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# Capital Intensity and the Impact of Government Subsidies on Companies' Competitiveness

Cláudia Alexandra Duarte Pereira

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FEP FACULDADE DE ECONOMIA
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# CAPITAL INTENSITY AND THE IMPACT OF GOVERNMENT SUBSIDIES ON COMPANIES' COMPETITIVENESS

**Cláudia Alexandra Duarte Pereira**

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**Miguel Augusto Gomes Sousa**

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**Abstract**

This study aims at analysing the impact of Government subsidies on companies' competitiveness. It also aims at studying whether this impact is different among industries, according to their level of capital. The sample of the study includes 487 Portuguese companies that obtained subsidies, between 2016 and 2020, through the Portugal 2020 programme. To analyse the impact of subsidies granted by the Government and companies' competitiveness, fixed effects panel regressions using four different dependent variables as proxy for competitiveness (return on assets, EBIT margin, assets turnover and market share) were estimated. Several control variable as growth, size, age and industry capital intensity, and time-dummies were also included. The empirical results suggest that Government subsidies have negative and significant effect on companies' competitiveness. Additionally, the results suggest that in the period under analysis the allocation of subsidies had a different impact among the industries considered, negatively affecting capital intensive industries the most.

**Keywords:** Goverment Subsidies; Competitiveness; Industry; Capital Intensity.

## Index

Acknowledgments ..... i

Abstract ..... ii

Index ..... iii

Table Index ..... v

1. Introduction ..... 1

2. Literature Review ..... 3

   a. Main Concepts and Definitions ..... 3

   b. Main Theories and Models ..... 4

   c. Methodology used in the literature ..... 6

   a. Formulation of Hypothesis ..... 7

3. Data and Sample ..... 8

4. Methodology ..... 10

   a. Variable Definition ..... 10

      i. Dependent Variables ..... 10

      ii. Independent Variable ..... 11

      i. Control Variables ..... 11

5. Empirical Model ..... 13

6. Empirical Results ..... 18

   6.1. Discriptive Statistics ..... 18

   6.2. Results ..... 22

      6.2.1. Subsidies' Impact on the level of competitiveness of companies ..... 22

      6.2.2. Subsidies' Impact on the level of competitiveness of companies: differences between industries. ..... 24

      6.2.3. Subbsidies' Impact on the level of competitiveness of companies: differences between industries, according to its level of capital intensity. ..... 32

7. Conclusions ..... 39

References.....41

Annexes.....44

## Table Index

Table 1 – Sample distribution by year and by subsidy allocation. ..... 9
Table 2 – Capital level of each industry, per year and on average ..... 16
Table 3 – Industries clustering according to their level of capital. ..... 17
Table 4 - Descriptive statistics of the analysis variables. ..... 18
Table 5 – Descriptive statistics of the variables, by sub-sample. ..... 20
Table 6 - Estimation results for the panel data model with fixed effects: the effect of subsidies on competitiveness (H1) ..... 23
Table 7 – Estimation results for the panel data model, with fixed effects, for the dependent variable ROA: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2). ..... 25
Table 8 – Estimation results for the panel data model, with fixed effects, for the dependent variable EBIT Margin: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2). ..... 26
Table 9 - Estimation results for the panel data model, with fixed effects, for the dependent variable Asset Turnover: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2). ..... 27
Table 10 – Estimation results for the panel data model, with fixed effects, for the dependent variable Market Share: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2). ..... 28
Table 11 – Residual sum of squares. ..... 31
Table 12 – F-statistics of the Chow test. ..... 32
Table 13 – Estimation results for the panel data model with fixed effects: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 1). ..... 33
Table 14 - Estimation results for the panel data model with fixed effects for the dependent variable ROA: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2). ..... 34
Table 15 - Estimation results for the panel data model with fixed effects for the dependent variable EBIT margin: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2). ..... 35

Table 16 - Estimation results for the panel data model with fixed effects for the dependent variable asset turnover: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2).....36
Table 17 - Estimation results for the panel data model with fixed effects for the dependent variable Market Share: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2). .....37

## 1. Introduction

Government subsidies are an important instrument of Government expenditure policy, affecting domestic and international resource allocation decisions. At the domestic level, resource allocation decisions, by reducing the flexibility of the economy, may affect structural and sectoral adjustment. At the international level, and with greater international integration, doubts may arise about whether subsidies cause distortions in the allocation of resources, affecting the competitiveness of firms (Schwartz and Clements, 1999). Thus, the study of how subsidies affect the market, and the competitiveness of companies becomes relevant.

One of the main objectives of Government subsidies is to correct market imperfections, being its use justified as a form of efficiency or economic justice (Schwartz & Clements, 1999). However, the literature presents various results, often disparate, and ambiguous conclusions regarding the effectiveness of the implementation of Government subsidies. While some studies identify positive effects associated with the attribution of subsidies, others believe that subsidies cause market distortions and inefficiencies. Thus, the real impact of this kind of Government help remains difficult to assess.

The present study aims at investigating the impact of Government subsidies in companies' competitiveness and if these subsidies produce different impacts in companies of different industries, namely in industries with different levels of capital. For that, the following competitiveness performance indicators will be analysed: return on assets (ROA), EBIT margin, asset turnover and market share.

Therefore, the aim of the study is to analyse if the subsidies will have different impacts according to the industry they will be granted to, through the study of companies in industries with different levels of capital.

The econometric analysis examines the impact of subsidies on firms' competitiveness using a panel data model with fixed effects, for the time interval between 2016 and 2020. The research uses a sample of Portuguese firms benefiting from Government subsidies between 2016 and 2020 under the Portugal 2020 programme, under the priority axes that are related to research and development, innovation and competitiveness. The data includes economic and financial information, collected through the "*Sistema de Análise de Balanços Ibéricos*" (SABI) database.

After an initial literature review, it could be perceived that there are many articles referring to the impact of subsidies at various company levels, but only few study the impact in an industry level perspective. It was also found that there are not many studies referring to the impact of such subsidies when considering different industries, according to their level of capital. Since capital intensive companies usually need high levels of investment in their activity, it is very relevant to investigate whether Government subsidies have a positive impact on these companies' activity or not. Therefore, the present study is motivated by the relevance of the topic to be studied, but mostly for the scarcity of information on it.

The results do not allow for the conclusion that subsidies are an essential tool in the competitiveness of firms. The results suggest that Government subsidies have a negative impact on the competitiveness of subsidized companies when measured by asset turnover and market share of firms. Furthermore, the study also suggests that the impact of Government subsidies is different from industry to industry, being greater (in a negative way) in industries with higher levels of capital.

The paper is structured as follows. Section 2 builds the theoretical model, presenting the literature review on Government subsidies and companies' competitiveness, as well as exposing the problem and developing the research hypotheses. Section 3 presents the data and sample of the study. Section 4 defines the variables and section 5 introduces the empirical model. Section 6 presents the empirical results and finally, section 7 discusses and the study and presents its main conclusions.

## 2. Literature Review

### a. Main Concepts and Definitions

To better understand the subjects to be studied in this dissertation, the definitions and concepts of Government Subsidies, Competitiveness and Capital Intensity should be presented, as a starting point.

Houthakker (1972) argues that the first concept, the concept of subsides, is very hard to define and that it will vary according to who is the beholder of the observation. Break (1972) is of the same opinion as Houthakker and argues that even if a definition for this concept could be found, there would still be a problem to measure the subsidy, since for subsidy programs it would be necessary to quantify both the benefits and the costs, which would be very elusive to do.

Therefore, most of the researchers on this topic use various concepts to arrange a definition of subsidy. A subsidy can then be defined as any support form Governments that will make prices drop to a level below the one established in a perfectly competitive private sector or that will allow producers to have higher levels of income, comparing to those that he would obtain without the help of this Government subsidies.

According to the OECD (2004), Governments may offer subsidies in order to distort competition in the market. Therefore, it defines the concept of subsidy as a Government policy capable of changing and affecting the market competition, providing benefits to specific companies and sectors and increasing or reducing (in the case that the objective of the assistance is the competition distortion) the general welfare.

Michael Porter defines competitiveness based on productivity and focuses on the microeconomic bases of competitive advantage that support productivity in nations, regions and clusters.

The World Economic Forum also defines competitiveness as the group of policies, institutions and factors that define the level of productivity of a country.

According to the International Trade Centre (ITC), competitiveness is "the demonstrated ability to design, produce and commercialize an offer that fully, uniquely and continuously fulfils the needs of targeted market segments, while connecting with and drawing resources

from the business environment, and achieving a sustainable return on the resources employed".

Moving on to the last concept, EDUCBA defines capital intensive as the business organization's capacity, measured by the level of capital invested by the company in its fixed assets with the objective of increasing production, which leads to higher profits and good levels of return on investment.

A capital-intensive industry is one in which a player is required to make large investments in fixed assets to compete with other already existing firms in the industry (Accounting Tools, 2021). In general terms, in these industries the companies' fixed cost base is very high, the debt-to-equity ratio is higher and there are fewer companies in these industries than in other industries that don't require that much capital.

### b. Main Theories and Models

Overall, the literature suggests that Government subsidies have a positive impact on the competitiveness and performance of subsidized companies (Meixner, Schlögl & Pichlbauer, 2020; Ravšelj & Aristovnik, 2017).

Profitability has a significant impact on firms' competitiveness (Voulgaris & Lemonakis, 2014). Indeed, many authors analysed the impact Government subsidies have on this indicator and therefore on firms' performance.

Meixner et. al (2020), for instance, studied the impacts of subsidies on profitability. It was concluded that subsidies have a positive impact on profitability and therefore also on competitiveness.

Spicka, Naglova and Gurtler (2017) found similar results in their study. They found that, although the results were not homogeneous in the whole sample, in some subsamples, and besides profitability, subsidies had a positive impact in some other economic indicators such as labour productivity and the production consumption's efficiency.

From their findings they could conclude that when considering more focused subsidies (in their case it was the "Rural Development Program" (RDP) subsidies), these subsidies affected labour productivity in the large companies and ROA in companies that are not

familiar. When considering broader subsidies (in this case at a national level, with the National Support Programme), the conclusions were that the ROA was also improved in family and medium sized companies.

On the following year, Spicka reached the same conclusion once again in its solo study. It was found that labour productivity was positively impacted by Government subsidies in the companies of the study in the long run (Spicka, 2018). The author creates a hypothesis to explain these results: subsidized companies will tend to use more bank loans to develop themselves by investing in fixed assets. Therefore, these subsidies will positively impact the labour productivity, as well as the capital structure of these companies. However, the author also reaches the conclusion that after receiving the subsidy and making the investments, i.e. in the short term, the fixed assets turnover was not significantly improved by the subsidy. The explanation he found is that companies that receive such subsidies are not able to materialize these investments in their production on the years after receiving the subsidy.

Meuleman and Maeseneire (2012) also sustain this theory. Their results show that subsidized companies will have easier access to financing and therefore will also be more willing to invest and innovate, becoming more competitive. This theory is once again corroborated in the following years by Mulier and Samarin (2021).

However, the literature suggests that R&D intensity and firms' financial competitiveness are not positively related when considering the impact of subsidies on this relationship (Zhu, Zhu, Xu & Xue, 2019). Therefore, and since there are still some theories pointing in opposite directions, it is of most importance to keep studying the effects of such subsidies in the companies' competitiveness.

When focusing on a sectoral perspective, subsidies can have various impacts among different sectors, when considering different levels of competitiveness and R&D (Mulier & Samarin, 2021). Moreover, it is also important to study these differences to better understand them.

Therefore, the main theories and studies on public subsidies indicate that subsidized companies will have improvements in several economic indicators, such as the ROA, labour productivity and profitability, improving their performance and competitiveness (Meixner et al., 2020; Ravšelj & Aristovnik, 2017; Spicka et al., 2017).

It is also concluded in several studies that companies that receive these subsidies have better access to financing (Spicka et al., 2017; Meuleman & Maeseneire, 2012; Mulier & Samarin, 2021; Spicka, 2018), thus making them more competitive in the market.

According to some studies, many companies would change the investment they made or even give up on the investment if they didn't get these subsidies, which shows how important this public support may be for companies (Meixner et al., 2020).

A summary of the information and the similarities between the studies found in the literature can be found in Annex 1.

### c. Methodology used in the literature

The studies carried out to analyse the impact of public subsidies on supported companies' economic indicators have been performed by using several methods. The models applied are different in terms of the analytic focus (sectoral or general approach) and the geographic level (from regional to transnational) (Harvey 1990).

Guo and Fraser (2015) divide the models into two groups: the group of methods that use logistic regression to forecast tendency scores (Heckman, Ichimura, Smith and Todd, 1998; Rosenbaum and Rubin, 1983) and the group that uses matching estimators. The latter don't require as many decisions and are easier to implement.

Many of the studies in the literature related to the topic of this dissertation use regression methods to estimate the economic indicators used (Meuleman & Maeseneire, 2012; Ravšelj & Aristovnik, 2017; Zhu et al. 2019). They use different kind of regression, depending on their objective and samples. For instance, Ravšelj and Aristovnik (2017) use an OLS (Ordinary Least Squares) regression, while others use a regression analysis using fixed effect models (Meuleman & Maeseneire, 2012; Spicka et al., 2017).

There are also some authors that use the difference-in-differences method, which consists of a quasi-experimental approach that compares the changes in outcomes over time between a population enrolled in a program (the treatment group) and a population that is not (the comparison group) (Spicka, 2018; Mulier & Samarin, 2021).

A summary of the information regarding the methods used by the mention authors in their studies can be found in Annex 2.

### a. Formulation of Hypothesis

As one can see above, although many authors have already studied the impact of subsidies on companies' competitiveness through many indicators, there is still a lack in the literature regarding the effects of these subsidies in different industries in terms of their capital intensity.

After reviewing the existing literature and defining the topic of study, the following hypotheses to be tested were constructed:

**H1**: Subsidies have an impact on the level of competitiveness of companies.

**H2**: The impact of subsidies on the competitiveness of the company depends on the industry where the company operates.

**H3:** The impact of subsidies on the competitiveness of the company depends on the industry where the company operates, according to the industry capital intensity.

## 3. Data and Sample

The data used in the study was collected from two main databases: the official database of the Portugal 2020 information system, which provides information on approved investment projects, and the database "*Sistema de Análise de Balanços Ibéricos*" (SABI), which provides individual information of economic and financial nature of Portuguese and Spanish companies.

The sample of this study consists of companies that received subsidies under Portugal 2020 programmes, whose priority axes are related to research and development, innovation, and competitiveness. The information regarding the projects and subsidies attributed to these companies was obtained from the Portugal 2020 database, having been considered only private companies that have information available in the database used to collect financial and accounting information (SABI) and that have an establishment date equal or prior to 2016. As a result, a sample of 487 companies was obtained. The period of analysis of this study is from 2016 to 2020.

Information is also collected on the various industries that will be analysed in this study. For this purpose, *Banco de Portugal* collects information on all industries by considering the first two digits of their CAE. These are clustered according to the section they belong to, as shown in annex 3, that, when considering the companies of the sample of the study, results in a total of 12 industries that will be analysed in the study.

Table 1 shows the number of companies that received some type of Government subsidy, within the priority axes considered, each year, between 2016 and 2020. There is some variation from year to year in the number of companies benefiting from subsidies, but it is clear from the analysis of the table that the number of companies receiving a subsidy increases significantly.

**Table 1** – Sample distribution by year and by subsidy allocation.

Table 1 shows the sample distribution by years, between 2016 and 2020, of the number of firms that benefited from government subsidies on that period, before and after its attribution. N corresponds to the number of enterprises.

| Year | Before Subsidy (SUB=0) | | After Subsidy (SUB=1) | |
|---|---|---|---|---|
| | N | % | N | % |
| **2016** | 487 | 100% | 0 | 0% |
| **2017** | 341 | 70% | 146 | 30% |
| **2018** | 200 | 41% | 287 | 59% |
| **2019** | 98 | 20% | 389 | 80% |
| **2020** | 0 | 0% | 487 | 100% |

## 4. Methodology

Considering previous research (Meuleman & Maeseneire, 2012; Ravšelj & Aristovnik, 2017; Zhu et al. 2019), the present study tests the developed hypotheses by estimating a set of regressions. These regressions will be done using panel data analysis with fixed effects.

### a. Variable Definition

#### i. Dependent Variables

Considering the multidimensional nature of corporate competitiveness performance, four dependent variables were used to measure firms' competitiveness. To measure the impact of government subsidies on competitiveness, the indicator of return on assets (ROA) was used, as well as two variables on which this ratio is broken down, namely the EBIT margin and asset turnover, and which aim to provide evidence of business profitability and productivity. Return on asset is the product of EBIT margin and asset turnover (Brealey et al., 2001). The market share was also used as the dependent variable. This last indicator gives a general idea of the size of a company in relation to its market and its competitors.

**Return on Assets (ROA)**

ROA is considered as proxies for performance. It is the most useful measure and the most important consideration when evaluating business performance (Tzelepis and Skuras, 2004). It will be measured as the ratio between the results earned by the company before deduction of interest and taxes - the EBIT, and the Total Assets of the company.

**EBIT Margin**

Earnings before interests and taxes (EBIT) corresponds to the results of operating activities of companies, reflecting the profitability of companies (Murphy, 2022). Therefore, to evaluate the margin of operating activities of companies, the margin of EBIT will be used. It will be calculated as the ratio of EBIT and Sales.

**Asset Turnover**

Asset turnover is a proxy for profitability and is intended to indicate how efficiently the company is using its assets (Brealey et al., 2001). It will be measured as the ratio between Sales and Total Assets.

**Market share**

According to Gale (1972) the company's market share is mainly determined by the intangible assets it owns both in the present and in the past. Higher shares can be expected to produce higher profitability. The market share will be measured by comparing the Company Sales with the Sector Sales.

### ii. Independent Variable

**Government Subsidy**

The independent variable will indicate whether a firm received any type of Government subsidy during a given period.

A dummy variable will be used for the subsidy. It will assume the value 0 in the years before the firm received the subsidy and the value 1 in the year the subsidy is granted, as well as in the following years, since the effect of receiving it may materialise only in the years after receiving it (post-project).

The information regarding the investment period and project's start and completion of the subsidised entities was collected manually, through the list of approved operations under the Portugal 2020 programme.

### i. Control Variables

Considering that other factors apart from the subsidy can influence business competitiveness, several control variables are included in the model.

**Growth**

Companies' growth is calculated by the growth rate of turnover (as a proxy for sales and services rendered). In theory, firms with higher sales growth are expected to have higher profitability ratios, as these firms can generate results from the investments made by exploiting growth opportunities, becoming in a stronger position than its competitors.

### Capital Intensity

The capital intensity of the industry was also used as a control variable. The capital intensity is measured by the ratio between the value of fixed assets and the total assets. Fixed assets denote the company's capacity to invest in capital to generate future growth options.

### Size

To control company's size the natural logarithm of total assets was used. Larger companies usually have a higher production capacity and therefore their cash flows are usually less volatile. The size of a firm may boost performance through the use of economies of scale, making them more able to compete in the market.

### Age

One effect that may affect the competitiveness of firms is age. An older firm can be expected to benefit from accumulated knowledge and become more productive over time but, on the other hand, it may become obsolete and lose competitiveness in relation to recent firms (Bergström, 2000). To control for age, the natural logarithm of the firm's age was used as the control variable. Age is measured by the number of years the firm has been operating, with the reference point being the year in which the firm was incorporated.

### Temporal Effects

To control time effects, dummy-year variables were included in the model. These dummy variables aim at capturing any cyclical changes and macroeconomic shocks. Regarding the year effect, four dummy variables are introduced in the regression to check the interaction between year and competitiveness level. The aim is to control the various (fixed) effects that may annually affect the behaviour of all firms, regardless of the allocation of government subsidies.

A summary of the definition of the variables used in the research is presented in annex 4.

## 5. Empirical Model

The main objective of the research is to analyse the impact of government subsidies on firms' competitiveness, controlling a set of factors that can influence it (growth, size, and age). In particular, the study aims to investigate whether this impact differs when different industries are considered, namely through their level of capital intensity.

To perform the econometric analysis a panel data of 2,435 observations was used, for (i) companies observed over (t) time periods. Panel data estimation is suitable for the model, as it enables the inclusion of information for a large sample size, allowing a more complete and efficient estimation. In fact, panel data models are suited to analyses of dynamic relationships, allowing heterogeneity between individuals to be controlled (Wooldridge, 2010). The research panel data is balanced because information is available for each sectional unit for the same number of time observations (Gujarati, 2004).

The fixed effects model is used as an estimation method. The estimation of panel data with fixed effects allows to control for firm-specific characteristics that are stable over time. The formulation of the fixed effects model assumes that the differences between individuals can be captured in the differences between the constant terms when there is correlation between the errors and the variables (Greene, 2002). Nevertheless, the Hausman test is conducted to decide between the use of the fixed and random effects model. The test suggests that the fixed effects model will be the most appropriate for this estimation.

The model specification is presented below, where i refers to the company and t refers to the year.

(1) $COMP_{i,t} = \beta 0 + \beta 1\ SUB_{i,t} + \beta 2\ GROWTH_{i,t} + \beta 3\ SIZE_{i,t} + \beta 4\ AGE_{i,t} + \beta 5\ D16_{i,t} + \beta 6\ D17_{i,t} + \beta 7\ D18_{i,t} + \beta 8\ D19_{i,t} + \varepsilon_{i,t}$

Where:

- β0 represents the constant term and β1, β2, β3 and β4 represent the coefficients associated with the variables subsidy, growth, size and age of firms, respectively.
- β5, β6, β7 and β8 represent the coefficients of the time dummy control variables for the years 2016, 2017, 2018 and 2019, respectively.

- COMP represents all dependent variables: return on assets, EBIT margin, asset turnover and market share.
- $\varepsilon$ is the error term of the regression.

(2) $COMP_{i,t} = \beta 0 + \beta 1\ SUB_{i,t} + \beta 2\ GROWTH_{i,t} + \beta 3\ SIZE_{i,t} + \beta 4\ AGE_{i,t} + \beta 5\ CAP_{i,t} + \beta 6\ D16_{i,t} + \beta 7\ D17_{i,t} + \beta 8\ D18_{i,t} + \beta 9\ D19_{i,t} + \varepsilon_{i,t}$

Where:

- β0 represents the constant term and β1, β2, β3, β4 and β5 represent the coefficients of the variables subsidy, growth, size, age and capital intensity, respectively.
- β6, β7, β8 and β9 represent the coefficients of the time dummy control variables for the years 2016, 2017, 2018 and 2019, respectively.
- COMP represents all dependent variables: return on assets, EBIT margin, asset turnover and market share.
- $\varepsilon$ is the error term of the regression.

(3) $COMP_{i,t} = \beta 0 + \beta 1\ SUB_{i,t} + \beta 2\ GROWTH_{i,t} + \beta 3\ AGE_{i,t} + \beta 4\ SIZE_{i,t} + \beta 5\ CAP_{i,t} + \beta 6\ SUB_{i,t}*CAP_{i,t} + \beta 7\ D16_{i,t} + \beta 8\ D17_{i,t} + \beta 9\ D18_{i,t} + \beta 10\ D19_{i,t} + \varepsilon_{i,t}$

Where:

- β0 represents the constant term and β1, β2, β3, β4, β5 and β6 represent the coefficients associated with the variables subsidy, growth, size and age of firms, industry capital intensity and an interactive variable resulting from the multiplication of subsidy by industry capital intensity, respectively.
- β7, β8, β9 and β10 represent the coefficients of the time dummy control variables for the years 2016, 2017, 2018 and 2019, respectively.
- COMP represents all dependent variables: return on assets, EBIT margin, asset turnover and market share.
- $\varepsilon$ is the error term of the regression.

The baseline model (1) allows testing H1 and H2 while the baseline models (2) and (3) allow testing H3, through two different methods.

To test H1, the baseline model (1) is applied to each of the dependent variables while to test H2, the same model is applied to each dependent variable 12 times, representing the number of industries considered in this study.

To test H3, two different methods were used. The first method consists in applying the baseline model (3) to the various dependent variables. The second method consists in applying the baseline model (2) to 4 distinct groups: companies operating in high, medium high, medium low and low capital industries.

To apply the second method, the 12 industries included in this study were divided into groups according to the average capital intensity of the companies operating in those industries. This led to 4 groups of industries, according to the level of capital needed to operate in those industries.

Table 2 presents the capital level of each industry in each year of the analysis and the respective 5-year average per industry, that will be considered to cluster the industries into groups.

**Table 2** – Capital level of each industry, per year and on average.

Table 2 presents the capital intensity of each industry in each year of analysis, given by the average capital intensity of each company operating in that industry. The last column presents the average capital intensity per industry, given by the average of all years under analysis (2016-2020), which will serve as the basis for the clustering of the various industries into groups according to their capital intensity.

| | Capital Intensity | | | | | |
|---|---|---|---|---|---|---|
| **Industry** | **2016** | **2017** | **2018** | **2019** | **2020** | **Industry Average** |
| Agriculture, livestock, hunting, forestry and fishing | 50. 06% | 53.61% | 59.56% | 61.81% | 61.62% | 57.33% |
| Accommodation, Restaurants and Similar Services | 61.63% | 63.00% | 69.01% | 72.49% | 76.48% | 68.52% |
| Administrative and support service activities | 8.63% | 17.03% | 8.54% | 11.50% | 51.39% | 19.42% |
| Artistic, entertainment, sports and recreational activities | 31.70% | 43.94% | 65.88% | 83.45% | 86.68% | 62.33% |
| Consulting, scientific, technical and similar activities | 30.75% | 32.49% | 40.21% | 36.14% | 48.23% | 37.56% |
| Real estate activities | 42.43% | 47.73% | 53.00% | 81.26% | 86.22% | 62.13% |
| Water supply; sewerage, waste management and remediation activities | 40.38% | 39.51% | 48.32% | 52.17% | 58.13% | 47.70% |
| Wholesale and retail trade; repair of motor vehicles and motorbikes | 25.92% | 28.94% | 33.53% | 41.25% | 47.34% | 35.40% |
| Construction | 24.63% | 28.71% | 35.81% | 41.17% | 47.42% | 35.55% |
| Extractive industries | 38.80% | 36.00% | 40.85% | 47.71% | 49.09% | 42.49% |
| Manufacturing industries | 40.92% | 42.75% | 47.08% | 49.55% | 51.54% | 46.37% |
| Transport and storage | 32.26% | 40.71% | 41.60% | 46.90% | 53.24% | 42.94% |

After analysing table 2, in particular the average capital intensity of each industry, they are grouped into 4 distinct groups. The first group corresponds to industries with a high capital level, the second to industries with a medium high capital level, the third to industries with a medium low capital level and the fourth to industries with a low capital level. A dummy variable is also created for each group to carry out the analysis of the impact of subsidies for each of the groups.

Table 3 presents the resulting clustering of the industries by the 4 defined groups.

**Table 3** – Industries clustering according to their level of capital.

Table 3 presents the distribution of the 12 companies in the study by groups according to their capital level. The first group corresponds to industries with a high capital level, the second to industries with a medium high capital level, the third to industries with a medium low capital level and the fourth to industries with a low capital level.

| **Group** | **Industries** |
|---|---|
| High Capital Intensity (HH) | Real estate activities<br>Artistic, entertainment, sports, and recreational activities<br>Accommodation, Restaurants and Similar Services |
| Medium High Capital Intensity (MH) | Manufacturing industries<br>Water supply; sewerage, waste management and remediation activities<br>Agriculture, livestock, hunting, forestry and fishing |
| Medium Low Capital Intensity (ML) | Consulting, scientific, technical and similar activities<br>Extractive industries<br>Transport and storage |
| Low Capital Intensity (LL) | Administrative and support service activities<br>Wholesale and retail trade; repair of motor vehicles and motorbikes<br>Construction |

Therefore, to test H3 by using the second method, the baseline equation (2) is applied to each of the four groups presented in table 3, for each of the dependent variables.

## 6. Empirical Results

The empirical results are presented in this section. First, the descriptive statistics of the variables are presented and then the results of the estimation of the econometric model are presented, analysed, and evaluated.

### 6.1. Descriptive Statistics

The descriptive statistics of the variables explored in the analysis are presented in table 4. For the analysis of descriptive statistics, the mean, standard deviation, maximum value, minimum value, and number of observations were considered, for the period from 2016 to 2020, for the dependent, independent and control variables.

**Table 4 -** Descriptive statistics of the analysis variables.

Table 4 shows the descriptive statistics of the main variables for the sample. 487 companies were analysed over the period 2016-2020, representing 2,435 company-year observations. The values shown for the variables SIZE and AGE are expressed, respectively, by the logarithm of total assets, expressed in thousands of Euros, and by the logarithm of the age of firms, expressed in years. The dummy variable SUB assumes the values 0 and 1. N corresponds to the number of observations.

| Variable | Average | Standard Deviation | Máximo | Mínimo | N |
|---|---|---|---|---|---|
| **ROA** | 0.06 | 0.09 | -1.19 | 1 | 2,435 |
| **EBIT Margin** | 0.008 | 1.81 | -86 | 4.82 | 2,435 |
| **Asset Turnover** | 0.81 | 0.50 | 0 | 5 | 2,435 |
| **Market Share** | 0.24 | 0.94 | 0 | 17.89 | 2,435 |
| **Subsidy** | 0.54 | 0.50 | 0 | 1 | 2,435 |
| **Size** | 8.59 | 1.23 | 1.1 | 12.01 | 2,435 |
| **Age** | 2.85 | 0.87 | 0 | 4.74 | 2,435 |
| **Capital Intensity** | 0.46 | 0.05 | 0.09 | 0.62 | 2,435 |
| **Growth** | -0.03 | 1.40 | -63 | 0.98 | 2,435 |

By analysing Table 4 it is possible to see that the companies from the sample show, during the whole period under analysis, an average return on assets equal to 6%, an average EBIT margin of 0.8%, an average turnover of assets of 81% and, finally, an average market share of 24%. Regarding the independent variable of interest, the period of analysis includes around 46% of observations corresponding to years prior to the granting of the subsidy, and around 54% of observations corresponding to the year in which the subsidy was granted and the subsequent period. It can also be seen that, on average, the turnover of the companies decreased by 3%. The companies in the sample have an average size (i.e. average Total

Assets) of 5,378 thousand Euros and an average age of approximately 17 years. Regarding the average capital intensity of the industries in which the sample companies operate, this is 46%, meaning that, on average and over the years, fixed assets represent 46% of the total assets of the companies on the sample.

Table 5 presents the descriptive statistics for two sub-samples: the sub-sample of firms before the allocation of subsidies, that is, when the dummy variable SUB assumes the value 0, and the sub-sample of firms after (and in the year) the allocation of subsidies, that is, when the dummy variable SUB takes the value 1.

**Table 5** – Descriptive statistics of the variables, by sub-sample.

Table 5 shows the descriptive statistics of the main variables. Two sub-samples are presented: the sub-sample before the subsidies to firms, when the independent variable SUB equals 0, and the sub-sample after (and within the year of) the subsidies to firms, when the independent variable SUB equals 1. Additionally, the last two columns of the table report the t-value and the z-value of the difference in means and medians, respectively, between the two subsamples. *, ** and *** indicate statistical significance levels of 10%, 5% and 1%, respectively. 487 companies are analysed over the period 2016-2020, representing 2,435 company-year observations. The values presented for the variables SIZE and AGE are expressed, respectively, by the logarithm of total assets, expressed in thousands of Euros, and by the logarithm of the age of the companies, expressed in years. The dummy variable SUB assumes the values 0 and 1. N corresponds to the number of observations.

| Variable | Before Subsidy SUB = 0 | | | | After Subsidy SUB = 1 | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | Average | Median | Standard Deviation | N | Average | Median | Standard Deviation | t-value | z-value |
| **ROA** | 1,126 | 0.07 | 0.05 | 0.003 | 1,309 | 0.05 | 0.04 | 0.002 | 6.16*** | 8.49*** |
| **EBIT Margin** | 1,126 | -0.002 | 0.06 | 0.08 | 1,309 | 0.02 | 0.06 | 0.02 | -0.25 | 3.04*** |
| **Asset Turnover** | 1,126 | 0.96 | 0.86 | 0.02 | 1,309 | 0.68 | 0.63 | 0.01 | 14.42*** | 14.10*** |
| **Market Share** | 1,126 | 0.27 | 0.06 | 0.03 | 1,309 | 0.21 | 0.06 | 0.02 | 1.34* | 0.56 |
| **Subsidy** | 1,126 | 0 | 0 | 0 | 1,309 | 1 | 1 | 0 | - | - |
| **Size** | 1,126 | 8.30 | 8.50 | 0.04 | 1,309 | 8.85 | 8.96 | 0.03 | -11.15*** | -9.30*** |
| **Age** | 1,126 | 2.74 | 2.94 | 0.03 | 1,309 | 2.94 | 3.09 | 0.02 | -5.62*** | -4.44*** |
| **Capital Intensity** | 1,126 | 0.43 | 0.43 | 0.002 | 1,309 | 0.49 | 0.50 | 0.0008 | -33.22*** | -32.52*** |
| **Growth** | 1,126 | -0.005 | 0 | 0.06 | 1,309 | -0.05 | 0.05 | 0.02 | 0.80 | 0.87 |

Before receiving the subsidy, the companies show an average return on assets equal to 7% (median equal to 5%). However, there is a decrease in this indicator of profitability to 5% (4%), and this difference is statistically significant, for a significance level of 1%. The average EBIT margin increases after the subsidy attribution, from -0.2% (6%) to 2% (6%), however the increase is not statistically significant. The average degree of asset turnover also decreases after the subsidy, from 0.96 (0.86) to 0.68 (0.63), the difference being statistically significant, for a significance level of 1%. Finally, the average market share decreases from 27% (6%) to 21% (6%), and this decrease is statistically significant, for a significance level of 10%. Thus, the results suggest that, on average, firms that received government subsidies observed a decrease in their ROA and asset turnover, with a significance level of 1%, as well as in their market share, with a significance level of 10%.

In relation to the average of the control variables, the values of the variables size, age, capital intensity and growth are higher after the allocation of Government subsidies. Note that, except for the control variable "growth", in all the remaining control variables this difference is statistically significant, for a significance level of 1%.

### 6.2. Results

After exploring the univariate analysis in the previous section, the econometric techniques of multivariate analysis with panel data were considered. To control for the time-invariant specific characteristics of individuals, the panel data model with fixed effects was used as estimation method.

The following sections show the panel data estimation results for each dependent variable for the full sample over the period 2016-2020. First the results of the impact of Government subsidies on competitiveness are presented, secondly it is analysed whether this impact differs according to the industry it is granted to and, finally, the impact of subsidies on the competitiveness of firms when the level of capital of industries is considered is presented.

#### 6.2.1. Subsidies' Impact on the level of competitiveness of companies

To analyse the influence of business investment subsidies on firms' competitiveness equation (1) was estimated. Table 6 shows the results of the estimation of the panel data with fixed effects, for the set of 2,435 observations of the sample for the period 2016-2020, for each competitiveness measure used as dependent variable, in response to Hypothesis 1.

**Table 6** - Estimation results for the panel data model with fixed effects: the effect of subsidies on competitiveness (H1).

Table 6 presents the results of the estimation of equation (1). The dependent variables are: ROA (Return on Assets), EBIT Margin, Asset Turnover and Market Share. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE and GROWTH. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| **Independet Variables** | **Dependent Variables** | | | |
|---|---|---|---|---|
| | **ROA** | **EBIT Margin** | **Asset Turnover** | **Market Share** |
| **Subsidy** | -0.004<br>(0.005) | 0.09<br>(0.13) | -0.07***<br>(0.02) | -0.04**<br>(0.02) |
| **Size** | 0.002<br>(0.005) | 0.25**<br>(0.11) | -0.34***<br>(0.02) | 0.005<br>(0.01) |
| **Age** | -0.03**<br>(0.01) | 0.53**<br>(0.29) | 0.009<br>(0.04) | -0.004<br>(0.04) |
| **Growth** | 0.01***<br>(0.001) | 0.16***<br>(0.03) | 0.02***<br>(0.004) | 0.001<br>(0.003) |
| **Constant** | 0.12***<br>(0.04) | -3.97***<br>(0.98) | 3.75***<br>(0.14) | 0.24*<br>(0.13) |
| **Year Fixed Effect** | YES | YES | YES | YES |
| **$R^2$** | 0.10 | 0.03 | 0.39 | 0.006 |
| **Adjusted $R^2$** | -0.13 | -0.22 | 0.24 | -0.25 |
| **F-Statistic** | 26.78 | 7.05 | 156.69 | 1.53 |
| **(p-value)** | 1.13 | 3.27 | 9.89 | 0.14 |
| **N** | 2,435 | 2,435 | 2,435 | 2,435 |

The results of the regressions conducted using equation (1) suggest that subsidies have a negative impact on asset turnover and market share ($\beta$=-0.07, $p<0.01$ and $\beta$=-0.04, $p<0.05$, respectively). The impact is statistically significant, with a significance level of 1% and 5%, respectively. However, subsidy allocation has no impact on ROA, as the coefficient, although equally negative ($\beta$=-0.004) is not statistically significant. The same happens with EBIT margin, which despite presenting a positive coefficient ($\beta$=0.09), is not statistically significant.

In line with results found on the literature, the evidence from this study suggests that subsidies have not a positive impact on companies' asset turnover after the subsidy is granted. As already pointed out, Spicka (2018) found that productivity, measured by the fixed assets

turnover, was not significantly improved by subsidies in the years after receiving it. Indeed, similar results are found in this study, as the asset turnover seems to be negatively affected by Government subsidies. One possible explanation for this impact may be that, after receiving the subsidy, firms tend to use it to invest in new assets, which, at least until these assets start generating new sales, lowers the asset turnover ratio.

Regarding market share, the results point in the opposite direction of what one would expect: the market share of subsidized companies decreases in the years after receiving the subsidy. This may be explained by the fact that companies that receive subsidies are not able to fully exploit new production capacities in the years after the project launch, falling "behind" their competitors who keep growing, ending up losing some share of the market in the short term.

Regarding the control variable "size", it shows a positive impact ($\beta=0.25$, $p<0.05$) on the EBIT margin, for a significance level of 5% and a negative impact ($\beta=-0.34$, $p<0.01$) on the asset turnover, for a significance level of 1%.

For variable "age", it presents a positive and statistically significant impact, with a significance level of 5%, on ROA and EBIT margin ($\beta=0.002$, $p<0.01$ and $\beta=0.25$, $p<0.01$, respectively).

In terms of growth, the control variable has a positive and statistically significant impact on ROA, EBIT margin and asset turnover ($\beta=0.01$, $p<0.01$, $\beta=0.16$, $p<0.01$ and $\beta=0.02$, $p<0.01$, respectively), for a significance level of 1%.

### 6.2.2. Subsidies' Impact on the level of competitiveness of companies: differences between industries.

Tables 7, 8, 9 and 10 show the results of the panel data estimation with fixed effects for the set of 2.435 observations in the sample for the period 2016-2020 for the dependent variables ROA, EBIT margin, asset turnover and market share, respectively, in response to Hypothesis 2.

**Table 7** – Estimation results for the panel data model, with fixed effects, for the dependent variable ROA: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2).

Table 7 presents the results of the estimation of equation (1), for the groups of firms in each industry. The dependent variable is ROA (Return on Assets) and the explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE and GROWTH. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations. Each industry is identified by its ID number. This identification is presented in annex 5.

| **ROA** | **Industry** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **5** | **6** | **7** | **8** | **9** | **11** | **12** | **13** | **16** |
| **Subsidy** | 0.03<br>(0.03) | 0.01<br>(0.02) | -0.005<br>(0.006) | 0.01<br>(0.04) | -0.02<br>(0.02) | -0.03<br>(0.04) | -0.03<br>(0.02) | -0.004<br>(0.02) | 5.03<br>- | 0.04<br>(0.07) | 0.28*<br>(0.14) | -0.06<br>(0.07) |
| **Size** | 0.02<br>(0.02) | -0.06**<br>(0.02) | 0.0007<br>(0.005) | -0.04<br>(0.05) | -0.05**<br>(0.02) | 0.01<br>(0.03) | 0.0006<br>(0.06) | -0.01<br>(0.02) | -17.29<br>- | -0.05<br>(0.08) | -0.14<br>(0.08) | 0.05<br>(0.08) |
| **Age** | -0.09*<br>(0.05) | 0.3<br>(0.19) | -0.02<br>(0.01) | 0.3<br>(0.3) | 0.04<br>(0.06) | 0.03<br>(0.08) | 0.02<br>(0.27) | -0.0009<br>(0.05) | -7.17<br>- | -0.03<br>(0.25) | -0.27<br>(0.18) | -0.03<br>(0.18) |
| **Growth** | 0.03<br>(0.03) | 0.02<br>(0.02) | 0.03***<br>(0.003) | 0.07<br>(0.04) | 0.005<br>(0.01) | 0.04*<br>(0.02) | 0.03<br>(0.07) | 0.03***<br>(0.008) | 0.46<br>- | 0.02<br>(0.02) | 0.008**<br>(0.004) | 0.02*<br>(0.002) |
| **Constant** | 0.06<br>(0.17) | -0.53<br>(0.59) | 0.1**<br>(0.05) | -0.48<br>(0.96) | 0.34*<br>(0.2) | -0.12<br>(0.22) | -0.03<br>(0.41) | 0.13<br>(0.12) | 196.09<br>- | 0.58<br>(0.55) | 1.39**<br>(0.55) | -0.25<br>(0.3) |
| **Year Fixed Effect** | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| **$R^2$** | 0.27 | 1.37 | 0.09 | 0.38 | 0.21 | 0.08 | 0.77 | 0.45 | 1 | 0.10 | 0.71 | 0.99 |
| **Adjusted $R^2$** | -0.12 | -0.16 | -0.14 | -0.06 | -0.16 | -0.21 | 0.20 | 0.27 | - | -0.47 | 0.38 | 0.93 |
| **F-Statistic** | 1.47 | 1.37 | 18.10 | 1.52 | 1.36 | 1.40 | 1.69 | 9.95 | - | 0.32 | 3.09 | 18.19 |
| **(p-value)** | 0.21 | 0.23 | 5.16 | 0.21 | 0.24 | 0.20 | 0.32 | 5.40 | - | 0.95 | 0.06 | 0.18 |
| **N** | 50 | 65 | 1,840 | 35 | 60 | 165 | 15 | 130 | 5 | 40 | 20 | 10 |

**Table 8** – Estimation results for the panel data model, with fixed effects, for the dependent variable EBIT Margin: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2).

Table 8 presents the results of the estimation of equation (1), for the groups of firms in each industry. The dependent variable is EBIT margin and the explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE and GROWTH. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations. Each industry is identified by its ID number. This identification is presented in annex 5.

| **EBIT Margin** | **Industry** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **5** | **6** | **7** | **8** | **9** | **11** | **12** | **13** | **16** |
| **Subsidy** | 0.08 | 0.05 | 0.01 | 0.07* | -0.02 | 2.08 | -0.005 | 0.08 | 163.18 | 0.12 | 0.75 | 0.46 |
| | (0.21) | (0.05) | (0.02) | (0.04) | (0.04) | (1.89) | (0.01) | (0.07) | - | (0.14) | (0.76) | (0.48) |
| **Size** | 0.15 | -0.07 | -0.05** | -0.06 | 0.006 | 1.07 | 0.01 | -0.07 | -570.62 | -0.26* | 0.29 | -0.56 |
| | (0.19) | (0.05) | (0.02) | (0.05) | (0.04) | (1.28) | (0.03) | (0.05) | - | (0.14) | (0.46) | (0.58) |
| **Age** | -0.56 | 0.67 | 0.08* | 0.35 | 0.09 | 5.56 | -0.04 | 0.03 | -232.61 | 0.37 | 0.95 | 0.2 |
| | (0.37) | (0.43) | (0.04) | (0.29) | (0.1) | (3.52) | (0.14) | (0.15) | - | (0.47) | (0.99) | (1.26) |
| **Growth** | 0.23 | 0.09* | 0.09*** | 0.12*** | -0.02 | -0.18 | -0.04 | 0.31*** | 16.64 | 0.59*** | 0.15*** | 0.32** |
| | (0.25) | (0.05) | (0.01) | (0.04) | (0.02) | (1.14) | (0.04) | (0.03) | - | (0.03) | (0.02) | (0.02) |
| **Constant** | 0.05 | -1.73 | 0.17 | -0.44 | -0.16 | -27.49*** | 0.02 | 0.5 | 6465.3 | 1.28 | -3.41 | 3.88 |
| | (1.36) | (1.35) | (0.16) | (0.91) | (0.32) | (10.03) | (0.21) | (0.4) | - | (1.03) | (2.98) | (2.1) |
| **Year Fixed Effect** | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| **$R^2$** | 0.15 | 0.21 | 0.06 | 0.56 | 0.20 | 0.09 | 0.85 | 0.76 | 1 | 0.95 | 0.91 | 1.00 |
| **Adjusted $R^2$** | -0.30 | -0.16 | -0.18 | 0.24 | -0.18 | -0.20 | 0.47 | 0.68 | - | 0.92 | 0.81 | 0.99 |
| **F-Statistic** | 0.72 | 1.42 | 11.64 | 3.12 | 1.23 | 1.61 | 2.82 | 37.69 | - | 61.22 | 12.64 | 120.51 |
| **(p-value)** | 0.67 | 0.22 | 3.75 | 0.02 | 0.31 | 0.13 | 0.17 | 2.21 | - | 4.31 | 0.0005 | 0.07 |
| **N** | 50 | 65 | 1,840 | 35 | 60 | 165 | 15 | 130 | 5 | 40 | 20 | 10 |

**Table 9** - Estimation results for the panel data model, with fixed effects, for the dependent variable Asset Turnover: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2).

Table 9 presents the results of the estimation of equation (1), for the groups of firms in each industry. The dependent variable is Asset Turnover and the explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE and GROWTH. Fixed effects were used as the panel data estimation method for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations. Each industry is identified by its ID number. This identification is presented in annex 5.

| **Asset Turnover** | **Industry** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **5** | **6** | **7** | **8** | **9** | **11** | **12** | **13** | **16** |
| **Subsidy** | -0.07 | -0.07 | -0.05** | -0.38 | -0.21 | -0.12* | 0.13 | -0.16** | 0.54 | -0.07 | -0.09 | -0.16 |
| | (0.13) | (0.08) | (0.02) | (0.23) | (0.2) | (0.07) | (0.15) | (0.06) | - | (0.1) | (0.25) | (0.08) |
| **Size** | -0.3** | -0.38*** | -0.33*** | -0.48 | -1.01*** | -0.39*** | -1.02* | -0.59*** | -1.93 | -0.37*** | -0.22 | 0.05 |
| | (0.12) | (0.09) | (0.02) | (0.3) | (0.21) | (0.05) | (0.44) | (0.05) | - | (0.11) | (0.15) | (0.1) |
| **Age** | 0.1 | -0.24 | 0.02 | -0.32 | -0.32 | 0.46*** | 2.17 | 0.18 | -0.77 | 0.21 | -0.4 | 0.19 |
| | (0.23) | (0.73) | (0.05) | (1.81) | (0.58) | (0.14) | (1.9) | (0.14) | - | (0.35) | (0.33) | (0.21) |
| **Growth** | 0.26* | 0.17** | 0.12*** | 0.5* | 0.41*** | 0.23*** | 1.31* | 0.06** | 0.04 | 0.03 | 0.006 | 0.03* |
| | (0.15) | (0.08) | (0.01) | (0.25) | (0.12) | (0.04) | (0.49) | (0.03) | - | (0.02) | (0.006) | (0.003) |
| **Constant** | 3.01*** | 4.83** | 3.6*** | 6.54 | 9.85*** | 2.98*** | 6.3* | 4.89*** | 21.85 | 3.14*** | 3.04** | -0.55 |
| | (0.84) | (2.28) | (0.17) | (5.8) | (1.84) | (0.39) | (2.92) | (0.38) | - | (0.77) | (0.98) | (0.35) |
| **Year Fixed Effect** | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| **$R^2$** | 0.46 | 0.47 | 0.39 | 0.55 | 0.61 | 0.62 | 0.80 | 0.77 | 1 | 0.70 | 0.83 | 1.00 |
| **Adjusted $R^2$** | 0.18 | 0.23 | 0.23 | 0.23 | 0.42 | 0.50 | 0.32 | 0.70 | - | 0.51 | 0.64 | 0.97 |
| **F-Statistic** | 3.46 | 4.83 | 116.04 | 3.00 | 7.69 | 25.27 | 2.06 | 40.93 | - | 6.89 | 6.17 | 45.95 |
| **(p-value)** | 0.006 | 0.0003 | 2.93 | 0.02 | 3.54 | 9.81 | 0.25 | 1.13 | - | 0.0001 | 0.007 | 0.11 |
| **N** | 50 | 65 | 1,840 | 35 | 60 | 165 | 15 | 130 | 5 | 40 | 20 | 10 |

**Table 10** – Estimation results for the panel data model, with fixed effects, for the dependent variable Market Share: the effect of subsidies on competitiveness depends on the industry in which the firm operates (H2).

Table 10 presents the results of the estimation of equation (1), for the groups of firms in each industry. The dependent variable is Market Share and the explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE and GROWTH. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations. Each industry is identified by its ID number. This identification is presented in annex 5.

| **Market Share** | **Industry** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **5** | **6** | **7** | **8** | **9** | **11** | **12** | **13** | **16** |
| **Subsidy** | -0.25 | -0.06 | 0.00001 | -1.19 | -0.003 | 0.005 | -0.57 | -0.05** | 18.57 | -0.15** | -0.03* | -0.79 |
| | (0.28) | (0.2) | (0.002) | (1.35) | (0.01) | (0.006) | (0.49) | (0.02) | - | (0.07) | (0.01) | (0.17) |
| **Size** | 0.14 | 0.19 | 0.003 | 0.3 | -0.008 | 0.002 | -1.93 | 0.003 | -66.58 | 0.13* | 0.01 | 0.66 |
| | (0.26) | (0.22) | (0.002) | (1.75) | (0.01) | (0.004) | (1.41) | (0.02) | - | (0.07) | (0.008) | (0.21) |
| **Age** | -0.22 | -2.44 | -0.0006 | -1.07 | 0.04 | -0.004 | 3.55 | -0.02 | -26.11 | -0.16 | -0.02 | 0.62 |
| | (0.49) | (1.83) | (0.005) | (10.67) | (0.03) | (0.01) | (6.14) | (0.05) | - | (0.22) | (0.02) | (0.45) |
| **Growth** | 0.28 | 0.59*** | 0.004*** | 0.12 | 0.02*** | 0.003 | 0.35 | -0.0003 | 1.35 | 0.01 | 0.0004 | -0.04* |
| | (0.33) | (0.2) | (0.001) | (1.46) | (0.007) | (0.004) | (1.6) | (0.008) | - | (0.01) | (0.0004) | (0.006) |
| **Constant** | 0.94 | 9.81* | 0.06*** | 3.96 | 0.07 | 0.03 | 12 | 0.25** | 153.46 | -0.35 | 0.03 | -4.26 |
| | (1.82) | (5.71) | (0.02) | (34.11) | (0.11) | (0.03) | (9.43) | (0.12) | - | (0.49) | (0.06) | (0.75) |
| **Year Fixed Effect** | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| **$R^2$** | 0.12 | 0.30 | 0.03 | 0.21 | 0.25 | 0.06 | 0.74 | 0.08 | 1 | 0.39 | 0.52 | 1.00 |
| **Adjusted $R^2$** | -0.35 | -0.01 | -0.22 | -0.34 | -0.10 | -0.24 | 0.10 | -0.23 | - | 0.007 | -0.002 | 0.97 |
| **F-Statistic** | 0.55 | 2.40 | 5.80 | 0.67 | 1.71 | 1.00 | 1.45 | 1.08 | - | 1.91 | 1.42 | 41.25 |
| **(p-value)** | 0.81 | 0.03 | 2.59 | 0.71 | 0.13 | 0.44 | 0.38 | 0.39 | - | 0.11 | 0.30 | 0.12 |
| **N** | 50 | 65 | 1,840 | 35 | 60 | 165 | 15 | 130 | 5 | 40 | 20 | 10 |

Government subsidies have a positive impact on the ROA of companies operating in the "Administrative activities and support services industry" (with ID 13) ($\beta$=0.28, $p<0.10$), with a significance level of 10%. For the remaining industries, this impact is statistically non-significant.

Regarding the EBIT margin, the attribution of subsidy has a positive impact only in the companies of the "Captation, treatment and distribution of water activity sector; sanitation, waste management and depollution" industry (ID 5) ($\beta$=0.07, $p<0.10$), for a significance level of 10%.

Moving on to asset turnover, it can be observed that subsidies have a negative impact on this dependent variable for companies operating in the "Manufacturing industries" (ID 3) and "Accommodation, restaurants and similar" (ID 9) activity sectors ($\beta$=-0.05, $p<0.05$ and $\beta$=-0.16, $p<0.05$), for a significance level of 5%, and in the "Wholesale and retail trade, repair of motor vehicles and motorbikes" (ID 7) sector ($\beta$=-0.12, $p<0.10$), for a significance level of 10%.

Finally, the impact of subsidies on the market share of the firms in the sample is negative for firms in the "Accommodation, food and beverage industry" and "Consulting, scientific and technical activities" (ID 12) ($\beta$=-0.05, $p<0.05$ and $\beta$=-0.15, $p<0.05$), for a significance level of 5% and for firms in the "Administrative activities and support services" industry ($\beta$=-0.03, $p<0.10$), for a significance level of 10%.

The results suggest that firms in the "Accommodation, Restaurants and Similar Services" industry are the most affected by the receipt of government subsidies, as they see both their asset turnover and market share decrease after receiving them. On the other hand, companies from the "Water supply, sewerage, waste management and remediation activities" and "Administrative and support services activities" are the only ones to show improvements in their EBIT margin and ROA, respectively, after receiving subsidies.

The Chow test allows testing the stability and predictive ability of the estimated model, or verifying structural changes over the estimation period, so it is important for economic forecasting (Pereira, 2001). It shows if the regression coefficients are different for split data sets. Basically, it tests whether one regression line or two separate regression lines best fit a split set of data. Thus, to test whether the impact of subsidies is different across industries in the study, the Chow test was applied to the sample.

The Chow test is a F-test with the following F-statistic[1] for this specific case:

$$(1)\quad F = \frac{\frac{RSSp-(RSS1+RSS2+RSS3+RSS5+RSS6+RSS7+RSS8+RSS9+RSS11+RSS12+RSS13+RSS16)}{k}}{\frac{RSS1+RSS2+RSS3+RSS5+RSS6+RSS7+RSS8+RSS9+RSS11+RSS12+RSS13+RSS16}{N1+N2+N3+N5+N6+N7+N8+N9+N11+N12+N13+N16-2*k}}$$

Where RSSp is the residual sum of squares of the pooled (constrained) equation and $RSS_1$, $RSS_2$, $RSS_3$, $RSS_5$, $RSS_6$, $RSS_7$, $RSS_8$, $RSS_9$, $RSS_{11}$, $RSS_{12}$, $RSS_{13}$ and $RSS_{16}$, are the residual sum of squares of the industries with the ID number 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, and 16, respectively. K is the number or estimated parameters (k=13 in this case) and $N_1$, $N_2$, $N_3$, $N_5$, $N_6$, $N_7$, $N_8$, $N_9$, $N_{11}$, $N_{12}$, $N_{13}$ and $N_{16}$ are the number of observations in industry with ID number 1, 2, 3, 5, 6, 7, 8, 9, 11, 12 ,13 and 16, respectively.

Therefore, the residual sum of squares of each industry is presented in table 11.

[1] Font: Equation retrieved from Stata's Support Manual (https://www.stata.com/support/faqs/statistics/computing-chow-statistic/)

**Table 11** – Residual sum of squares.

Table 11 presents the residual sum of squares (RSS) for each industry and for the sample as a whole. "Pooled" refers to the full sample, with all industries. Each industry is identified by its ID number. This identification is presented in annex 5. N represents the number of observations.

| | RSS | | | | N |
|---|---|---|---|---|---|
| | **ROA** | **EBIT Margin** | **Asset Turnover** | **Market Share** | |
| **Pooled** | 9.8639 | 5,383.7076 | 114.237 | 90.9784 | 2,435 |
| **Industry 1** | 0.0647 | 4.0713 | 1.5635 | 7.2326 | 50 |
| **Industry 2** | 0.0674 | 0.3586 | 1.0216 | 6.4195 | 65 |
| **Industry 3** | 5.7819 | 70.3296 | 76.8117 | 0.7367 | 1,840 |
| **Industry 5** | 0.0426 | 0.039 | 1.5666 | 54.2414 | 35 |
| **Industry 6** | 0.0692 | 0.1804 | 6.0284 | 0.0212 | 60 |
| **Industry 7** | 2.1995 | 4,727.8901 | 7.0574 | 0.0525 | 165 |
| **Industry 8** | 0.0016 | 0.0004 | 0.0786 | 0.8188 | 15 |
| **Industry 9** | 0.3168 | 3.4114 | 3.0496 | 0.3052 | 130 |
| **Industry 11** | 0 | 0 | 0 | 0 | 5 |
| **Industry 12** | 0.2405 | 0.8381 | 0.4649 | 0.1905 | 40 |
| **Industry 13** | 0.2658 | 7.7339 | 0.8413 | 0.0026 | 20 |
| **Industry 16** | 0.0003 | 0.0142 | 0.0004 | 0.0018 | 10 |

The F-statistic calculated by using equation (1) for each dependent variable of the model is presented in table 12.

**Table 12 –** F-statistics of the Chow test.

Table 12 presents the result of F-statistic for each dependent variable of the model: ROA, EBIT margin, asset turnover and market share. The test statistic is distributed F(k, N1+N2+...+N16-2*k), where, in the specific case of this study, k is 13 and "N1+N2+...+N16" are the number of observations of each industry, presented in table 11. For this distribution (F(13,2,409), the critical value is t=0.02, for a significance level of 5%.

| | **ROA** | **EBIT Margin** | **Asset Turnover** | **Market Share** |
|---|---|---|---|---|
| **F statistic** | F(13;2,409)= 16.66 | F(13;2,409)= 21.89 | F(13;2,409)= 29.64 | F(13;2,409)= 55.46 |

After aplying the Chow test, the hypothesis that there are differences on the impact caused by government subsidies among industries is supported. Since for all dependent variables the F-statistic is higher than the critical value of the distribution, it means that the results are different for each industry.

### 6.2.3. Subbsidies' Impact on the level of competitiveness of companies: differences between industries, according to its level of capital intensity.

To analyse the impact of government subsidies on the competitiveness of firms according to the intensity level of each industry (Hypothesis 3) two distinct methods will be used, as mentioned above.

Table 13 presents the main results of panel data estimation with fixed effects, for the set of 2,435 observations in the sample for the period 2016-2020, to test Hypothesis 3 through method 1.

**Table 13** – Estimation results for the panel data model with fixed effects: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 1).

Table 13 presents the results of the estimation of equation (3). The dependent variables are: ROA (Return on Assets), EBIT Margin, Asset Turnover and Market Share. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE, GROWTH, Capital Intensity and an interactive variable, defined by the product between subsidy and capital intensity. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| **Independent Variables** | **Dependent Variables** | | | |
|---|---|---|---|---|
| | **ROA** | **EBIT Margin** | **Asset Turnover** | **Market Share** |
| **Size** | 0.002<br>(0.005) | 0.24**<br>(0.11) | -0.34***<br>(0.02) | 0.005<br>(0.01) |
| **Age** | -0.03**<br>(0.01) | 0.50*<br>(0.29) | 0.008<br>(0.04) | -0.004<br>(0.04) |
| **Growth** | 0.01***<br>(0.001) | 0.16***<br>(0.03) | 0.02***<br>(0.004) | 0.001<br>(0.003) |
| **Subsidy** | 0.10<br>(0.08) | 0.84<br>(1.76) | 0.11<br>(0.26) | -0.05<br>(0.23) |
| **Capital Intensity** | 0.07<br>(0.05) | 4.35***<br>(1.12) | 0.09<br>(0.16) | -0.02<br>(0.15) |
| **Subsidy*Capital Intensity** | -0.22<br>(0.16) | -1.52<br>(3.78) | -0.40<br>(0.55) | 0.02<br>(0.49) |
| **Constant** | 0.10**<br>(0.05) | -5.93***<br>(1.13) | 3.73***<br>(0.17) | 0.25*<br>(0.15) |
| **Year Fixed Effect** | YES | YES | YES | YES |
| **$R^2$** | 0.10 | 0.04 | 0.39 | 0.006 |
| **Adjusted $R^2$** | -0.13 | -0.21 | 0.24 | -0.25 |
| **F-Statistic** | 21.85 | 7.22 | 125.36 | 1.22 |
| **(p-value)** | 4.41 | 2.80 | 1.03 | 0.27 |
| **N** | 2,435 | 2,435 | 2,435 | 2,435 |

The results from the first method suggest that the EBIT margin is positively affected by the level of capital of the industries in the study ($\beta$=4.35, $p<0.01$), with a significance level of 1%.

Nevertheless, method 1 does not provide any significant results regarding the relation between the level of capital of the industries and the subsidy attribution, leading to the conclusion that the impact of the subsidies is not related with the intensity of capital of the industry.

Although method 1 does not identify any relationship between the attribution of subsidies and the industries' capital level, the second method, by clustering the companies into subsamples according to the level of capital intensity of the industry where they operate, may lead to different conclusions.

Table 14, 15, 16 and 17 present the main results of panel data estimation with fixed effects for the set of 2,435 observations in the sample for the period 2016-2020 for the dependent variables ROA, EBIT margin, asset turnover and market share, respectively, to test Hypothesis 3 by using method 2.

**Table 14** - Estimation results for the panel data model with fixed effects for the dependent variable ROA: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2).

Table 14 presents the results of the estimation of equation (2) for the dependent variable ROA. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE, GROWTH, Capital Intensity and an interactive variable, defined by the product between subsidy and capital intensity. HH, MH, ML and LL corresponds to the group of industries with high, medium high, medium low and low capital level, respectively. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| | | **Dependent Variable** | | | |
|---|---|---|---|---|---|
| | | **ROA** | | | |
| | | **HH** | **MH** | **ML** | **LL** |
| **Independent Variables** | **Subsidy** | 0.001<br>(0.02) | -0.004<br>(0.005) | 0.01<br>(0.02) | -0.01<br>(0.03) |
| | **Size** | 0.0009<br>(0.02) | 0.0006<br>(0.005) | -0.03<br>(0.03) | 0.002<br>(0.02) |
| | **Age** | -0.04<br>(0.04) | -0.02<br>(0.01) | -0.02<br>(0.10) | -0.04<br>(0.06) |
| | **Growth** | 0.02***<br>(0.005) | 0.03***<br>(0.003) | 0.02**<br>(0.008) | 0.01***<br>(0.002) |
| | **Capital Intensity** | 0.01<br>(0.15) | 0.18<br>(0.25) | -0.01<br>(0.43) | -0.78*<br>(0.44) |
| | **Constant** | 0.10<br>(0.15) | 0.009<br>(0.14) | 0.38<br>(0.26) | 0.56**<br>(0.27) |
| | **Year Fixed Effect** | YES | YES | YES | YES |
| | **$R^2$** | 0.46 | 0.09 | 0.08 | 0.15 |
| | **Adjusted $R^2$** | 0.27 | -0.14 | -0.26 | -0.12 |
| | **F-Statistic** | 9.98 | 16.79 | 0.84 | 3.53 |
| | **(p-value)** | 5.31 | 1.26 | 0.58 | 0.0005 |
| | **N** | 145 | 1,925 | 120 | 245 |

**Table 15** - Estimation results for the panel data model with fixed effects for the dependent variable EBIT margin: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2).

Table 15 presents the results of the estimation of equation (2) for the dependent variable EBIT Margin. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE, GROWTH, Capital Intensity and an interactive variable, defined by the product between subsidy and capital intensity. HH, MH, ML and LL corresponds to the group of industries with high, medium high, medium low and low capital level, respectively. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| | | **Dependent Variable** | | | |
|---|---|---|---|---|---|
| | | **EBIT Margin** | | | |
| | | **HH** | **MH** | **ML** | **LL** |
| **Independent Variables** | **Subsidy** | 0.17<br>(0.32) | 0.01<br>(0.02) | 0.08<br>(0.06) | 1.38<br>(1.28) |
| | **Size** | 0.35<br>(0.25) | -0.04**<br>(0.02) | -0.14**<br>(0.06) | 1.14<br>(0.88) |
| | **Age** | -1.23*<br>(0.70) | 0.06<br>(0.04) | 0.23<br>(0.27) | 3.90*<br>(2.28) |
| | **Growth** | 0.39***<br>(0.08) | 0.10***<br>(0.01) | 0.54***<br>(0.02) | 0.14<br>(0.09) |
| | **Capital Intensity** | -2.07<br>(2.48) | -1.27<br>(0.88) | -0.22<br>(1.14) | -16.76<br>(18.15) |
| | **Constant** | 1.59<br>(2.40) | 0.86*<br>(0.48) | 0.65<br>(0.69) | -12.85<br>(11.07) |
| | **Year Fixed Effect** | YES | YES | YES | YES |
| | **$R^2$** | 0.30 | 0.06 | 0.87 | 0.09 |
| | **Adjusted $R^2$** | 0.06 | -0.18 | 0.83 | -0.19 |
| | **F-Statistic** | 5.19 | 10.36 | 66.41 | 2.03 |
| | **(p-value)** | 7.68 | 1.17 | 3.71 | 0.04 |
| | **N** | 145 | 1,925 | 120 | 245 |

**Table 16** - Estimation results for the panel data model with fixed effects for the dependent variable asset turnover: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2).

Table 16 presents the results of the estimation of equation (2) for the dependent variable Asset Turnover. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE, GROWTH, Capital Intensity and an interactive variable, defined by the product between subsidy and capital intensity. HH, MH, ML and LL corresponds to the group of industries with high, medium high, medium low and low capital level, respectively. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| | | **Dependent Variable** | | | |
|---|---|---|---|---|---|
| | | **Asset Turnover** | | | |
| | | **HH** | **MH** | **ML** | **LL** |
| **Independent Variables** | **Subsidy** | -0.11*<br>(0.06) | -0.06***<br>(0.02) | -0.07<br>(0.05) | -0.16*<br>(0.08) |
| | **Size** | -0.55***<br>(0.05) | -0.33***<br>(0.02) | -0.36***<br>(0.06) | -0.34***<br>(0.06) |
| | **Age** | 0.08<br>(0.13) | 0.03<br>(0.05) | -0.11<br>(0.25) | 0.01<br>(0.15) |
| | **Growth** | 0.03**<br>(0.02) | 0.12***<br>(0.01) | 0.04**<br>(0.02) | 0.01*<br>(0.006) |
| | **Capital Intensity** | -0.11<br>(0.48) | 2.13**<br>(0.91) | 0.52<br>(1.05) | 0.62<br>(1.19) |
| | **Constant** | 4.84***<br>(0.46) | 2.50***<br>(0.50) | 3.98***<br>(0.63) | 3.37***<br>(0.73) |
| | **Year Fixed Effect** | YES | YES | YES | YES |
| | **$R^2$** | 0.74 | 0.39 | 0.49 | 0.46 |
| | **Adjusted $R^2$** | 0.64 | 0.23 | 0.31 | 0.30 |
| | **F-Statistic** | 33.16 | 106.79 | 9.42 | 17.85 |
| | **(p-value)** | 4.34 | 4.06 | 7.22 | 3.44 |
| | **N** | 145 | 1,925 | 120 | 245 |

**Table 17** - Estimation results for the panel data model with fixed effects for the dependent variable Market Share: the effect of subsidies on competitiveness depends on the industry in which the firm operates, according to its level of capital (H3 - Method 2).

Table 17 presents the results of the estimation of equation (2) for the dependent variable Market Share. The explanatory variables are SUB (Subsidy for Business Investment), SIZE, AGE, GROWTH, Capital Intensity and an interactive variable, defined by the product between subsidy and capital intensity. HH, MH, ML and LL corresponds to the group of industries with high, medium high, medium low and low capital level, respectively. Fixed effects were used as the panel data estimation method, for the period from 2016 to 2020. The first row presents the coefficient values and the value of the standard deviation is presented between "()". *, ** and *** indicate statistical significance level of 10%, 5% and 1%, respectively. N corresponds to the number of observations.

| | | **Dependent Variable** | | | |
|---|---|---|---|---|---|
| | | **Market Share** | | | |
| | | **HH** | **MH** | **ML** | **LL** |
| **Independent Variables** | **Subsidy** | -0.07** (0.03) | -0.04** (0.02) | -0.09 (0.12) | -0.001 (0.005) |
| | **Size** | 0.01 (0.02) | 0.004 (0.02) | 0.01 (0.14) | 0.003 (0.004) |
| | **Age** | -0.02 (0.06) | -0.001 (0.04) | -0.46 (0.60) | -0.004 (0.01) |
| | **Growth** | -0.02** (0.007) | 0.009 (0.01) | 0.07 (0.05) | 0.0003 (0.0004) |
| | **Capital Intensity** | -0.63*** (0.22) | -0.50 (0.89) | 5.85** (2.50) | 0.07 (0.08) |
| | **Constant** | 0.64*** (0.21) | 0.43 (0.49) | -0.06 (1.50) | 0.008 (0.05) |
| | **Year Fixed Effect** | YES | YES | YES | YES |
| | **$R^2$** | 0.17 | 0.009 | 0.12 | 0.05 |
| | **Adjusted $R^2$** | -0.11 | -0.25 | -0.20 | -0.24 |
| | **F-Statistic** | 2.51 | 1.49 | 1.38 | 1.05 |
| | **(p-value)** | 0.01 | 0.15 | 0.21 | 0.40 |
| | **N** | 145 | 1,925 | 120 | 245 |

As seen in hypothesis 1, subsidy has a negative impact on asset turnover and market share.

Through this second method, it is possible to verify that this impact is larger in industries with higher level of capital. In fact, subsidy has a negative impact on market share in industries with high and medium-high capital ($\beta$=-0.07, $p<0.05$ and $\beta$=-0.04, $p<0.05$, respectively), for a significance level of 5%. Additionally, the impact on asset turnover is also negative in high and medium high capital industries ($\beta$=-0.11, $p<0.10$ and $\beta$=-0.06, $p<0.01$, respectively), for significance levels of 10% and 1%, respectively. Moreover, firms with low

capital also see their asset turnover decrease ($\beta$=-0.16, $p<0.10$), for a significance level of 10%.

In line with the results found by Zhu et. al (2019), who in their study show that the level of R&D and the competitiveness of firms are negatively related when considering Government subsidies, the allocation of subsidies also seems to have a negative impact on the competitiveness of firms (measured by ROA, EBIT Margin, asset turnover and market share) of industries with higher levels of capital, measured through their fixed assets.

Although the opposite would be expected, the evidence in this study suggests that, in fact, industries with higher levels of capital, i.e. with a higher percentage of fixed assets in relation to their total assets, will, after receiving the subsidy, use it to invest in current assets in larger quantities, in relative terms, than in fixed assets. An explanation to this phenomenon could rely on the fact that these companies opt to take advantage of the subsidy granted to try to reduce their dependence on fixed assets, disinvesting in them and "converting" them into current assets, as these represent an easier consumption, recovery, and conversion into cash in a shorter period of time.

## 7. Conclusions

This study analysed the impact of government subsidies on firms' competitiveness. It was also analysed whether this impact is different according to the industry in which the companies operate or not, namely when the average level of capital of each industry is considered.

Based on a sample of 487 Portuguese firms for the period between 2016 and 2020, the results suggest that public financing, through subsidies to investment projects, has a predominantly negative impact on firms' competitiveness, measured by the return on assets, EBIT margin, asset turnover and market share of companies. Furthermore, the results show that this negative impact is different between industries, being stronger on the industries with the highest level of capital intensity.

It would be expected that state intervention, through the attribution of government subsidies, would act on market failures and make companies more competitive. However, the evidence on this study suggests that Government subsidies granted to companies are not able to improve their competitiveness, presenting a negative effect on the competitiveness indicators of the subsidized companies. It would also be expected that industries with higher level of capital would be the most benefited from Government subsidies, since these are the ones that are likely to invest more in new fixed assets, but evidence in this study suggests otherwise.

Even though the relationship between Government subsidies and firm competitive performance has attracted the attention of academics, the results are often disparate. The brief literature review shows that there is no single point of view on the relationship between subsidies and companies' competitiveness. The heterogeneity of the academic contributions shows that most of the research conducted is empirical work, thus, although there is some progress, this topic remains controversial. It is possible that the complexity and fragmentation in this domain results from the difficulty in conducting comparisons between investigations with different study objects, research methodologies, data, and results.

The conducted study aims to provide a detailed analysis of the exploration of the interaction between Government subsidies and the competitiveness of subsidized companies and present the different results according to the industries the subsidy is granted to, namely

when considering their level of capital, and thus make available to Government authorities a quantitative assessment of the effectiveness of public subsidy policies.

The research does, however, present some limitations. The fact that the analysis by industries contains samples with few observations may be a biasing factor in the results obtained. For instance, "Real estate activities" industry (ID 11) presents only five observations. Moreover, the time considered may not be sufficient to reflect the impact of subsidies in the medium and long term, given that the materialisation of subsidised firms' investments often has no immediate effects on their productivity and sales.

To deepen the subject matter of the present study, future research could include a longer time interval, to enable the appearance of medium and long-term effects. It is expected that in the long term, as some previous studies have already proven (Spicka, 2018), the impact becomes positive, since the investments made begin to produce effects on productivity and sales, increasing the asset turnover and market share of companies, respectively, which, according to the evidence of this and previous studies, in the short term are negatively affected.

Besides the longer period, it would be good to conduct studies at the industry level, since there are still few studies on this specific topic in the literature and, as it was possible to observe in this study, the results, although good, could be better if a more detailed analysis and a more consistent sample of each industry were made.

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## Annexes

**Annex 1** – Studies considered in the literature review.

The table summarizes the information found in the literature and shows the similarities between the studies.

| Authors | Variables Analysed | Theories/Main Contributions |
|---|---|---|
| **Meixner et al. (2020)** | Profitability; Competitiveness. | The impact of subsidies is positive. |
| **Spicka et al. (2017)** | Profitability; Labour productivity; Efficiency of production consumption. | Subsidies should improve the indicators analysed and contribute to an increase of the supported companies' competitiveness. |
| **Zhu et al. (2019)** | Intensity of R&D investment; Financial competitiveness. | Subsidies have an adjustment effect on the relationship between R&D investment intensity and the companies' financial competitiveness. |
| **Špička (2018)** | Productivity; Capital Structure; Labour productivity. | Subsidies have a positive impact on subsidized companies in the long run; in the short term, productivity does not significantly improve. |
| **Meuleman & Maeseneire (2012)** | Access to external financing. | Companies that receive subsidies have better access to financing and are more willing to invest in R&D and become more innovative, enhancing their financial competitiveness. |
| **Mulier & Samarin (2021)** | Competitiveness level; R&D level or intensity of knowledge. | There is a lot of heterogeneity among the sectors studied.<br>Easier access to bank loans. |
| **Ravšelj & Aristovnik (2017)** | Corporate performance. | R&D subsidies have a positive impact on corporate performance. |

**Annex 2 –** Methods applied in the existing literature.

The table summarizes the information regarding the methods used by the authors of the studies considered in the literature review.

| Authors | Country of Study | Sample Size | Industrial Sector | Data Collection | Statistical Analysis |
|---|---|---|---|---|---|
| Oliver Meixner, Franz Schlögl, and Manfred Pichlbauer | Austria | 69 | Food and beverage industry | Personal Interviews | Simple correlation analysis |
| Jindrich Spicka, Zdenka Naglova, Martin Gurtler | Czech | 130 | Meat Processing Industry | Database | Regression analysis using fixed effect models |
| Zhihong Zhu, Zhiwei Zhu, Ping Xu, Dawei Xue | China | 98 | Energy Industry | Database | Regression |
| Jindřich Špička | Czech | 550 | Food and beverage industry | Database | Average treatment effect (ATE); Difference-in-differences method |
| Miguel Meuleman, Wouter De Maeseneire | Belgium | 1,107 | All | Database | Regression analysis using fixed effect models |
| Klass Mulier, Ilia Samarin | Europe | 1,735 | All | Database | Difference-in-differences method |
| Dejan Ravšelj, Aleksander Aristovnik | Slovenia | 407 | All | Database | Ols regression |

**Annex 3** - Distribution of the sample by sector of activity (CAE-Rev.3, 2 Digits).

The table presents the distribution of the sample companies by sector of activity (CAE-Rev.3, 2 Digits), according to the CAE of each section.

| CAE-Rev.3, 2 Digits | Section | Sector Name | No. of sample companies |
|---|---|---|---|
| 01; 02 | A | Agriculture, livestock, hunting, forestry and fishing | 10 |
| 08 | B | Extractive industries | 13 |
| 10; 11; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32 | C | Manufacturing industries | 368 |
| 38 | E | Water supply; sewerage, waste management and remediation activities | 7 |
| 41; 42; 43 | F | Construction | 12 |
| 45; 46; 47 | G | Wholesale and retail trade; repair of motor vehicles and motorbikes | 33 |
| 49; 52 | H | Transport and storage | 3 |
| 55; 56 | I | Accommodation, Restaurants and Similar Services | 26 |
| 68 | L | Real estate activities | 1 |
| 70; 71; 72; 73 | M | Consulting, scientific, technical and similar activities | 8 |
| 80; 82 | N | Administrative and support service activities | 4 |
| 93 | R | Artistic, entertainment, sports and recreational activities | 2 |

**Annex 4** – Variable Definition.

The table illustrates the construction of the variables and their measurement, where i refers to the firm, s refers to the industry and t refers to the year.

| | Variable | Definition |
|---|---|---|
| **Dependent Variables** | Return on Assets | $EBIT_{i,t}$/Total $Assets_{i,t}$ of company i in year t. |
| | EBIT Margin | $EBIT_{i,t}$/$Sales_{i,t}$ of company i in year t. |
| | Asset Turnover | $Sales_{i,t}$/Total $Assets_{i,t}$ of company i in year t. |
| | Market Share | $Sales_{i,t}$/$Sales_{s,t}$ of company i and industry s in year t. |
| **Independent and Control Variables** | Subsidy | Dummy variable assuming the value 1 if the company received a subsidy in a given year and on the years after receiving it, or assuming the value 0 otherwise. |
| | Size | $Log_e$(Total $Assets_{i,t}$)of company i in year t. |
| | Age | $Log_e(Age_{i,t})$ of company i in year t. |
| | Growth | $(Sales_{i,t} – Sales_{i,t-1})/Sales_{i,t-1}$ of company i in year t. |
| | Capital Intensity | Fixed $Assets_{i,t}$/Total $Assets_{i,t}$ of company i in year t. |

**Annex 5** – Sectors of activity identification.

The table presents the identification of each activity sector considered in the study, through an ID number.

| ID | Sector Name |
|---|---|
| 1 | Agriculture, livestock, hunting, forestry and fishing |
| 2 | Extractive industries |
| 3 | Manufacturing industries |
| 5 | Water supply; sewerage, waste management and remediation activities |
| 6 | Construction |
| 7 | Wholesale and retail trade; repair of motor vehicles and motorbikes |
| 8 | Transport and storage |
| 9 | Accommodation, Restaurants and Similar Services |
| 11 | Real estate activities |
| 12 | Consulting, scientific, technical and similar activities |
| 13 | Administrative and support service activities |
| 16 | Artistic, entertainment, sports and recreational activities |