UNIVERSIDADE CATÓLICA PORTUGUESA

# The efficiency of Horizon 2020 funds on Portuguese SME's performance

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# Resumo

De 2014 a 2020, várias PME na União Europeia receberam fundos através do programa Horizonte 2020.

Neste trabalho, foram aplicados métodos de Propensity Score Matching (PSM) para analisar o impacto dos fundos provenientes do Horizonte 2020 na performance das PME Portuguesas. A comparação da evolução de indicadores específicos de empresas com e sem fundos, entre os anos de 2013 e 2019, permitiu perceber se há vantagens intrínsecas em receber este tipo de apoios no que toca a performance e competitividade. Neste caso, os indicadores selecionados foram ROCE, ROA, Gross Margin, EBITDA Margin, Operating Margin e Net Margin.

É possível concluir que, com base nos rácios selecionados, empresas que receberam fundos de 2014 a 2017 revelam melhor performance e têm vantagem competitiva sobre as que não receberam fundos. Isto é especialmente evidente no impacto em ROCE, EBITDA Margin, Operating Margin e Net Margin.

Palavras-chave: PME, Propensity Score Matching, Horizonte 2020, Performance

# Abstract

From 2014 to 2020, several SME in the European Union received funding through the Horizon 2020 program.

In this paper, the Propensity Score Matching (PSM) methods were applied to analyse the impact of the Horizon 2020 funds on Portuguese SME's performance. Comparing the evolution of specific indicators from funded and unfunded enterprises, between the years of 2013 and 2019, allows us to understand if there are any advantages in receiving the funds regarding performance and competitiveness. In this case, the selected indicators were ROCE, ROA, Gross Margin, EBITDA Margin, Operating Margin and Net Margin.

We are able to conclude that, based on the indicators selected, the enterprises funded from 2014 to 2017 reveal better performance and have competitive advantage over those that have not received funding. This is especially evident in the impact on ROCE, EBITDA Margin, Operating Margin and Net Margin.

Keywords: SME, Propensity Score Matching, Horizon 2020, Performance

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# Introduction

The main goal of this paper is to understand if funding from the Horizon 2020 program allowed Portuguese SME to have a greater performance and subsequently competitive advantage over its fellow unfunded enterprises.

For that comparison, Propensity Score Matching (PSM) methods proposed by (Rosenbaum and Rubin 1983) were used, in which a synthetic control group is built and the average impact of the treatment, i.e. the funding, is estimated. The synthetic control group is formed of Portuguese SME that have received no funding from the Horizon 2020 program, to be "paired" with the ones who have received, based on similarities before the funding occurred. This "pairing" is defined as PSM on nearest-neighbors, and in this paper, we opted to match on 5 nearest-neighbors to take advantage of our broad dataset, increasing the accuracy of the results. After the matching, the evolution of specific ratios from 2013 to 2019 was compared, i.e., from the year prior to the start of the Horizon 2020 program to 2 years after the funding of the Portuguese SME.

The forementioned ratios are Return on Capital Employed (ROCE), Return on Assets (ROA), Gross Margin, Operating Margin, Net Margin and EBITDA Margin. They were selected based on previous literature, data availability and domain knowledge.

In the end, we are able to answer the hypothesis proposed in the beginning of this paper: Portuguese SME that have received funding from the Horizon 2020 program show greater sustainable development as well as competitive advantage when compared to unfunded enterprises in the same industry.

In this thesis, Chapter 1 will be focusing on the literature review regarding SME and their competitiveness, the importance of the EU funds and the impact these funds have on SME. Chapter 2 gives a more detailed view on the Horizon 2020 program, focusing on the types of funding. Finally, Chapter 3 presents the methodology and the process of data selection and in Chapter 4 we analyse the results of the analysis.

# Chapter 1
# Literature Review

## 1. Small to Medium Enterprises (SME)

### 1.1. Definition of SME

In 2003, The European Commission revised the original definition of SME created in 1996 and added some amendments, namely regarding the values of annual turnover and balance.

According to the EU, the following characteristics define a SME (updated in 2003 through the 361/2003/EC Recommendation from its initial version of 1996 - 96/280/EC Recommendation):

- less than 250 employees
- turnover inferior to €50.000.000 or annual balance inferior to €43.000.000
- maximum ownership of other company of 25%

SME can additionally be divided into 3 categories:

| Category | Number of workers | Annual Turnover | Annual Balance |
|---|---|---|---|
| Microenterprise | <10 | € 2 Million | € 2 Million |
| Small enterprise | <50 | € 10 Million | € 10 Million |
| Medium enterprise | <250 | € 50 Million | € 43 Million |

**Table 1**: Categories of SME[1]

[1] Source: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003H0361&from=EN

## 1.2. Importance of SME

According to the OECD, "SME are crucial for the well-being of both the economy and the society. They represent roughly 99% of all businesses and generate about 60% of employment. SME are essential for the sustainable and inclusive economic growth. They are instrumental to guarantee the economic and social adaptation to great transformations, such as digitalisation, globalisation, ageing and environmental pressures."[2]. In the case of Portugal, by 2019, SME represented 99,9% of all businesses, employed 58% of the active population and were responsible for 57% of the national turnover. The importance of SME in the Portuguese economy is reinforced by its contribution to the Gross Domestic Product (GDP), with the data revealing that the SME were responsible for 38% of the Gross Value Added (GVA)[3].(PORDATA 2019)

Besides the importance that SME have, some authors demonstrate that these enterprises are less affected during economic crisis thanks to their ability to adapt do the changing conditions (Keskin et al. 2010), making them essential to re-launch the economy after said crisis.

Due to the vital role of SME for the national and regional development, the European Commission finds it crucial to provide support for SME to achieve its main priorities, such as economic growth, job creation and socio-economic cohesion.

Thus, by facilitating the investments for SME and boosting their ability to respond to trade and investment opportunities, the EU is strengthening the performance of SME and, consequently, having a positive impact in the economic and demographic development, as well as on employment levels (Ph, Marius, and Ciubotariu 2013).

[2] Angel Gurría, OECD Secretary-General

[3] Source: https://www.pordata.pt/Subtema/Portugal/Pequenas+e+M%C3%A9dias+Empresas+(PME)-378

## 1.3. Sources of Competitiveness of SME

The competitiveness theory first appeared in the 1980s, by the hands of (Ethier 1982; Helpman 1981; Krugman 1980), and accompanied the ideas of the "founding fathers" of Economics: Adam Smith, David Ricardo, Joseph Schumpeter, Peter Drucker, Robert Solow, amongst others. It reached its greater development during the 1990s with Michael Porter's book "The Competitive Advantage of Nations"(Porter 1990), in which he identifies the sources of sustainable prosperity in global economy.

In a very simplistic way, we may state that one firm possesses a competitive advantage over its rivals when it earns (or has the potential to earn) a persistently higher rate of profit (Grant 2005). Although this statement is not entirely truthful, as an enterprise may renounce current profit to invest in market share, technology, etc. (Rumelt and Kunin 2003), we can assume that there must be driving factors for enhancing enterprise competitiveness. However, as it would be expectable, there are a lot of divergences on which specific factors drive competitiveness. For that matter, this thesis will focus on Ahmedova's (Ahmedova 2015) paper, in which the situation of the SME sector is examined and five key factors are defined for sustainable development and competitiveness:

- Access to finance
- Implementation of best practices
- Intellectual property-related activities
- Internationalization
- Innovation activities

### 1.3.1. Access to Finance

One weakness that SME possess is lacking creditworthiness, resulting in difficulty securing funds (Kasekende and Opondo 2003). For that matter, facilitated access to finance has an important role in SME competitiveness, as it allows them to have more liquidity and cash flow, resulting in greater scope for investment in innovation and export development.

Targeted initiatives ought to make this access less risky through loan or credit guarantees, therefore improving SME's access to finance. The resulting innovation and exporting improvement would help firms "generate export earnings, overcome capital constraints and increase capital investment" (Love and Roper 2015).

### 1.3.2. Implementation of best practices

To achieve and maintain competitive advantage, it is imperative to develop organizational learning in SME. In other words, managing the knowledge in a firm to achieve a better performance (Ahmedova 2015), as some of the major problems that firms face are related to knowledge loss (Singh, Garg, and Deshmukh 2008). Organizational knowledge loss can be defined as the evaporation of knowledge that accumulates from learning and from individual and collective actions (Perrott 2007).

SME should focus on developing HR initiatives with the goal of enhancing management talent and techniques as well as improving the level of equipment, technology, and innovation capabilities (Singh, Garg, and Deshmukh 2010). Furthermore, SME should improve their networking with other SME and entities in all stages of the supply chain to boost their competitiveness and strengthen their sustainability (Gloet 2006), as well as to acquire new or missing knowledge (van de Vrande et al. 2009).

### 1.3.3. Intellectual property-related activities

The value of intellectual property (IP) is many times underappreciated, even though it is vital in the increasingly knowledge-driven economy (Sukarmijan and Sapong 2014). An effective management of IP rights may benefit SME with specific needs and technological magnitude, as it will influence their ability to make the most of their innovative capacity and recover their investments (Burrone 2005).

As it was previously mentioned, SME often have financial difficulties that can endanger future endeavours to grow. Taking patents can help to mitigate said difficulties. According to (de Rassenfosse 2012), there are three channels enterprises can use: protecting their patents early in order to reduce the asymmetry of information; using patents as collateral to secure funding; licensing patents to generate additional cash and, ultimately, use it to further invest in innovation.

(de Rassenfosse 2012) also states that "while SME mainly patent to protect from imitation, almost half of them also do it for monetary reasons". The same applies for large companies, that do it to prevent imitation as well, and to protect their freedom to operate. In other words, to exploit their invention's results (González-Álvarez and Nieto-Antolín 2007).

It is essencial for government and policy makers to promote a more effective use of the IP system for SME by raising awareness and improving knowledge of all its elements, including not just patents, but also trademarks, industrial designs, utility models, copyrights, etc. There should also be an effort in facilitating the application process and reducing transaction costs for SME when using the IP system. For example, introducing the concept of accelerated grants of IP rights or even having lower application fees for SME (Sukarmijan and Sapong 2014). However, this doesn't mean that patent offices should "lower the bar" on patent quality, as it would be tempting for them to focus on quantity of patents at the expense of quality (de Rassenfosse 2012).

### 1.3.4. Internationalization

(Francis and Collins-Dodd 2004) analysed the impact of export promoting programs in Canadian SME. They observed that SME who received more funding from these programs, revealed greater internationalization capacity, and subsequently, competitive advantage over other similar firms in the industry.

Nevertheless, (Bartlett and Beamish 2018) argue that for a firm to attain sustainable competitive advantage internationally, it must fulfil three strategic objectives: attain global-scale efficiency in its activities, develop multinational flexibility to supervise country-specific risks and opportunities, and create the ability to learn from its international exposure and exploit that learning globally.

Moreover, (Suárez-Ortega and Álamo-Vera 2005) and (José Acedo and Florin 2006) conclude that, as the source of competitive advantage is rather unique regarding each company's characteristics, the crucial force is really played by management, whose role allows to identify the firm's strategic strengths and weaknesses and direct them towards being better competitors. Thus, it is crucial to create programs that develop manager's skills and capabilities, as well as their awareness on the advantages of internationalizing.

Equally important is the need for public assistance for SME to go global (Suárez-Ortega and Álamo-Vera 2005), as they face many constraints due to their limited resources and scarcity of innovation in capacity development (Singh et al. 2008).

### 1.3.5. Innovation activities

Innovation is extensively recognized as one of the most important sources of sustainable competitive advantage in a progressively dynamic environment, as it leads to product and process development, makes continuous breakthroughs,

enables firms' growth and efficiency, and ultimately, allows enterprises to be more profitable than those who do not innovate (Atalay, Anafarta, and Sarvan 2013).

According to (van de Vrande et al. 2009), open innovation can be separated into two categories: technology exploitation (innovation practices that result in outflows of knowledge) and technology exploration (deliberate inflows of knowledge). Their paper observed that when it comes to technology exploitation, most SME try to benefit from the knowledge of their own (non-R&D) workers. On the other hand, in terms of technology exploration, most SME try to involve their customers in the innovation process, supporting the value of user innovation referred in (von Hippel 2005)'s work. Both actively contribute to the higher competitiveness of SME.

#### 1.3.5.1.Benefits and Barriers for SME Innovation

A great barrier that small firms often encounter is the lack of resources to develop and commercialize new in-house products, being inclined, or even forced to seek other firms to collaborate with (van de Vrande et al. 2009).

The size of the firm is also a differentiator in the adoption of open innovation, with medium-sized enterprises adopting it more often than small enterprises, as innovation associated costs have a much bigger impact on small firms (Madrid-Guijarro, Garcia, and Van Auken 2009). Furthermore, smaller firms can be dominated by larger incumbents according to (Porter 2004) and receive unfavourable terms in joint programmes as well. (Rosenbusch, Brinckmann, and Bausch 2011) refer to these obstacles as liabilities of smallness and newness, in other words, complications smaller, more recent firms face when entering a market. However, their characteristics may prove to be beneficial in some situations. For example, newer and smaller firms are more flexible than established firms, which may result in greater innovation-success (Amit and

Schoemaker 1993). Moreover, they can adapt to changing environments more easily or even create sudden industry change themselves. Therefore, the so called liabilities of newness and smallness can in fact be assets for SME if the entrepreneurs follow the appropriate strategies (Rosenbusch et al. 2011).

Although innovation may require substantial initial investments, greater risks, and uncertainty, the benefits such as differentiation from competition, customer loyalty, premium prices for innovative products, and entry barriers for potential imitators generally seem to exceed these drawbacks.

(Rosenbusch et al. 2011) conclude in their paper that SME benefit more from having an innovation driven strategy than from just developing innovative products. Moreover, focusing on innovation all along the value chain will result in better perception from the market, higher brand equity, better partners and attracting more qualified employees.

#### 1.3.5.2.Inter-firm innovation vs innovation with external partners

When following an innovation strategy, SME face the dilemma of pursuing the projects either internally or via external partners. The opinions diverge on this matter as different authors defend contradictory perspectives.

On one hand, (Rosenbusch et al. 2011) advocate that "internal innovation leads to greater performance than innovation projects with external partners", as innovation with external entities may result in longer duration of project, leading to greater costs with coordination, supervision and intellectual property protection efforts. They defend that internal innovation speeds up the project as the decision process is facilitated, permitting the full allotment of the project's returns for the SME. (Zeng, Xie, and Tam 2010) also concluded that vertical cooperation all along the value chain (inter-firm) has a greater role in innovation for SME than cooperation with external partners.

On the other hand, (Czarnitzki, Ebersberger, and Fier 2007) and (Lee et al. 2010) defend networking with other firms as a way of facilitating the innovation process for SME, thanks to the collaboration with other firms at the R&D or commercialisation stages respectively. Accordingly, the policy makers should create effective institutional conditions to ease learning and cooperation between SME and external partners (Zeng et al. 2010).

In sum, the eco-system in which SME operate is of crucial importance, as it can either enable or limit their strategic development and, consequently, have a major impact on the firm's decision of innovation strategy (Love and Roper 2015).

## 1.4. Importance of EU funds

Regarding the forementioned barriers to SME innovation, such as lack of resources or liability of smallness, we understand the importance and need of additional funding for these enterprises.

Most Political spaces, either national like the United States of America, or supra-national like the European Union (EU), depend on a system of fiscal federalism which grants transfers across jurisdictions (Becker, Egger, and von Ehrlich 2010).

The major purpose of these transfers (in which we may include funds) is to institute equalization of fiscal capacity and per capita income amongst the participating jurisdictions (Ma 1997).

Following this line of thought, we get to the *raison d'être* of the EU funds. Not only do they have a key contribution to the social and economic development of countries, helping less developed countries to converge with the most developed ones (Beugelsdijk and Eijffinger 2005), but they are also responsible for regional development through financial support (Madrid-Guijarro et al. 2009).

### 1.4.1. Effectiveness of EU funds for SME

There are divided opinions on the true effectiveness of public funding: where some authors see palpable results in growth and development of enterprises, others highlight the obvious flaws in this redistribution mechanism.

For instance, (de Avellar and Botelho 2016; Duch-Brown, Montolio, and Mediavilla 2012; Foreman-Peck 2013) all conclude in their papers that SME innovation policy, more exactly SME funding, is both efficient and effective, highlighting the importance of investing in R&D development accompanied by an innovation driven strategy. Their studies try to estimate how an enterprise would have performed if it had not received innovation support, using propensity score matching (PSM) - the method chosen for this paper and that will be explained in a subsequent chapter. (de Avellar and Botelho 2016) observe that the innovation supporting programs increase the Brazilian SME spending with innovative activities. (Duch-Brown et al. 2012) show that recipient firms improve their performance as a direct result of public subsidy programs in Cataluña. Foreman-Peck's model (Foreman-Peck 2013) shows that self-reported innovation predicts differences in enterprise turnover growth with great significance and that it ultimately results in notable boosts to SME's revenue.

Nevertheless, some studies (Bachtrögler 2016; Norek 2018; Petelski, Milesi, and Verre 2020) have found that obtaining funds does not directly translate into SME being more efficient and innovative. In some cases, if entrepreneurs can easily access funds, it can lead to innovations projects being carried in an unplanned and unprofessional manner, resulting in great difficulty evaluating the efficiency of one's innovations as well as having worse results than SME that did not obtain funding at all. On that matter, (Bachtrögler 2016) shows that in regions with greater institutional quality (and less corruption), funds have larger positive impacts on GDP per capita growth, something that may be the key for better allocation of the current EU funds. The reason for this would be that the regions who need more support may be currently absorbing a significant amount

of funds with no visible results due to its institutional and political characteristics.

(Tomova et al. 2013) also conclude that EU funds' effectiveness is enhanced in the presence of a sound macro framework and of compliant fiscal policies with the European economic governance, leading ultimately to greater welfare and growth.

Based on the previous assumptions, (Dall'erba and Le Gallo 2007) infer that the funds are much more effective in more developed environments. Hence, it appears that the support provided by funds is least efficient where it is needed the most, as the growth and development in poorer regions are hindered by the unfavourable framework and scarcity of R&D capabilities. Thus, these funds ought to be accompanied by policies that enhance the competence of the receiving environments, to prevent the divergence between member countries.

### 1.4.2. Implications for the current applications of EU Funds

In the (European Commission 2017) interim evaluation, the areas for improvement related to the funds' effectiveness , match with the ones previously mentioned. Accordingly, they mention the importance of giving better support to disruptive innovation, particularly in SME, as Horizon 2020 has not been able to reach them as well as expected.

On the other hand, there is the need to improve the policy coordination at the EU, stimulating national reforms, in order to reinforce the Research and Innovation (R&I) systems in low-performing R&I countries, "through the European Semester, the Policy Support Facility and Smart Specialisation Strategies" (European Commission 2017).

Moreover, potential barriers to innovation must be better addressed, mainly in terms of "regulations, standards, access to finance and customer acceptance",

possibly by creating the appropriate framework conditions for full market perceptivity.

In its Interim Evaluation, the (European Commission 2017) states the following:

"Horizon 2020 is seen as improving participants' competitive advantage, for example, through international multi-disciplinary networks, the sharing of knowledge and technology transfer, and access to new markets."

And in this paper, I hope to break down this statement and infer if, indeed, the Horizon 2020 Funds bestow Portuguese SME with competitive advantage and are, subsequently, being effective in supporting innovation, as well as contributing to the sustainable development of said enterprises.

# Chapter 2
# Horizon 2020

## 2. What is Horizon 2020

Horizon 2020 is a Research and Innovation programme from the EU, with EUR 74.8 billion worth of funds available from 2014 to 2020. It is a financial instrument whose main goal is to maintain Europe's global competitiveness. It aligns with EU's targets of smart, sustainable, and inclusive economic growth, as well as job creation.

Its mission is to stimulate the production of world class science in Europe, remove barriers to innovation and ease the work relationship between the private and public sectors in order to deliver said innovation.

## 2.1. Types of Action

Horizon 2020 is segmented in several types of action, each one with its specific characteristics that we can observe in the following table:

| Action Types | Description | Who may apply |
|---|---|---|
| Research and innovation actions (RIA) | Funding for research projects tackling clearly defined challenges, which can lead to the development of new | Consortia of partners from different countries, industry, and academia. Min. 3 legal entities established in 3 Member |

| | | |
|---|---|---|
| | knowledge or a new technology. | States or Associated Countries. |
| Innovation actions (IA) | Funding is more focused on closer-to-the-market activities (e.g.: prototyping, testing, demonstrating, piloting, scaling-up etc.) which aim to produce new or improved products or services. | Consortia of partners from different countries, industry and academia. Min. 3 legal entities established in 3 Member States or Associated Countries. |
| Coordination and support actions (CSA) | Funding covers the coordination and networking of research and innovation projects, programmes and policies. Funding for research and innovation per se not covered. | Single entities or consortia of partners from different countries, industry and academia. Min. 1 legal entity established in 1 Member State or Associated Country. |
| Frontier research grants – European Research Council (ERC) | Funding available for projects in any field of research, carried out by a single national or multinational research team led by a Principal Investigator (PI). Sole evaluation criterion is scientific excellence. | Excellent young, early-career researchers, already independent researchers, and senior research leaders, of any nationality. 1 legal entity established in 1 Member State or Associated Country. |
| Support for training and career development – Marie Skłodowska-Curie Actions (MSCA, except cofund) | Funding available for research training and career development, international and intersectoral mobility, partnerships between academic and non-academic organisations, doctoral programmes, staff exchanges and outreach activities. | Early stage or experienced researchers of any nationality, technical staff, and national/regional research mobility programmes. Depending on the action, different eligibility rules apply. |
| SME Instrument (SME) | Instrument aimed at highly innovative SME with the ambition to develop their growth | Only SME can participate. Either a single SME or a consortium of SME |

| | | |
|---|---|---|
| | potential. It offers lump sums for feasibility studies, grants for an innovation project's main phase, and lastly, the commercialisation phase is supported indirectly through facilitated access to debt and equity financial instruments. | established in an EU or Associated Country. |
| Fast track to innovation (FTI) | Continuously open, innovator-driven calls will target innovation projects addressing any technology or societal challenge field. | Industry (including SME) with a minimum of three and maximum of five partners and a maximum EU contribution of €3 million per project. |

**Table2:** Horizon 2020 Types of Action[4]

As of January 1st of 2017, EUR 20.4 billion were allocated to 11 108 signed grants. The funds were allocated mainly through RIAs (39.3 %), frontier research grants awarded by the ERC (19.0 %), IAs (17.2 %) and MSCA (10.3 %). MSCA accounts for the highest number of grants signed (3246) followed by ERC (2440) and RIA (1680).[5]

### 2.1.1. IA, CSA and SME Instrument

The analysis in this paper will focus on the following types of action: Innovation Actions (IA), Coordination and support actions (CSA) and SME

[4]Source: https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/Facsheet_SME_H2020_Nov2015.pdf
[5]Source: https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/evaluation-impact-assessment-and-monitoring_en

Instrument (SME); as they are the ones from whom SME benefit the most. As such, these mechanisms are explained in greater detail below.[6]

**Innovation Actions (IA)**

The IA funding focuses on activities which aim to produce new or improved products or services.

The financing rate for IA differs between profit and non-profit organizations. Profit making entities are financed in 70% of their direct costs and 25% of their indirect costs. Whereas non-profit organisations are financed at 100% of direct costs and 25% of indirect costs. The typical duration of these types of actions goes from 30 to 36 months and the European Commission's (EC) contribution goes from €2M to €5M.

**Coordination and Support Action (CSA)**

The CSA funding concentrates on the coordination and networking of research and innovation projects, programmes and policies.

The financing rate for CSA is 100% of the direct costs and 25% of the indirect costs. The typical duration goes from 12 to 30 months and the EC's contribution goes from €0.5M to €2M.

**The SME Instrument**

The SME Instrument is aimed at innovative SME that wish to develop their growth potential. It is divided in three distinct phases through the innovation cycle:

- Phase 1: There is an evaluation of the technological and commercial potential of a project. The EC's Contribution is of €50K per project.
- Phase 2: A main grant is provided to support innovative projects focused on activities such as demonstration, testing, prototyping, pilot lines, scale-up studies, miniaturisation, design, performance verification

[6]Source: https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/H2020_inBrief_EN_FinalBAT.pdf

and market replication. In terms of Financing Rate, 70% of the eligible costs are reimbursed and the typical duration goes from 12 to 24 months. The EC's Contribution goes from €1M to €2.5M

- Phase 3: The commercialization phase is supported indirectly through access to finance and to customers (no funding is involved), the so-called Financial Instruments support for SME.

# Chapter 3
# Methodology

## 3. General aspects

This thesis aims to assess the impact of the Horizon 2020 funds in the performance of Portuguese SME. On that matter, it should be mentioned that there have been several studies on the impact of public funding in the last few years.

As described previously, (Czarnitzki et al. 2007) have studied the impact of Innovation policies in Germany and Finland; (Duch-Brown et al. 2012) have analysed the effects of the public funding program CIDEM in Cataluña; (de Avellar and Botelho 2016) evaluated the impact of I&D funding in Brazilian SME; (Petelski et al. 2020) analysed the impact of public funding on science, technology and innovation in Argentina.

What all these studies have in common is the use of the same method of analysis, Propensity Score Matching (PSM), recommended to study the impact of policies in a specific region, and therefore, the one chosen to study the impact of the Horizon 2020 funds in Portuguese SME.

## 3.1. The PSM method

The analysis is based on the Propensity Score Matching (PSM) methods proposed by (Rosenbaum and Rubin 1983) in which a synthetic control group is built and the causal Average Treatment on the Treated effect (ATT) estimated. The ATT estimates the average impact of the treatment in the outcome variables when compared with the untreated firms, removing effects attributed to auto-selection or to economical/financial factors unrelated to the treatment.

The main goal behind matching estimators is that, conditional on a set of observable co-variates X, the outcomes for the treated[7] ($Y^T$) and control group ($Y^C$) are independent from the treatment assignment T, and thus the selection effect is no longer present.

This is called the Conditional Independence Assumption (CIA), and it is the first of two main assumptions necessary for employing matching techniques. It is written as follows:

$$(Y^T, Y^C) \perp T \mid X \tag{1}$$

It is a bold assumption as it stands on the idea that the unobserved selection is small or nonexistent. It is more credible when there is a large set of data and preprogram data, which is the case in our setting; and when robustness tests can be performed to lend credibility to the hypothesis that the hidden selection is not a concern.

The second assumption is Common Support: there must be enough comparison observations (i.e., untreated) that are a close match on observed characteristics to the treated observations, to ensure a substantial overlap of propensity score distributions:

[7] The treated being the Portuguese SME that received funding from 2014 to 2017.

$$0 < P(T = 1 \mid X) < 1 \quad (2)$$

(Smith and Todd 2005) defend that when the objective is to estimate the ATT, as it is in this paper, both assumptions can be relaxed, while still maintaining a high-quality matching. Instead of the CIA, we can build on:

$$Y^C \perp T \mid X \quad (3)$$

And instead of the Common Support assumption we can build on:

$$\Pr(T = 1 \mid X) < 1 \quad (4)$$

That being said, the ATT can be theoretically written as:

$$ATT = E[Y^T - Y^C | T = 1] \quad (5)$$

As such, the ATT will correspond to the mean difference in outcome between the average treatment effect on the treated and the average treatment effect on the untreated. A crucial part for estimating the ATT is the matching, which we conduct based on estimated propensity scores. The Propensity Score is an estimate of the probability of a subject/observation to be treated, ($T_i = 1$), as a function of the chosen covariates X. In the following equation, P represents the propensity score:

$$P = P(X) = \Pr[T = 1 \mid X] \quad (6)$$

Essentially, the matching must satisfy the balancing property T ⊥ X | P(X). If it is satisfied, it means that, regardless of treatment status, observations with the same propensity score have equal distributions both on observed and

unobserved characteristics. If this is valid, then the assignment to treatment can be considered random.

Taking in consideration all the forementioned equations, the ATT is calculated by comparing the outcome of a treated unit with the outcome of an untreated unit with the same propensity score. It can be rewritten as follows:

$$ATT = E_{P(X)|T=1}(E[Y^T|T = 1, P(Y^T)] - E[Y^C|T = 0, P(Y^C)]) \quad (7)$$

The Propensity Score can be estimated using Maximum Likelihood Estimators: logit or probit, choosing the X covariates that are considered most relevant towards treatment assignment. We use the logit estimator since it is simpler to compute and saves computational processing time. The logistic function is described as follows:

$$F(X) = \frac{\exp(X)}{1+\exp(X)} \quad (8)$$

And the probability function:

$$P(T = 1|X) = \frac{1}{1+\exp(-(\alpha+\beta X))} \quad (9)$$

There is no automatic formula to choose the most relevant covariates as they are context specific. Based on that, we chose covariates based on previous literature, data availability and domain knowledge.

## 3.2. Performance Analysis Ratios

In order to assess SME performance and make comparisons between firms, 6 indicators were selected: ROCE, ROA, Gross Margin, EBITDA Margin, Operating Margin and Net Margin.

(McKinsey & Company et al. 2010) identify return on capital as the pivotal indicator of the invested firm's efficacy in generating profits from its assets. Thus, ROCE and its closely related measure, return on assets (ROA), are valuable performance indicators.

On the other hand, (Grant 2005) argues that margins are useful to compare the performance of firms within the same industry but not for firms in different industries because margins depend on an industry's capital intensity.

With this in mind, we selected the following Performance Analysis Ratios:

$$Return\ on\ Capital\ Employed\ (ROCE) = \frac{Operating\ profit\ before\ interest\ after\ tax}{Equity + Long - term\ debt}$$

$$Return\ on\ Assets\ (ROA) = \frac{Operating\ profit}{Total\ Assets}$$

$$Gross\ Margin = \frac{Sales - Cost\ of\ Bought\text{-}in\ goods\ and\ services}{Total\ Assets}$$

$$EBITDA\ Margin = \frac{EBITDA}{Sales}$$

$$Operating\ Margin = \frac{Operating\ profit}{Sales}$$

$$Net\ Margin = \frac{Net\ income}{Sales}$$

## 3.3. Propensity Score Matching on Nearest-Neighbours

Based on the propensity score generated through the logistic distribution, PSM on nearest-neighbor searches for the untreated observation ("non funded") with the closest score to the treated observation ("funded"), pairing them. As the available dataset of untreated observations is very broad, we opted to match on 5 nearest-neighbors to take advantage of that fact. If properly performed, this should increase the accuracy of the results. However, it might be that the untreated "nearest-neighbor" is still very far away in terms of propensity score to the treated observation, resulting in poor matches. To avoid this, we use a caliper together with the nearest-neighbor option, which defines the maximum threshold of difference between propensity scores for two observations to be considered a match. In this specific case, we use a caliper of 0.01. This forces the propensity scores for matched observations to be different from one another by no more than 0.01. We also match with replacement: this means that one untreated observation may be used as a match to more than one treated observation, if it is the case that it also has the closest propensity score to that second treated observation. Additionally, common support is imposed by dropping treated observations with a propensity score higher than the maximum or less than the minimum of the propensity score for untreated observations. Finally, we match on "ties" as well: if there are two or more untreated observations that have identical propensity score to a treated observation, they are used in addition to the nearest neighbor.

We follow (Abadie and Imbens 2006) and calculate heteroskedasticity-consistent analytical standard errors. The practical implementation of this process is done through STATA, utilizing the -psmatch2- software by (Leuven and Sianesi 2003). It offers many options together with a range of robustness checks that are important to validate our process.

## 3.4. Data Description

The data of the firms was obtained through SABI by Bureau Van Dijk, a database for Portuguese and Spanish companies. This data set contains detailed Balance Sheet data, as well as Income Statement data on Portuguese SME. The years considered for analysis range from 2013 to 2019.

The information about the Portuguese SME that received funding from Horizon 2020 was taken from the European Commission's database (European Commission 2020)[8], and focused on the ones that received funding from 2014 to 2017.[9]

In the context of the limitations of our data, a firm is considered treated if it has received Horizon 2020 funding (in the form of IA, CSA or SME instrument) between 2014 and 2017. Since the funding usually lasts more than one year, it is likely that companies that have received funding in more than one year present this characteristic precisely due to the program we are analysing. With this key assumption, we have 108 treated firms. Due to missing values to calculate the ratios, we end up having 78 firms. And following the forementioned assumption of Common Support[10], we end up with the final number of 74 firms.

We chose to analyse only the SME funded from 2014 to 2017 so we could have a minimum of 2 years since the final moment of funding until the moment of comparison and therefore, better understand its impact.

In the SABI database, information was gathered from a year before the start of Horizon 2020 (2013) to the most recent available data, with 2019 being the furthest year accepted.

[8] https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/a879124b-bfc3-493f-93a9-34f0e7fba124/state/analysis

[9] Ideally, data on the exact year in which the guarantees were granted would be most relevant for the analysis, but this information was not available.

[10] Common Support assumption - there must be enough comparison observations that are a close match on observed characteristics to the treated observations.

Regarding the untreated group, these are the characteristics used to filter de database:

- Active enterprises headquartered in Portugal
- Minimum of 2 and maximum of 250 people employed
- Year of last available data: 2019, 2020
- Turnover less than €50.000.000
- Have the same 3 first digits of the CAE code[11] in common with the funded SME

This filtering resulted in a database of 38 341 enterprises.

[11] The CAE code is a compilation of the areas of activity of the enterprises. Having the 3 first digits in common allows for a better analysis, guaranteeing comparisons in the same industry.

# Chapter 4
## Results

The outcomes of interest analysed are six: the impact on ROCE, ROA, Gross Margin, EBITDA Margin, Operating Margin and Net Margin.

For all outcomes, we focus on the Average Treatment on the Treated Effect (ATT) growth rate change in percentual points - we define each outcome variable as the difference between the variable in 2019 and in 2013 (e.g., ROCE = ROCE2019 - ROCE2013). The results are presented in Table 3.

| | ATT | T - stat |
|---|---|---|
| ROCE | 4.70 | 1.45 |
| ROA | 0.03 | 0.48 |
| Gross Margin | 0.20 | 1.17 |
| EBITDA Margin | 3.58 | 1.60 |
| Operating Margin | 4.70 | 1.45 |
| Net Margin | 5.25 | 1.31 |

**Table 3 -** Results

Starting with ROCE, we find an increase in Return on Capital Employed of 4.70 pp.[12] In other words, treated firms generate more profit from the capital they use.

ROA for treated firms increases on average 0.03 pp, meaning that funded enterprises appear to be more efficient in using their assets to generate earnings.

Gross Margin is positively affected as well, with an increase of 0.20 pp. From this variation, it can be inferred that treated firms retain more gross profit on each euro of revenue. Nevertheless, it is worth mentioning that the variation in growth rate in ROA and in Gross Margin is fairly close to 0, and therefore, not as relevant as the rest of the growth rates.

EBITDA Margin also registers a significant increase of approximately 3.58 pp. This means that treated firms show greater profitability when compared to untreated firms of the same industry.

For the Operating Margin, we also find an increase of approximately 4.70 pp. This shows that treated firms are more efficient in their operations and better at turning sales into profits.

Net margin registers the greater increase in the selected ratios with 5.25 pp, meaning that enterprises that have received funding from Horizon 2020 create more profit on every euro in revenue.

From the analysis conducted, we may conclude that the more meaningful variations are observed on ROCE, EBITDA Margin, Operating Margin and Net Margin. Regarding these variations, we may deduce that treated companies show signs of greater performance when compared to untreated firms, supporting the hypothesis of EU funding leading to sustainable development and bestowing competitive advantage to companies within the same industry.

[12] For these results to have statistical significance, it would require a T-stat of at least 1.65 for it to be significative at 10%. This is a consequence of the low number of treated firms, however, there are still valuable conclusions we can take from this analysis.

From the analysis conducted, it may be inferred that the funds from Horizon 2020 help Portuguese SME to become more efficient operationally, as we can see in the ATT growth rate of the Operating Margin, and this subsequently leads to them being more profitable than their counterparts, as it is shown by the growth rate of ROCE, EBITDA Margin and Net Margin.

These results should be carefully interpreted, as there might not be a clear link between receiving funding and performing better as a company. Although it is logical to assume that a funded enterprise will use the subsidies to improve its profitability, there might be other explanations for the improvement. For instance, the SME could be cooperating with other firms, thus hiding the real effect of the funds. Moreover, the profitability growth may be a result of a better strategy and not necessarily the result of greater funding.

In other words, although a rigorous approach was presented, with the concern of removing factors unrelated to the treatment, the causality can always be questioned.

# Conclusion

This paper assesses whether the funding from the Horizon 2020 Program granted Portuguese SME greater development and competitive advantage. That is to say, we try to assess if the funding caused great differences between funded and unfunded enterprises in the short run.

To answer this research question, the PSM methods were employed by creating a synthetic control group with unfunded enterprises and using it to compare with the enterprises that had received funding from the Horizon 2020 Program in Portugal from 2014 to 2017.

We are able to observe that Portuguese SME who have received funding from the Horizon 2020 program show greater sustainable development as well as competitive advantage when compared to their unfunded counterparts – this conclusion is supported by the variations observed on ROCE, EBITDA Margin Operating Margin and Net Margin.

Future research on the effects of the Horizon 2020 funding would benefit from greater data availability, as well as an analysis of the effects of these funds in SME development at least 2 years after the end of the program. The limitations faced during this paper were mainly due to the small number of Portuguese SME that have received funding from the program as well as missing values in the database. As a greater number of treated firms would allow for greater statistical significance of the analysis, the suggestion would be to either apply the PSM methods in an analysis with greater time span of funding, or to include more countries where the SME are headquartered.

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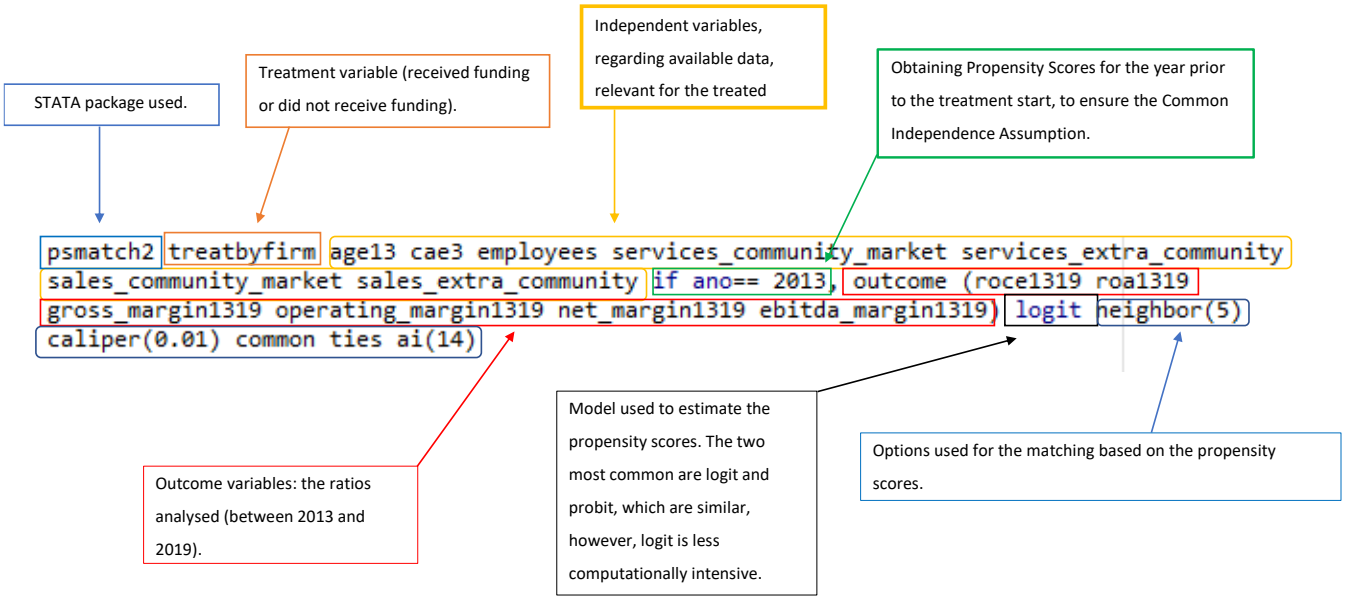
# Appendix

## *Appendix 1- Propensity Score Match Explanation*



## *Appendix 2- STATA Codes*

```
.
. set more off

.
. set seed 55152

.
. xtset nif ano
       panel variable:  nif (strongly balanced)
        time variable:  ano, 2012 to 2019
                delta:  1 unit

.
. **5 nearest neighbors**
. psmatch2 treatbyfirm age13 cae3 employees services_community_market services_extra_community sales
> _community_market sales_extra_community if ano== 2013, outcome (roce1319 roa1319 gross_margin1319
> operating_margin1319 net_margin1319 ebitda_margin1319) logit neighbor(5) caliper(0.01) common ties
>  ai(14)

Logistic regression                             Number of obs     =     36,008
                                                LR chi2(7)        =     112.40
                                                Prob > chi2       =     0.0000
Log likelihood = -500.22889                     Pseudo R2         =     0.1010
```

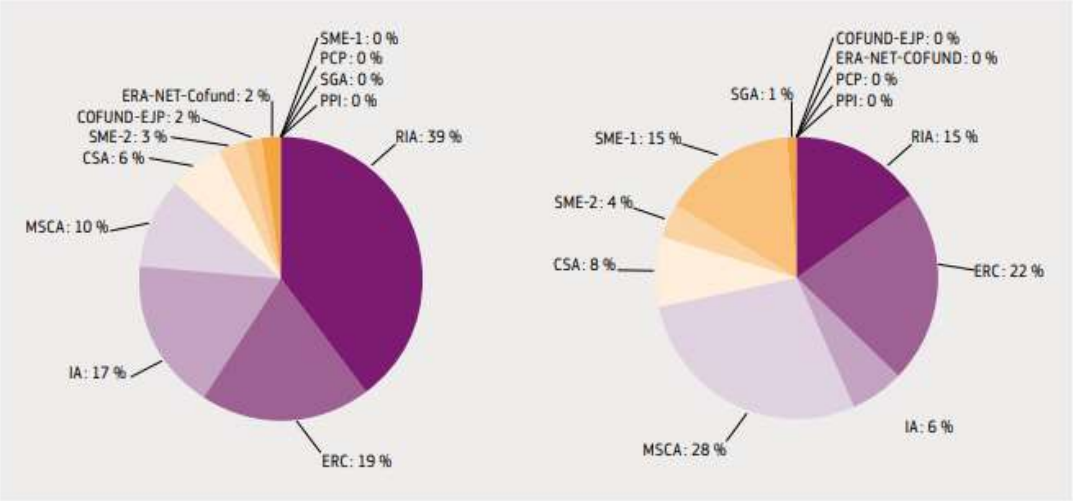
| treatbyfirm | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| age13 | -.0393128 | .0144877 | -2.71 | 0.007 | -.0677081 | -.0109174 |
| cae3 | .0000232 | 5.89e-06 | 3.93 | 0.000 | .0000116 | .0000347 |
| employees | .0081827 | .0021206 | 3.86 | 0.000 | .0040264 | .0123391 |
| services_community_market | .0004183 | .0000593 | 7.06 | 0.000 | .0003021 | .0005345 |
| services_extra_community | -.0000844 | .0000493 | -1.71 | 0.087 | -.000181 | .0000122 |
| sales_community_market | .0000161 | .0000178 | 0.91 | 0.364 | -.0000187 | .000051 |
| sales_extra_community | .0000113 | .0000174 | 0.65 | 0.518 | -.0000229 | .0000454 |
| _cons | -7.132201 | .4088006 | -17.45 | 0.000 | -7.933435 | -6.330966 |

| Variable | Sample | Treated | Controls | Difference | S.E. | T-stat |
|---|---|---|---|---|---|---|
| roce1319 | Unmatched | 3.73000244 | 1.24152634 | 2.4884761 | 17.8033632 | 0.14 |
| | ATT | 3.9338901 | -.755701671 | 4.68959177 | 3.23970868 | 1.45 |
| roa1319 | Unmatched | .051570742 | .008968973 | .042601769 | .432528606 | 0.10 |
| | ATT | .055444731 | .028178743 | .027265987 | .056955643 | 0.48 |
| gross_margin1319 | Unmatched | -.189076227 | .040229266 | -.229305493 | .768375878 | -0.30 |
| | ATT | -.191340545 | -.395606891 | .204266346 | .174303629 | 1.17 |
| operating_m~1319 | Unmatched | 3.73000244 | 1.24152634 | 2.4884761 | 17.8033632 | 0.14 |
| | ATT | 3.9338901 | -.755701671 | 4.68959177 | 3.23970868 | 1.45 |
| net_margin1319 | Unmatched | 4.49482464 | 2.26804541 | 2.22677923 | 26.3360951 | 0.08 |
| | ATT | 4.73917515 | -.513561507 | 5.25273665 | 4.00163459 | 1.31 |
| ebitda_marg~1319 | Unmatched | 2.84291853 | 1.15352207 | 1.68939647 | 17.0281763 | 0.10 |
| | ATT | 2.99810051 | -.584498035 | 3.58259854 | 2.23357148 | 1.60 |

Note: Sample S.E.

| psmatch2: Treatment assignment | psmatch2: Common support | | |
|---|---|---|---|
| | Off suppo | On suppor | Total |
| Untreated | 0 | 35,930 | 35,930 |
| Treated | 4 | 74 | 78 |
| Total | 4 | 36,004 | 36,008 |

*Appendix 3- Horizon 2020 Funding allocation (left) and number of grants (right) by type of action*




*Source: Corda, calls until end of 2016, signed grants cut-off date: 1/1/2017*