior." SSRN Electronic Journal, 2009.

Bernard, Andrew B., J. Bradford Jensen, and Robert Z. Lawrence. "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987." Brookings Papers on Economic Activity. Microeconomics 1995 (1995): 67.

Boehe, Dirk Michael, and Alfredo Jiménez. "How Does the Geographic Export Diversification–performance Relationship Vary at Different Levels of Export Intensity?" International Business Review 25, no. 6 (2016): 1262-272.

Biesebroeck, Johannes Van. "Exporting Raises Productivity in Sub-Saharan African Manufacturing Plants." 2003.

Boehe, Dirk Michael, and Alfredo Jiménez. "How Does the Geographic Export Diversification–performance Relationship Vary at Different Levels of Export Intensity?" International Business Review 25, no. 6 (2016): 1262-272.

Bravo-Ortega, Claudio, Jose Miguel Benavente, and Álvaro González. "Innovation, Exports, and Productivity: Learning and Self-Selection in Chile." Emerging Markets Finance and Trade 50, no. Sup1 (2014): 68-95.

Burgel, Oliver, and Gordon C. Murray. "The International Market Entry Choices of Start-Up Companies in High-Technology Industries." Journal of International Marketing 8, no. 2 (2000): 33-62.

Bruderl, Josef, and Rudolf Schussler. "Organizational Mortality: The Liabilities of Newness and Adolescence." Administrative Science Quarterly 35, no. 3 (1990): 530.

Calof, Jonathan L. "The Relationship Between Firm Size and Export Behavior Revisited." Journal of International Business Studies 25, no. 2 (1994): 367-87. doi:10.1057/palgrave.jibs.8490205.

Carvalho, Pedro, and Marinho, João. "Assessing the Competitiveness of the Portuguese Metalworking Sector". 2018.

Chadha, Alka. "Product Cycles, Innovation, and Exports: A Study of Indian Pharmaceuticals." World Development 37, no. 9 (2009): 1478-483.

Chatla, Suneel, and Galit Shmueli. "Linear Probability Models (LPM) and Big Data: The Good, the Bad, and the Ugly." SSRN Electronic Journal, 2013.

Chong, Terence, Law, Daniel, and Yao, Feng. "The debt-equity choice of Japanese firms". International Journal of Business and Society, Vol. 17 No. 2 (2016), 2016, 167-182

Correia, Ana, and Gouveia, Ana. "What Determines Firm-level Export Capacity? Evidence from Portuguese firms". 2016.

Estrin, Saul, Klaus E. Meyer, Mike Wright, and Francesca Foliano. "Export Propensity and Intensity of Subsidiaries in Emerging Economies." International Business Review 17, no. 5 (2008): 574-86.

Fabling, Richard, and Lynda Sanderson. "Exporting and Firm Performance: Market Entry, Investment and Expansion." Journal of International Economics 89, no. 2 (2013): 422-31.

Greenaway, David, Alessandra Guariglia, and Richard Kneller. "Do Financial Factors Affect Exporting Decisions?" SSRN Electronic Journal, 2005.

Greenaway, David, and Richard Kneller. "Exporting and productivity in the United Kingdom". Oxford Review of Economic Policy vol. 20 no. 3 (2004).

Guner, Berrin, Jooh Lee, and Berhe Habte-Giorgis. "Strategies Orientation and Export Performance." Journal of Transnational Management 12, no. 2 (2007): 61-77.

Guner, Berrin, Jooh, Lee, and Lucius, Harold. "The impact of industry characteristics on export performance: A three country study". International Journal of Business and Economics Perspectives. 2010.

Haque, Nadeem Ul Ul, and M. Ali Kemal. "Impact of Export Subsidies on Pakistans Exports." SSRN Electronic Journal, 2007.

Hur, Jung, Manoj Raj, and Yohanes E. Riyanto. "Finance and Trade: A Cross-country Empirical Analysis on the Impact of Financial Development and Asset Tangibility on International Trade." World Development 34, no. 10 (2006): 1728-741.

Ito, Kiyohiko, and Vladimir Pucik. "R&D Spending, Domestic Competition, and Export Performance of Japanese Manufacturing Firms." Strategic Management Journal 14, no. 1 (1993): 61-75.

Koc, Erdogan. "A Review of Country Tourism Competitiveness, Research Performance and Overall Country Competitiveness." Competitiveness Review 19, no. 2 (2009): 119-33.

Krugman, P. "Making Sense of the Competitiveness Debate." Oxford Review of Economic Policy 12, no. 3 (1996): 17-25.

Lamotte, Olivier, and Ana Colovic. "Innovation and Internationalization of Young Entrepreneurial Firms." SSRN Electronic Journal, 2013.

Levinsohn, James, and Amil Petrin. "Estimating Production Functions Using Inputs to Control for Unobservables." 2000.

Lien, Donald, and David Rearden. "Practitioners Corner: A Remark on 'An Advantage of the Linear Probability Model over Probit or Logit'." Oxford Bulletin of Economics and Statistics 52, no. 2 (2009): 223-25.

Loecker, Jan De, and Frederic Warzynski. "Markups and Firm-level Export Status." 2009.

Moen, O. "The Relationship Between Firm Size, Competitive Advantages and Export Performance Revisited." International Small Business Journal 18, no. 1 (1999): 53-72.

Panagariya, Arvind. "Evaluating the Case for Export Subsidies." Policy Research Working Papers, 2000.

Safi, Abed El-Azez. "Individual Paper of The Effect of Subsidies on Trade". 2010.

Sinani, Evis, and Bersant Hobdari. "Export Market Participation with Sunk Costs and Firm Heterogeneity." Applied Economics 42, no. 25 (2010): 3195-207.

Schank, Thorsten, Claus Schnabel, and Joachim Wagner. "Higher Wages in Exporting Firms: Self-selection, Export Effect, or Both? First Evidence from Linked Employer-employee Data." Review of World Economics 146, no. 2 (2010): 303-22.

Sousa, Carlos M.p., Francisco J. Martínez-López, and Filipe Coelho. "The Determinants of Export Performance: A Review of the Research in the Literature between 1998 and 2005." International Journal of Management Reviews, 2009.

Wagner, Joachim. "A Note on Firm Age and the Margins of Exports: First Evidence from Germany." The International Trade Journal 29, no. 2 (2014): 93-102.

Wooldridge, Jeffrey M. Econometric Analysis of Cross Section and Panel Data. Cambridge, MA: MIT Press, 2011.