CATÓLICA LISBON
BUSINESS & ECONOMICS

Inventory behaviour and an aggressive pricing strategy in the Portuguese manufacturing industry

Jorge Pereira de Sousa

Dissertation written under the supervision of Ricardo Reis

Dissertation submitted in partial fulfilment of requirements for the MSc in Finance, at the Universidade Católica Portuguesa, May 29th of 2018.

Thesis: "Inventory behaviour and an aggressive pricing strategy in the Portuguese manufacturing industry"

Author: Jorge Gustavo Pereira de Sousa

Abstract

The present thesis analyses the relation between inventory levels and market price variations in the Portuguese manufacturing industry during the period from 2006 to 2016. During financial downturns, smaller firms rely on inventory as an internal source of funding. By reducing prices, firms hope to quickly sell stocks and obtain the necessary cash to face their financial obligations and avoid bankruptcy. To study this phenomenon is adopted a sector perspective, in which small and medium-sized firms are analysed separately. In both cases, the average inventory level is regressed on manufacturing market price variations. The model is tested for endogeneity, normal distribution, jointly significance and robustness; additionally, for consistency purposes, were computed distinct regression model verions. Results show that inventory has a negative effect on market prices, as expected by the economic theory. Moreover, according to estimation results, the negative impact of inventory seems to be greater in the case of medium-sized firms. Nevertheless, these estimation coefficients are not statistically significant. In a first instance, this phenomenon could be seen as an early warning sign for financial difficulties in the industry. Notwithstanding, all the assumptions and limitations regarding data availability, collection and computation contribute to a loss of results' precision.

Resumo

Nesta tese é analisada a relação entre o nível de inventários e as variações de preços de mercado na indústria transformadora portuguesa durante o período 2006-2016. Durante recessões económicas, as pequenas empresas são forçadas a recorrer aos inventários como fonte interna de financiamento, reduzindo preços de modo a estimular vendas e obter a liquidez necessária à sua sobrevivência. Para o estudo deste fenómeno é adotada uma perspetiva setorial, e as pequenas e médias empresas são analisadas separadamente. Em ambos os casos regrediu-se o nível médio de inventários sobre variações anuais no nível de preços de mercado da indústria transformadora. Após a realização de vários testes para controlo da endogeneidade, distribuição normal, significância e robustez, e após a computação de várias regressões de modo a conferir consistência aos resultados, verificou-se que o nível de inventários tem um impacto negativo sobre os preços de mercado, estando em linha com o previsto pela teoria económica. Adicionalmente, observou-se que a magnitude deste efeito negativo é ligeiramente superior no caso das médias empresas. No entanto, estes coeficientes de estimação não são estatisticamente significativos. Numa primeira análise, este fenómeno poderá ser visto como um indicador de que a indústria poderá estar a passar por dificuldades financeiras. Contudo, as limitações relacionadas com a recolha, disponibilidade e tratamento dos dados fornecidos nas bases de dados conduzem a uma perda de eficiência das conclusões obtidas.

Key words: financial distress, internal liquidity source, inventory behaviour, aggressive pricing behaviour, survival, small and median enterprises, manufacturing industry

Contents list

1. Introduction

Financial distress is among the most important areas in the field of corporate finance, and a great understanding of this matter is vital in order to better manage firms and prevent them to go bankrupt. If firm owners, managers, shareholders and all the other stakeholders possess greater knowledge in this matter, they will be able to predict downturns more precisely and, consequently, be able to make better decisions, know how to react under financial pressure and, eventually, have higher changes to lead firms out of a financial distress situation.

In this sense, there has been done a substantial amount of research on financial distress. Academics and researchers have covered a wide variety of areas, such as financial distress risk, direct and indirect costs, financial constraints, pricing behaviour, corporate restructuring, reforms and resolutions of financial distress, evolution of cash-flows, competition during recessions and the development financial distress prediction models. According to Chen *et al.* (1995), a firm is in financial distress when the total value of its assets is less than the total value of its obligations. In other words, the total liquidity available to the firm is not enough to cover the total value of creditors' claims, which *"can lead to forced liquidation or bankruptcy"*. The availability of liquidity and the access to bank credit are key factors to avoid bankruptcy allowing firms to overcome economic and financial downturns (Hendel, 1996). Hence, there is a strong connection between liquidity and survival. Additionally, when a firm is expecting to enter a situation of financial distress, it has more chances of survival if is able to responds and takes measures immediately (Koh *et al.,* 2015). Therefore, the better provided with information firms' decision-makers are, the better are firms' survival probabilities.

The economic issue analysed in the present thesis lies on firms' competition during recessions. Th study aims to shed some light on aggressive pricing as a source of funding, focusing on the economic relationship between aggressive pricing behaviour and inventory sales. The economic rationale behind this approach is that firms can consider inventory as an internal source of liquidity (Carpenter *et al.*, 1995). Some theorize that liquidity-constrained firms do not have access to capital markets and other "usual" sources of funding; therefore, they must rely on other alternatives such as inventory in order to collect the necessary liquidity to pay their financial obligations and stay in business.

In fact, during downturns, smaller firms find themselves in a critical situation and, in an attempt to respond to demand and market conditions, are forced to reduce price to quickly sell inventory and obtain cash (Hendel, 1996). This process of reshaping their asset composition leads to a smoothing effect on sales across the economic cycle and to a general decrease on market price levels, because non-liquidity-constrained firms are forced to also reduce prices to be able to compete in the market.

Prior literature lies on the base of the current study, specially Hendel's 1996 and 1997 research. However, this empirical investigation aims to take an innovative approach and differentiate itself from existing literature, with the intention of contributing with new evidences and as an attempt to add value to the enhancement of this economic issue. Thus, the object under analysis, the selected timeframe and the methodology applied on this empirical approach are different from past works: (1) it is analysed the relation of aggressive pricing and inventory behaviours over the last decade (2006 to 2016), which encompasses the beginning of the financial crisis and the latter recovery period; (2) the focus lies on the Portuguese manufacturing industry, where manufacturing CAE code sectors are treated as individual firms; (3) the analysis is applied to small and median enterprises (SME from now on), analysing them separately; (4) the variables included in the model are expressed in sector average values; and (5) the different sources of liquidity at a firm's disposal and the different input costs (such as material costs, electricity, steam, cold air, hot and cold water and wages) that are likely to influence market prices are included as explanatory variables. These peculiarities of the present approach are fully explained throughout this paper.

In this sense, this study aims to check if this economic reasoning can be verified in the Portuguese manufacturing industry during the world economic crisis that severely affected Europe, the EU and, specifically, the Portuguese economy and its firms. The econometric model used tries to comprehend if there is any connection between inventory behaviour and the manufacturing market price.

The main motivation behind this empirical study is to check if there any evidence of aggressive pricing and inventory behaviour on the Portuguese manufacturing industry, which is a key industry for the Portuguese economy. Moreover, it is proposed to analyse the role played by inventory – as a source of liquidity – on setting market prices, and the subsequent impact on the volume of sales, as well as the effects and evolution of other

funding sources over the period of the world economic crisis. As small-sized and medium-sized firms are studied separately, their effects can be compared and checked which one has a more significant impact on market prices.

From the regression' outputs, it is possible to identify that inventory has a negative effect over manufacturing market prices, in line with the economic theory dictates. Furthermore, it is shown that the negative impact on manufacturing market prices is slightly greater in the case of medium-sized firm, comparatively to the effect generated by small-sized firms.

Additionally, according to the results of the current empirical thesis, in the context of the Portuguese manufacturing industry, the shift from a competitive to a survival behaviour, *i.e.* the aggressive pricing behaviour adopted by SME in the early years of a recession period, could be seen as an early warning sign for liquidity shortages and, consequently, a potential predictor of bankruptcy processes in the market. In this sense, managers would benefit from identifying this behaviour, as it would alert them to take the required measures beforehand to forearm bankruptcy situation. However, the approach's limitations need to be overtaken in order to enable these conclusions to reach a higher level of economic significance.

This thesis is organized in different sections as it follows: in Section 2 is exposed and reviewed the main literature on financial distress and on firms' behaviour under recessionary periods; Section 3 states the aim of the study, explaining the process behind data and timeframe selection, the construction of the econometric model and describing the methodology applied; in Section 4, the summary statistics of the variables of interest included in the model, as well as the most significant outputs and results of the regression models computed, are described and discussed; and finally, Section 6 provides the final summary of the conclusions and considerations of this paper.

2. Literature review

The pricing behaviour in Portugal, as well as, in the rest of the countries in the euro area is similar, as Martins (2005) and Fabiani *et al.* (2005) demonstrate in their papers. Traditionally, there are two approaches for firms' pricing behaviour: time-dependent rules and state-dependent rules. In the first approach, firms review prices periodically and independently of the conditions of the economy. On the other hand, under state-dependent rules firms only review their prices as a response to economic shifts in market conditions. This reaction may vary depending on the nature and size of the shocks.

Fabiani *et al.* (2005) findings are robust across euro zone countries. According to these authors' research, one third of firms present in the euro area use time-dependent pricing rules, while the other two thirds follow state-dependent pricing rules. Evidence shows that around 50 percent of euro zone firms adopt a forward-looking pricing behaviour, taking into account *"both past and forward expected economic developments"*. Martins (2005) showed that the majority of firms present in the Portuguese market *"follow time –dependent price reviewing"* approaches.

Analysing more specifically the Portuguese environment, Martins (2005) demonstrates the existence of a significant degree of price stickiness. In his research, he observed that most firms *"do not review or change their prices more than once a year"*, but after suffering specific shocks *"only one-third stick to that practice"*. In addition to these facts, he identified *"significant time lags in firms' price reactions to cost and demand shocks"*. Notwithstanding, Martins noticed that *"firms seem to respond faster to cost shocks"* than to demand shocks, and that the response is faster in manufacturing rather than in services. Similar results were found for the euro zone, as research demonstrates that price reviews occur, on average, between one and three times a year, being services firms the ones that recorded a higher level of price stickiness. Martins observed, as Fabian *et al.* (2005) had already identified for the euro zone as a whole, that price stickiness seems to be higher in the services sector than in the manufacturing industry.

Several sources of price stickiness were identified in these studies, namely, the pressure of implicit contracts between firms and customers, competition prices, high proportion of fixed costs, the existence of relatively stable marginal costs and contracts that are costly to renegotiate. Initially, to set the optimal price, firms use all the available and

relevant information. After the "price reviewing stage", firms enter the so-called "price changing stage", where they verify if the deviation of the current price from the optimal one justifies a price change.

Results, from Martins (2005) and Fabiani *et al* (2005), indicate that the price reviews are more frequent than price changes. Martins also points out that the main source of infrequent price adjustments ("price stickiness") comes from the "implicit contracts" theory, as firms aim to maintain customers for a long period of time *"in order to maintain their sales more predicable"*, *e.g.* to maintain a stable inflow of cash. Implicit and explicit contracts are also the main reason for price stickiness found for firms present across euro zone markets. Finally, there are evidences that indicate that, in the Portuguese economy, the price of raw materials, demand fluctuations and competitors' price are the main factors leading to price decreases. Fabiani *et al.* (2005) also consider shifts on market conditions to be the main contributor to price decreases.

As observed for the euro area by Fabiani *et al.* (2005), in most of cases, large firms and firms facing a high level of competition review their prices more often. Approximately, 30 percent of euro zone firms' prices are influenced by competitors' prices. In this sense, markets that are more competitive force firms to change prices more frequently. As observed, price of competitors is regarded as the most relevant factor for price setting behaviour across euro zone markets.

Firms' price setting behaviour depends greatly on market characteristics, which includes the location of the main market, level of competition and the relationship with customers. First, domestic and foreign markets require different approaches. In Portugal, around three-quarters of Portuguese firms are mainly present in the domestic market with the majority being smaller firms and belonging in the services sector. Second, *"price stickiness is only possible if there is some departure from perfect competition"*. With a lower level of competitors in the market, firms have to maintain prices while marginal costs change. In general, in the Portuguese reality, *"firms seem to have limited market power"*; however, large firms experience a lower degree of competition. Third, the relationship with customers (long-standing *vs* occasional) also conditions firms' pricing behaviour, in line with Martins (2005). According to Hall *et al.*(1997), loyal customers lead firms not to revise prices often, while Martins argues that log-term customers act *"as a kind of implicit contract"*, which leads to a stabilization of prices, since firms seek to increase customers' loyalty.

The Portuguese price setting behaviour, as seen in Dias *et al.* (2004)'s research is characterized, on one hand, by 40 percent of total price changes being price decreases, and on the other hand, by similar magnitude of price increases and price decreases.

A firm finds itself in a situation of financial distress when is unable to generate the required operating cash flows, and/ or the value of its assets is so reduced that the firm does not have the capacity to successfully cover its debt obligations. In this kind of situation, it is key that managers know the consequences of financial distress and choose the best course of action to avoid bankruptcy.

In this sense, to avoid and overcome a situation of financial distress, firms need cash to face their daily obligations, *e.g.* they seek liquidity on a daily basis to cover for short-run obligations. Firms change their behaviour, shifting from taking decisions to maximize their current profits to finding financing sources to obtain liquidity. Therefore, there is a trade-off between a competition behaviour and a survival behaviour (Hendel, 1996).

There are different funding sources for firms to finance themselves: through external sources, such as issuing debt or access to bank credit, and through internal sources, such as liquidation of assets or liquidation of inventories. However, not all firms are able to generate cash through the same funding channels.

For instance, large firms are perceived to generate cash flows more easily, have a higher level of collateral and be able to absorb greater negative (exogenous) impacts. Hence, this type of firms can obtain the necessary liquidity using external sources: in one hand, banks grant access to credit more willingly, and in the other hand, investors and debtholders see them as lower risk investment opportunities. In both situations, economic agents see larger firms as a safer option and as having less trouble in complying with the repayments amounts and deadlines in the future.

On the contrary, in downturns, the same scenario is not applied for the case small and median enterprises. Smaller firms are perceived to not have the necessary conditions and means to generate the funds to repay debt and loans to debtholders and banks, respectively. In other words, they are seen as liquidity-constrained firms. In this sense, external sources of financing are, normally, out of arms' reach for SME, so they must rely mainly on internal funding sources to generate the cash amounts needed for running

the daily operations and to survive. They have two choices, liquidation of assets and liquidation of inventories.

Nevertheless, the former (asset liquidation) is seen as a non-effective choice, leaving the latter (inventory liquidation) as the main and most effective source of cash flows for SME during recessionary periods. The reasoning behind this concept emerged from the results of Shleifer and Vishny (1992)'s research that dictate that, when the economy is in a downturn, is likely that a firm and its competitors find themselves in financial difficulties. Hence, firm's assets (like machinery and buildings, which are related with the economic activity developed in a specific sector) become non-liquid, because the potential buyers (the firm's competitors) are also in financial distress and do not have the necessary purchase capacity. To reinforce these results, Gertker and Gilchrist (1994) and Carpenter, Fozzari and Peterson (1994) argue that the inventory behaviour of liquidity-constrained firms is sensitive to the variations of cash flows, while the inventory behaviour of non-constrained firms is not.

Notwithstanding, these findings have some limitations, as they are only valid for industries with high levels of inventory. It does not make sense to expect this behaviour in industries with (none or) low levels of inventory, and in which the economic activity is characterized mostly by substantial levels of intangible assets. So, is foreseeable to observe these results in manufacturing and production industries rather than industries characterized by research and development activities.

In times of financial trouble, firms adapt their asset composition, increasing the weight of liquid assets and decreasing the weight of non-liquid assets. Inventory liquidation is an internal financing source where firms take short-run pricing decisions to sell inventory (the non-liquid asset) in exchange of cash (the liquid asset). In line with Hengel (1996)'s results, during financial crises, SME adopt a survival behaviour by implementing pricing decisions to decrease prices which, ultimately, lead to a smoothing effect on sales over the business cycle. Therefore, by dropping inventory prices, sales stay constant and SME hope to maintain a stable inflow of cash (in other words, liquidity) even though reducing the price too much may lead to higher debt levels further down the road. Consequently, to compete with these low prices, the other non-constrained firms in the market, including large firms, are forced to also drop their prices, which means that sector prices will tend to fall during financial downfalls. "*In*

financial distress firms price tougher, negatively influencing competition, which is forced to drive prices down (…)".

From his research, Hengel formulated some key conclusions. First, shifting to a survival behaviour implies the creation of cooperative groups, as non-constrained firms prefer to compete against wealthy enterprises because they are not forced to reduce prices. Thus, by adopting this approach, they are trying to facilitate credit access to distressed firms. Second, it is perceived that in these kind of situations, collusion in the sector breaks out, because there is an incentive to decrease prices and the first firm to do that will (in the very short-run) gain all the profits. Consequently, after one firm gives in to that incentive the other players follow, also dropping their prices, as there are no gains left to be made by holding the collusion agreement. Third, this reasoning poses as an alternative to the idea that, when large firms perceive that their small competitors are in financial distress, they drop prices to drive smaller firms out of business, as larger firms have higher margins and can absorb more losses. Thus, this raises an interesting question regarding the cause of financial difficulties in a SME' perspective: whether are low prices that generate bankruptcy, or is a situation of financial distress that is the origin of low prices.

There are also other economic theoretical models that aim to shed some light in how firms behave near bankruptcy. Some models link firms' capital structure and product market competition. In other words, they seek to identify how quantity-setter firms behave for different levels of debt. Brander and Lewis (1986) and Maksimeric (1988) show that *"higher levels of debt make firms more aggressive",* as debtholders carry the majority of risk, managers are willing to take more extreme measures to try to avoid bankruptcy. Researchers like Phillips (1995) and Chevalier (1995) link prices with debt, presenting evidences that prices fluctuate after major leverage buyouts (from now on LBO) and increase with leverage. This result comes from the fact that firms with *"illiquid capacities, (…) charge higher prices during non-recessionary periods"* in order to get the maximum amount of cash, and to be able to sustain economic recessions. Nevertheless, for industries with high levels of inventory (namely the gypsum industry), Phillips (1995) demonstrated that post-LBO prices decline, in line with the results described early in this chapter.

On a different note, Opler and Titman (1994) highlight the positive relationship between financial condition and firm performance in downturns. In their studies, they revealed

that "*if financial distress is costly, more highly leverage firms will have greater operating difficulties in downturns"*. Therefore, highly leverage firms are likely to lose their market share to their less leveraged competitors, as their losses are portrayed as a decline in sales and in market value of equity. These results are inconsistent with Hengel's model and its short-run effect of financial distress on pricing, because according to Hengel, Opler and Titman use annual data on their research, which does not allow them to capture the short-run effect.

3. Data and methodology

3.1. The issue under analysis

The economic mechanism behind this thesis is that small firms can turn to inventory as an internal source of liquidity when facing economic difficulties (Carpenter *et al.*, 1995). In this project, the main goal is to comprehend the roles of inventory and aggressive pricing behaviour of SME during recessions, which are critical periods for these firms, as they are not able to obtain, through the usual financing sources, the necessary liquidity to survive and meet their financial obligations. By reducing prices, firms attempt to *fire sell* inventory and reshape their asset composition, producing a smoothing effect on sales over the economic cycle, and keeping a stable inflow of cash (Hengel, 1996).

In this sense, the present thesis focuses on the Portuguese market, in order to check if this trade-off between a competition behaviour and a survival behaviour exists. In more detail, the focus is on the Portuguese manufacturing industry during the recent economic crisis, because it is an industry where firms have relevant levels of inventory, therefore where it is more reasonable for this economic theory to hold.

Although the methodology applied in this thesis takes inspiration on existing literature, (specially on Hendel's work from 1996 and 1997), it is sought to study the problem in an innovative way, analysing it from a sectoral perspective, treating the manufacturing industry's CAE code sectors as individual representative firms. With this mindset, the investigation is adapted to the information and data made available in official and reliable databases. An econometric model has been created with different independent variables, and several financing sources have been taken into consideration, namely equity, debt and financial investments, as well as liquid assets such as cash and bank deposits.

The main purpose of the econometric model is to comprehend if there is any connection between inventory and the manufacturing market price. Nevertheless, other factors that may influence market prices are also taken into consideration. The same line of thinking is applied to both small and medium-sized firms, as their effects on market prices are analysed separately.

In this context, the current study takes this economic issue in a new perspective by adopting a new methodology and setting itself apart from what has been done so far in the economic literature. Firstly, it is applied over the timeframe of the recent economic and financial crisis. Secondly, the object under analysis is the Portuguese manufacturing industry, which is one of the most prominent sectors in Portugal – one of the most affected economies of the European Union, along with Greece, Ireland, Italy and Spain. Thirdly, it studies the economic issue considering sector average firms instead of individual firms, as usually done in economic theory.

Nevertheless, by taking this innovative approach, were encountered some limitations, which prevented this thesis to produce stronger results. In this sense, the lack of variables and available data for a wide timespan imposed a major issue during the initial stages of the current study. The inability to separate price changes, costs and input prices for each CAE sector compromised the capacity to produce precise outputs and better compare CAE sectors. Additionally, the lack of years with available CAE sector information limited the selection of the timeframe.

3.2. Sample and timeframe selection

The data selected refers to sector averages and was collected from Banco de Portugal website's sectoral analysis (https://www.bportugal.pt/qesweb/UI/QSApplication.aspx?mlid=1193). For the present approach, were selected the thirteen most representative 2-digit CAE codes from the manufacturing industry with available information for the selected timeframe, *i.e.* the 2-digit CAE codes with the highest number of SME. The choice to focus on SME lies on two main reasons: first, according to economic theory, during recessions, smaller firms influence prices due to their aggressive pricing strategy as an attempt to generate liquidity (Hendel, 1996); and second, the Portuguese industrial tissue is mostly characterized by SME. The selected 2-digit CAE code for this empirical study are the following:

- CAE 10 – Manufacture of food products;
- CAE 13 – Manufacture of textiles;
- CAE 14 – Manufacture of wearing apparel;
- CAE 15 – Manufacture of leather and related products;

- CAE 16 – Manufacture of wood and of products of wood and cork, except furniture;
- CAE 20 – Manufacture of chemicals, chemical products and man-made fibers, except pharmaceutical products;
- CAE 22 – Manufacture of rubber and plastic products;
- CAE 23 – Manufacture of other non-metallic mineral products;
- CAE 25 – Manufacture of fabricated metal products, except machinery and equipment;
- CAE 27 – Manufacture of electrical equipment;
- CAE 28 – Manufacture of machinery and equipment n.e.c.;
- CAE 29 – Manufacture of motor vehicles, trailers, semi-trailers and parts and accessories for motor vehicles; and
- CAE 31 – Manufacture of furniture.

The data extracted from Banco de Portugal's database refers to an 11-year time period, from 2006 to 2016. The selected timeframe covers the world financial crisis, which has its origins in the collapse of the Lehman Brothers Holdings Inc. bank in September 2007. From that point on, the financial crisis has spread out through the world economy and caused a deep economic crisis on the European Union and on European economies, especially Portugal, which was forced to implement several austerity measures and was subjected to a bailout program imposed by the International Monetary Fund (IMF), which the country is still recovering from.

Therefore, during the recession and difficult economic environment lived in Portugal, that characterize the period under analysis were reunited the conditions for the Portuguese SME to experience financial constraints. In this sense, it is during these years that the economic theory under study might hold, as SME are most likely to rely on aggressive pricing to obtain the liquidity necessary to survive.

3.3. Model

$$Pr_{i,t} = \alpha + \beta_1 . PrIn_{i,t} + \beta_2 . MC_{i,t} + \beta_3 . Log(Inventory)_{i,t} + \beta_4 . Log(Cash)_{i,t} + \beta_5 . Log(Invest)_{i,t} + \beta_5 . Log(Equity)_{i,t} + \beta_6 . Log(Ltdebt)_{i,t} + \beta_7 . Log(Stdebt)_{i,t} + \beta_9 . Log(Wages)_{i,t} + \delta . D_i + \theta . D_t + \varepsilon_{i,t}$$

See the glossary present in Table 8 that contains the definitions of the variables included in the model.

3.4. Variables

3.4.1. Dependent Variable

Yearly Manufacturing Price Changes (*Pr*) – Similarly to Hendel's approach, in order to measure the yearly price variations, the price index of manufacturing products was extracted from *Pordata*'s database (https://www.pordata.pt/Portugal/%C3%8Dndice+de+pre%C3%A7os+na+produ%C3%A7%C3%A3o+industrial-2314). This price index has 2006 as the base year and measures the yearly percentage change of manufacturing product prices in the Portuguese market.

Due to the lack of available information, it was not possible to select different price indexes that would measure, more accurately, price changes on each CAE sector within the manufacturing industry selected in this investigation. Therefore, this constitutes one limitation of the current approach representing an issue that can be improved in future researches.

3.4.2. Explanatory Variables

The sectoral information regarding each one of the selected 2-digit CAE codes, as previously mention, was collected from Banco de Portugal sector analysis' database. Since the main objective is to study price changes as a consequence of the process of obtaining liquidity through inventory, during the computation of this model, was decided to include the different sources of liquidity at a firm's disposal, as well as other factors that (in this perspective and similarly to Hendel's 1997 methodology) also have a significant impact in setting market prices. These factors include, for example, costs with materials used during the manufacturing process or personnel costs, such as wages. In this sense, the econometric model includes the following independent variables:

I) Inventory *(Inventory*) is the key variable of this approach and it represents the total value of inventory held by the average firm for each CAE sector. Since, for liquidity-constrained firms, pricing can be used as a mechanism to obtain liquidity, higher the level of inventory, greater is the ability to

turn it into cash. Under recessions, financially constrained firms will tend to decrease prices to sell inventory. Hence, in this perspective, this variable is expected to have a negative impact on market price changes. It aims to capture the same effect of the average inventory to sales ratio (IS) present in Hendel's model.

II) Equity (*Equity*), Long-term debt (*Ltdebt*), Short-term debt (*Stdebt*) and Financial investments (*Invest*) refer to firms' financing sources other than inventory. These are in fact the external financing channels firms normally rely on to get cash. Nevertheless, when financial obligations begin to accumulate, and firms are experiencing difficulties in their businesses, they send negative signs to the market and its players. Consequently, these funding sources "start to disappear", forcing firms to find alternatives and quickly sell inventory. In this sense, these independent variables allow to evaluate how these liquidity sources evolve over the years, in a sector average perspective.

Taking into consideration the financial matter under analysis, firms are able to obtain liquidity more easily from these "usual" sources when they are not in a liquidity-constrained situation. In that scenario, firms are not forced to decrease prices to sell inventory. Therefore, these variables are expected to have a positive effect on price changes.

III) Cash and bank deposits (*Cash*) are the most liquid asset hold by firms, and constitute what firms seek to face their financial obligations. It represents the total amount of liquid funds held by the average firm in each CAE sector. In the context of the present thesis, *Cash* is expected to have a positive effect on the dependent variable because, if a firm hold large amounts of cash, it does not need to rapidly sell inventory to obtain liquidity.

IV) Wages (*Wages*) refer to the sectorial average operating costs of salaries paid by firms to employees during the manufacturing process. *Wages* are expected to lead to a positive impact on price changes, because higher the

costs incurred during the operating process, higher will be the price of the output.

V) Material costs (*MC*) refer to the average variation of prices of manufacturing inputs, such as the case of raw materials and other finished products used during the manufacturing process. With the available information, it was defined the inflation rate of the overall economy as a proxy to measure these material cost changes. In this sense, it has been have assumed that the price of manufacturing inputs follows the average evolution of the prices of the Portuguese market. Therefore, the yearly inflation rate was collected from *Pordata*'s database. This variable measures the yearly percentage change on market prices, and it has 2006 as its base year.

MC are expected to have a positive effect on price changes, since with an increase on the price of inputs, the output's price will, ultimately, be superior.

VI) Price index of electricity, natural gas, hot and cold water, steam and cold air (*PrIn*) refers to the average manufacturing operating costs of these other inputs used on the manufacturing activities, and on firms' normal operations. As it happens with the previous variable, this price index was also collected from *Pordata*'s database, and has 2006 as its base year. It measures the yearly percentage change on prices of those specific inputs and, like the aforementioned cost variables, is expected to have a positive effect on price changes, because increases on costs during the manufacturing process will lead to higher output prices.

Wages, MC and *PrIn* aim to capture a similar effect as the variable materials price index (PM) present in Hendel's model.

VII) Control variables have also been included in the model, such as year and CAE characteristics dummies, to capture the individual and time-level effects. Although this analysis only focus on the Portuguese manufacturing industry, each of the CAE sectors have their own demand and supply functions, use different inputs, have significant different cost structures, are

at different stages on the technologic and automatization process, attracted investors differently. Hence, the CAE dummy variables aim to capture the sector specific characteristics that vary for each sector. On the other hand, the year dummy variables aim to capture the different stages of the financial crisis that had a gradual effect on the Portuguese economy. In this sense, by including year dummy variables, as the impact of the financial crisis intensifies the effects of the different liquidity sources can be compared to the initial period (Year 2006) – before the beginning of the world financial crisis.

Equity, Stdebt, Ltdebt, Invest, Cash, as well as , the control variables present in this econometric model aim to capture similar industry specific characteristics like the industry controls included by Hendel in his approach.

3.5. Methodology

In this thesis, the econometric model seeks to understand the effects of the different sources of liquidity at a firm's disposal on market price variations, specifically, on manufacturing market price changes. The econometric model created in this investigation takes into consideration previous approaches on this matter, namely, Hendel's studies of 1996 and 1997. Nevertheless, the approach taken has been adapted to the available information and variables that could be collected from reliable and official databases.

Therefore, it is a completely new approach with an econometric model that is different from what has been done so far. Furthermore, the study is applied to a recent timeframe – which encompasses the recent financial crisis that affected the world economy, analysing the issue in a yearly basis and on a sector average perspective, considering each manufacturing CAE sector as a unique firm. Additionally, small and median enterprises are studied separately, due to the fact that this is how the available information, regarding the Portuguese firms, is presented on the databases.

In a first stage of this empirical approach, an analysis to all the descriptive statistics of the selected variables was performed, for both cases of small-sized and medium-sized enterprises.

The second stage consisted in executing several estimation methods to evaluate which regression model's results would better fit the collected data. In the econometric model, to control for the presence of heteroskedasticity and as an attempt to be closer to a normal distribution (and minimize the effect of outliers), the natural logarithm was computed for some explanatory variables, and a Winsor process was applied to all variables, with a cut-off of 1.5%. Additionally, to prevent the presence of heteroskedasticity and to control for inefficient estimators, all regressions were computed with robust estimators.

For consistency and robustness purposes, and to give power to the model's result, the estimation models were also computed: (1) with the original variables without any treatment, *i.e.* before computing the natural logarithm and applying the Winsor process; (2) with only the natural logarithm applied to the explanatory variables; and (3) with some explanatory variables divided by the total value of assets, in order to control for size in each manufacturing CAE sector, since one small-sized firm in a CAE sector could be perceived as a median-sized enterprise in another sector. Posteriorly, with the objective of giving economic significance to this thesis' conclusions, the results from these regressions were compared with the initial estimation output.

The same procedures were applied separately for small and median enterprises, and their results were compared to assess which one has a more significant impact on manufacturing market prices changes.

In the following section, the results obtained in each stage of the empirical testing are explained and interpreted.

4. Results' analysis

In this section is proceeded to the analysis and interpretation of the main results from the regression models executed as described in the previous chapter, contextualizing the numeric results according to the economic subject of the present thesis.

In both cases, of small and median enterprises, the panel data was strongly balanced with a total of 143 observations each. This means that each CAE code on the dataset contains a time variable and it does not have any missing value from the panel data.

4.1. Summary statistics

Before computing any regressions, the first step taken was briefly analyse the descriptive statistics of the main variables included in the econometric model.

4.1.1. Portuguese manufacturing industry average variables

According with the selected data (See Table 1), from 2006 to 2016, the average manufacturing industry market price was approximately 90.45% of 2006´s manufacturing industry market price level. In other words, in the Portuguese manufacturing industry during the selected 11-year period, the market price was, on average, 9.51 percentage points below the market price of 2006 – the year before the beginning of the economic crisis.

At a first sight, this can be a promising sign as it could indicate that the tested theory could be verified in the Portuguese manufacturing industry.

On the other hand, for the same time interval, the market prices (costs) of inputs and materials used during firms' operating process are, on average, higher than 2006´s price levels. In this context, on average, *PrIn* was 125,15% of 2006´s market prices, while *MC* was 108,50%. This is consistent with the fact that, during recessions, the level of resource's scarcity might be higher leading to an increase in their prices.

It is also relevant to mention that *Pr* and *MC* registered low standard deviations, meaning that their value do not suffer extreme variations over the years. This may be justified by a certain degree of demand elasticity of Portuguese manufacturing firms, as a small change on input prices leads to a significant change on demand level.

Conversely, *PrIn* registered a greater level of price volatility. This may happen because these inputs (electricity, hot and cold water, natural gas, steam and cold air) are mandatory for any firm to function – firms cannot operate without these resources. Therefore, these inputs are associated with a higher level of demand inelasticity, which means that price variations do not generate significant demand changes.

4.1.2. Average manufacturing enterprise variables

The rest of the variables included in the econometric model characterize, on one approach, the average small-sized manufacturing firm (See Table 2) and, on the other approach, the average medium-sized manufacturing enterprise (See Table 3). With the only purpose of making a more consistent interpretation of the summary statistics, these variables were divided by the value of total sales to control for firm size, as well as for different technology and demand levels in each CAE sector.

The most relevant variable for the subject under analysis on the current paper is *Inventory*. The rest of the variables represent sector control variables, which include external liquidity sources usually used by firms in non-recessionary economic periods and other operating costs, for example wages paid to employees.

Inventory represents the average total value of inventory of a manufacturing firm over the entire sample period and, in the context of the present paper, is expected to have explanatory power for the aggressive pricing behaviour of liquidity-constrained firms. The average values of Inventory-to-sales ratio are not much different from small to medium-sized firms, which have registered 0.2027 and 0.2153, respectively. These values indicate that the value of inventory is, approximately, one fifth of the total value of sales on both SME.

Notwithstanding, the values of this ratio are more volatile (that it, they registered a higher standard deviation) for medium-sized enterprises, reaching more extreme minimum and maximum values. At a first glance, this may suggest that, in the Portuguese manufacturing industry, the aggressive pricing behaviour during recessions is more likely to be found in medium rather than in small-sized firms.

Regarding the remaining explanatory variables referring to firms' liquid assets (cash) and to the usual funding sources (equity, short-term debt, long-term debt and financial investments), from a quick analysis, it is possible to say that, except for *cash-to-sales*

ratio, all the other ratios are greater for medium-sized firms. Additionally, the respective standard deviations are also greater in the case of medium firms. Once again, this could mean that, during recessionary periods, medium-sized firms adjust their funding sources more significantly when compared with small-sized firms. Hence, once again, this might indicate that the economic theory studied on this thesis could be more easily confirmed in the case of medium-sized firms.

4.2. Regression results

At this point, was selected the regression model that would be a better fit for the dataset and, therefore, could produce the most efficient estimators. For that purpose, were run several tests to control for endogeneity and jointly significance of all coefficients for all sample years.

In order to produce the best possible results, the final panel regression included time and individual fixed-effects, *i.e.* Year and CAE sector dummy variables were added to the econometric model. These dummy variables serve to control for effects over the years that impact the dependent variable and to control for sector specific characteristics, for example different technology levels, as well as different cost and demand functions. Moreover, to control for heteroskedasticity and eliminate the potential effects of outliers, all variables in the model were *winsorized* at a 1.5% level[i], and the natural logarithm was computed for all manufacturing firm average variables.

For results' consistency and robustness purposes, the regression model was also computed with the original explanatory variables, with the logarithmized variables and with the manufacturing firm average variables divided by total assets. The procedure was executed for small firms and median firms, allowing for a better understanding of the impact of each type of enterprise on manufacturing market price variations.

4.2.1. Small-sized enterprises

The estimators produced by the robust fixed-effects, with time fixed-effects, regression model confirm partially the results predicted on Chapter 3 (See Table 4). Regarding the variable of interest – *Inventory* –, as the economic theory suggests, it has a negative

[i] This cut-off value was set taking in consideration skewness and kurtosis values of each variable in order to get as close as possible to a normal distribution, assessing that skewness values were near zero while kurtosis values were approximately equal to three.

impact on market price variations. Indeed, according to the model, an increase of 1% on the total value of inventory will lead to a decrease of 0.006237[ii] percentage points on the yearly manufacturing industry price index. However, this coefficient is not statistically significant at 10%, 5% or 1% level.

On the other hand, material costs (*MC*) and the price of other inputs (*PrIn*) display statistically significant coefficients at a 1% level, while wages registered a statistically significant coefficient at a 10% level. Thus, according to the estimation, it is foreseeable that an increase of 1% on material costs (measured by the inflation rate) will produce an increase of 8.94 percentage points on manufacturing market prices. Nonetheless, the estimated coefficients of *PrIn* and *Wages* have a negative effect on the dependent variable, contrary to what was expected.

It is noteworthy that all coefficients from the Year dummy variables are statistically significant at a 1% level. These estimated coefficients suggest that, everything being equal[iii], relatively to 2006´s market price level, manufacturing market prices are on average lower in every year from 2007 to 2016. Although this behaviour is in line with the economic theory under analysis, the predicted estimator values indicate relatively big yearly differences.

Concerning the remaining estimation coefficients, none of them is statistically significant at a 10%, 5% or 1% levels. Additionally, only financial investments appear to confirm the expected impact on manufacturing market price changes. In a final note, this robust fixed-effects, with time fixed-effects, regression model with logarithmized and *winsorized*, at 1.5% level, variables has an adjusted-R^2 of 0.71, meaning that the independent variables that actually affect the dependent variable explain, approximately, 71% of the real variation of manufacturing market prices.

The main conclusions of this regression model are in line with the results extracted from the regressions that take in consideration the original variables, the logarithmized variables and the variables divided by total assets (See Table 5). Indeed, the effects on the independent variable caused by *PrIn*, *MC*, *Inventory* and the Year dummy variables are consistent throughout the regression models abovementioned, as well as the

[ii] $\frac{0.6237}{100} = 0.006237$

[iii] *Ceteris paribus* condition

significance levels of their coefficients. The only (minimal) differences are on the effects of some of the remaining, statistically non-significant, explanatory variables.

4.2.2. Medium-sized enterprises

Similar results can be found when the regressions are executed for medium-sized firms (See Table 6). Once again, the regression estimators partially confirm the outcomes predicted in Section 3.

From the robust fixed-effects, with time fixed-effects, regression model (with logarithmized and *winsorized,* at a 1,5% level, variables), *Inventory* has a negative impact on price changes, as in accordance with the economic theory. According to the estimated coefficients, 1% increase on the value of inventory will lead to a decrease of around 0.006899[iv] percentage points on the yearly manufacturing market prices. Notwithstanding, as happened with small firms' regression, this coefficient is not statistically significant at a 10%, 5% or 1% level.

On the opposite side, similarly to what was found previously, the coefficients of material costs and prices of other inputs are statistically significant at a 1% level. While *MC* has a positive effect on *Pr* (as expected), *PrIn* produces a negative impact on manufacturing market prices, which goes against expectations. In this sense, a 1% increase on *MC* will lead, on average, to a 0.1046 percentage points increase on *Pr*; and a 1% increase on *PrIn* will produce, on average, a 0.02703 percentage points drop on manufacturing market prices.

Lastly, the regression coefficients of all the year dummy variables are statistically significant at a 99% confidence interval and suggest that, *ceteris paribus*, manufacturing market prices are, on average, lower in each period from 2007 to 2016 when compared with 2006's market price levels. Nevertheless, as in the results from small firms' model, despite the fact that these effects are in line with the economic theory, the predicted market prices changes seem too volatile.

The remaining estimation coefficients are not statistically significant at a 10%, 5% or 1% levels, nor produced the expected effects on *Pr* (being equity and wages the exceptions). This robust fixed-effects, with time fixed-effects, estimation, with

[iv] $\frac{0.6899}{100} = 0.006899$

logarithmized and *winsorized* (at a 1.5% level) variables is characterized by an adjusted R^2 of approximately 0.67, meaning that the independent variables are able to explain around 67% of the real changes that occur on manufacturing market prices.

On a closing note, it is important to highlight that the main results extracted from this regression are consistent with the outputs from the estimation models which take into consideration the original variables, the logarithmized variables and the variables divided by total assets (See Table 7). The confidence levels and the predicted impacts of the estimation coefficients reported above are similar across all regressions. The most significant difference encountered was on the amplitude and confidence level of cash-to-assets ratio, in the regression model that includes the variables divided by total assets. In that specific case, a 1% increase in the cash-to-assets ratio is predicted to lead, on average, to a drop of 52.22 percentage points on *Pr*, which goes against what the economic theory predicts.

5. Final discussion and conclusions

The present thesis analyses inventory as an internal source of liquidity in recessionary periods, investigating the aggressive pricing behaviour of SME in the Portuguese manufacturing industry, from 2006 to 2016. According to existing economic literature, during economic downturns, smaller firms face difficulties to obtain liquidity, which is required for them to meet their short-run financial obligations. As inventory can be seen as an alternative internal source of funding, liquidity-constrained firms adopt an aggressive pricing strategy to sell inventory and obtain cash. Therefore, market prices are forced to decrease, producing a smoothing effect on sales and allowing smaller firms to survive.

To study this issue and analyse the relation between inventory behaviour and aggressive pricing strategy, the average level of inventory was regressed on manufacturing market price changes (measured by the yearly price index of manufacturing products). Additionally, were also included other explanatory variables regarding other funding sources and costs incurred by firms during the development of their operating activities. Small and median companies were threated separately, and different regressions were computed to assure stronger and consistent results.

As seen in the previous sections, the findings of the present thesis suggest that the regression model is not able to fully capture the effects predicted by the economic theory in the Portuguese manufacturing industry in both cases of SME.

According to all estimation results, inventory produces a negative impact on manufacturing market prices, leading to a decrease on manufacturing market price level. Nevertheless, this effect is not statistically significant at any of the estimation models.

On the other hand, material costs and the price of other inputs used by firms (such as electricity, hot and cold water, natural gas, steam and cold air), are statistically significant on all the obtained estimation outputs. However, while material costs produce, on average, the expected positive impact on manufacturing market prices, the price of other inputs seems to have a negative effect on the independent variable, contrarily to what was forecasted.

Lastly, regarding the other explanatory variables, the effects of their estimated coefficients are not consistent across regression models, neither is their statistical significance.

In order to completely analyse the issue and understand the obtained outputs, is key to fully comprehend the limitations of the present approach. Regarding the collected information, the available data only considers the active companies in each year. In this context, firms that are bankrupted and, consequently, cease to exist are discarded from the dataset and do not affect the sector averages of the following years. This survival bias has an impact on the regressions' results, as new firms entering the market do not demonstrate the survival behaviour under analysis, while firms that have demonstrated it are dropped from the dataset and stop influencing the data for the remaining of the selected timeframe. As new "healthy" firms are introduced in the dataset, the results from this thesis should suffer, as the impact of the aggressive pricing strategy is minimized, not allowing this empirical approach to fully confirm the economic theory.

On another note, it is important to mention the lack of CAE sector average data regarding input and output prices. This issue was surpassed assuming that the overall inflation rate and the price index for the entire manufacturing industry, respectively, would reasonably measure yearly changes on those prices. Notwithstanding, the precision of the obtained results would increase if this sector average information was available, as each CAE sector has different number of SME firms, different levels of competition and was affected by the financial crisis differently, leading firms to react in different ways.

Furthermore, some CAE sector may be characterized by a proportionally lower number of smaller firms which, consequently, do not have enough influence in the market and will not be able to exert a relevant influence on the market price level, in order to pushing it downwards. Therefore, this inability to drive market prices down should have an influence on the overall results of the manufacturing industry. In the case of adequately availability of CAE sector average variables, these effects would have been captured and the final results would have achieved a greater level of precision.

Given all the above, in this thesis is possible to verify that, in fact, inventory has a negative impact on manufacturing market prices, in both cases of SME. The negative impact, produced on manufacturing market prices, is slightly higher in the case of

medium-sized firms. For medium-sized firms, 1% increase in the average level of inventory will produce a drop on market price level of, approximately, 0.006899 percentage points; while, in the case of small-sized firms, the produced drop on manufacturing market prices is around 0.006237 percentage points. Nevertheless, these estimated coefficients are not statistically significant.

Like was presented in Section 2, and according to existing literature, the reduced negative market price changes produced by inventory levels reflect a certain degree of price stickiness, which may be explained by the pressure of implicit contracts between firms and customers, high proportion of fixed costs, the existence of relatively stable marginal costs or by the existence of contracts that are too costly to renegotiate. Additionally, as argued by Martins (2005), in the Portuguese economic environment, firm generally *"seem to have limited market power"*, which can also help to explain the reduced impact of inventory on manufacturing market prices estimated by the regression models.

These results can be an initial indication that inventory behaviour could be seen as an early warning sign for the financial difficulties experienced in an industry, alerting managers for the need to implement adequate measures to prevent a bankruptcy scenario.

Nonetheless, only after overcoming the abovementioned limitations, this assumption can achieve a higher level of economic significance, and far more reaching conclusions will be drawn from this approach.

Appendix

Table 1

Summary statistics of Portuguese manufacturing industry average variables

Variables	# of observations	Mean	St. Dev.	Skewness	Kurtosis	1st Quartile	Median	3rd Quartile
Pr (%)	143	90.49	8.49	0.53	2.03	83.04	87.26	98.50
PrIn (%)	143	125.15	21.96	0.021	1.30	100.00	122.19	149.27
MC (%)	143	108.50	4.85	-0.34	1.59	104.32	109.70	113.11

This table displays the summary statistics of the Portuguese manufacturing industry average variables included in the econometric model. The reported values refer to the Portuguese manufacturing industry over the period 2006-2016.

Table 2

Summary statistics of small-sized firms

Variables	# of observations	Mean	St. Dev.	Skewness	Kurtosis	1st Quartile	Median	3rd Quartile
Values in Euros								
Inventory	143	295019	135656	1.33	9.47	196914	297458	364957
Cash	143	152082	82286	1.32	4.49	90057	129371	190582
Invest	143	52957	75483	3.43	15.10	18290	30140	55670
Equity	143	584384	327234	0.92	4.31	385932	540396	756526
Ltdebt	143	269386	189604	3.19	21.75	165067	244045	346520
Stdebt	143	200323	97009	0.67	3.26	137882	191947	258360
Instpaid	143	21269	11127	0.82	3.81	13509	19961	26293
Wages	143	239444	57527	0.37	2.03	185765	234938	283818

This table displays the summary statistics of the average manufacturing small-sized firm variables included in the econometric model. The reported values refer to firms belonging to the selected thirteen most representative 2-digit CAE code sectors from the Portuguese manufacturing industry over the period 2006-2016.

Table 3

Summary statistics of medium-sized firms

Variables	# of observations	Mean	St. Dev.	Skewness	Kurtosis	1st Quartile	Median	3rd Quartile
Values in Euros								
Inventory	143	1796810	694384	0.37	2.96	1414849	1817016	2048875
Cash	143	675881	359137	0.84	3.24	390556	621977	898745
Invest	143	618282	596670	2.29	9.34	241639	488350	787101
Equity	143	4091971	2045960	0.86	4.49	3019101	3965053	5121282
Ltdebt	143	1711071	1210214	2.90	17.06	1074363	1651987	1962486
Stdebt	143	1582037	1030785	2.68	16.58	993818	1446691	1944810
Instpaid	143	155400.3	102272.6	2.38	13.40	91455	137985	187476
Wages	143	1298252	302436.9	-0.16	1.97	1046946	1343185	1516784

This table displays the summary statistics of the average manufacturing medium-sized firm variables included in the econometric model. The reported values refer to firms belonging to the selected thirteen most representative 2-digit CAE code sectors from the Portuguese manufacturing industry over the period 2006-2016.

Table 4

Small-sized firms' estimation results with logarithmized and *winsorized* explanatory variables

Variables	Coefficiets	P-value
Constant	-154.5918	0.401
PrIn	-2.2461***	0.000
MC	8.9493***	0.000
Log(Inventory)	-0.6237	0.485
Log(Cash)	-2.1000	0.454
Log(Invest)	1.9320	0.101
Log(Equity)	-10.1697	0.116
Log(Ltdebt)	-0.1213	0.955
Log(Stdebt)	-4.1358	0.307
Log(Wages)	-18.1477*	0.071
Year dummy variables		
2007	-25.7328***	0.000
2008	-53.2777***	0.000
2009	-34.5168***	0.000
2010	-29.2044***	0.000
2011	-42.2743***	0.000
2012	-33.0013***	0.000
2013	-15.9304***	0.000
2014	Omitted because of collinearity	
2015	-12.1621***	0.000
2016	-23.1571***	0.000
# of observations	143	
Adjusted R^2	0.7120	

The table reports the estimation results of the contemporaneous small firms' robust regression model, taking in consideration logarithmized and winsorized, at a 1,5% level, explanatory variables, as well as firm and time fixed-effects. The significance levels of 10%, 5% and 1% are shown by *, ** and ***, respectively.

Table 5

Complementary small-sized firms' estimation results

Variables	(1)	(2)	(3)
Constant	-604.401***	-227.512	-566.152***
PrIn	-2.504***	-2.29***	-2.307***
MC	9.677***	9.157***	8.874***
Inventory	-2.21e-06	-.504	-0.380
Cash	-4.58e-06	-2.350	-22.871
Invest	-5.79e-06	1.844	3.520
Equity	6.49e-06	-9.378	4.189
Ltdebt	-6.03e-06	-0.194	Omitted to avoid collinearity
Stdebt	-0.00001193	-4.223	-10.069
Wages	-0.00005287	-13.918	38.818
Year dummy variables			
2007	-28.049***	-26.345***	-26.362***
2008	-58.173***	-54.647***	-54.860***
2009	-37.836***	-35.310***	-36.325***
2010	-32.112***	-29.724***	-30.681***
2011	-46.427***	-43.292***	-43.439***
2012	-36.006***	-33.826***	-33.553***
2013	-18.246***	-16.351***	-16.608***
2014	Omitted because of collinearity		
2015	-14.044***	-12.561***	-12.938***
2016	-27.290***	-23.9319***	-25.270***
# of observations	143	143	143
Adjusted R^2	0.679	0.708	0.679

The table reports the estimation results of different contemporaneous small firms' robust regression models taking in consideration: (1) the original explanatory variables; (2) the logarithmized explanatory variables; and (3) the explanatory variables divided by total value of assets. In all estimations firm and time fixed-effects are included. The significance levels of 10%, 5% and 1% are shown by *, ** and ***, respectively.

Table 6

Medium-sized firms' estimation results with logarithmized and *winsorized* explanatory variables

Variables	Coefficiets	P-value
Constant	-647.4813	0.006
PrIn	-2.7025***	0.000
MC	10.4611***	0.000
Log(Inventory)	-0.6899	0.469
Log(Cash)	-3.1394	0.189
Log(Invest)	-0.3052	0.830
Log(Equity)	4.5086	0.563
Log(Ltdebt)	-0.8635	0.585
Log(Stdebt)	-2.1541	0.351
Log(Wages)	0.0252	0.999
Year dummy variables		
2007	-30.1606***	0.000
2008	-62.5844***	0.000
2009	-40.1090***	0.000
2010	-34.3119***	0.000
2011	-49.8285***	0.000
2012	-38.8945***	0.000
2013	-19.6732***	0.000
2014	Omitted because of collinearity	
2015	-14.6588***	0.000
2016	-29.2486***	0.000
# of observations	143	
Adjusted R^2	0.6743	

The table reports the estimation results of the contemporaneous median firms' robust regression model, taking in consideration logarithmized and winsorized, at a 1,5% level, explanatory variables, as well as firm and time fixed-effects. The significance levels of 10%, 5% and 1% are shown by *, ** and ***, respectively.

Table 7

Complementary medium-sized firms' estimation results

Variables	(1)	(2)	(3)
Constant	-674.507***	-704.980***	-668.523***
PrIn	-2.721***	-2.788***	-2.659***
MC	10.411***	10.785***	10.329***
Inventory	-3.79e-07	-1.046	-2.526
Cash	-4.10e-06	-2.875	-52.218*
Invest	-1.70e-06	-0.546	-19.131
Equity	1.86e-06	4.961	17.985
Ltdebt	-3.45e-07	-0.765	Omitted to avoid collinearity
Stdebt	1.42e-07	0.233	0.272
Wages	2.13e-06	-0.191	-11.017
Year dummy variables			
2007	-30.5219***	-31.366***	-29.796***
2008	-63.133***	-64.729***	-61.541***
2009	-40.898***	-41.369***	-39.727***
2010	-35.494***	-35.822***	-34.376***
2011	-50.975***	-51.978***	-49.828***
2012	-39.079***	-40.574***	-38.907***
2013	-20.055***	-20.495***	-20.045***
2014		Omitted because of collinearity	
2015	-14.978***	-15.032***	-14.913***
2016	-29.875***	-29.973***	-29.418***
# of observations	143	143	143
Adjusted R^2	0.677	0.672	0.688

The table reports the estimation results of different contemporaneous median firms' robust regression models taking in consideration: (1) the original explanatory variables; (2) the logarithmized explanatory variables; and (3) the explanatory variables divided by total value of assets. In all estimations firm and time fixed-effects are included. The significance levels of 10%, 5% and 1% are shown by *, ** and ***, respectively.

Table 8
Glossary with the variables' definitions

Variables	Definition
Pr	Yearly Manufacturing industry price changes
PrIn	Yearly variations on prices of inputs such as electricity, natural gas, hot and cold water, steam and cold air
MC	Yearly variations on prices of manufacturing inputs such as raw materials and other finished products used during the operating process of firms
Inventory	Sector average level of inventory
Cash	Sector average value of cash and bank deposits
Invest	Sector average value of financial investments
Equity	Sector average value of equity
Ltdebt	Sector average value of long-term debt
Stdebt	Sector average value of short-term debt
Wages	Sector average value of remuneration paid to employees
Di	Individual dummy variables to each manufacturing CAE code under analysis, i = 13, 14, 15, …. , 31
Dt	Time dummy variables for each year of the selected time frame, t = 2007, 2008, 2009, … , 2016

References

Brander, J. A., & Lewis, T. R. (1986). Oligopoly and financial structure: The limited liability effect. The American Economic Review, 956-970.

Carpenter, R. E., Fazzari, S. M., Petersen, B. C., Kashyap, A. K., & Friedman, B. M. (1994). Inventory investment, internal-finance fluctuations, and the business cycle. Brookings Papers on Economic Activity, 1994(2), 75-138.

Chen, Y., Weston, J. F., & Altman, E. I. (1995). Financial distress and restructuring models. Financial Management, 57-75.

Chevalier, J. A. (1995). Capital structure and product-market competition: Empirical evidence from the supermarket industry. The American Economic Review, 415-435.

Fabiani, S., Druant, M., Hernando, I., Kwapil, C., Landau, B., Loupias, C., ... & Stokman, A. C. (2005). The pricing behaviour of firms in the euro area: New survey evidence.

Gertler, M., & Gilchrist, S. (1994). Monetary policy, business cycles, and the behavior of small manufacturing firms. The Quarterly Journal of Economics, 109(2), 309-340.

Hendel, I. (1996). Competition under financial distress. The Journal of Industrial Economics, 309-324.

Hendel, I. (1997). Aggressive pricing as a source of funding. Economics Letters, 57(3), 275-281.

Koh, S., Durand, R. B., Dai, L., & Chang, M. (2015). Financial distress: Lifecycle and corporate restructuring. Journal of Corporate Finance, 33, 19-33.

Maksimović, L. (1988). The Byzantine provincial administration under the Palaiologoi. Adolf m Hakkert.

Martins, F. (2005). The price setting behaviour of Portuguese firms: evidence from survey data.

Neves, P. D., Dias, M., & Dias, D. (2004). Stylised features of price setting behaviour in Portugal: 1992-2001.

Opler, T. C., & Titman, S. (1994). Financial distress and corporate performance. The Journal of Finance, 49(3), 1015-1040.

Phillips, G. M. (1995). Increased debt and industry product markets an empirical analysis. Journal of financial Economics, 37(2), 189-238.

Shleifer, A., & Vishny, R. W. (1992). Liquidation values and debt capacity: A market equilibrium approach. The Journal of Finance, 47(4), 1343-1366.