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European structural funds and the performance of Portuguese firms

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Abstract
This article provides new evidence on the impact of receiving European structural funds on Portuguese firms. It explores a novel dataset, covering the universe of projects submitted to the COMPETE programme under the 2007-2013 framework, combined with rich longitudinal firm-level data for 2006-2019. This long time span allows contrasting firms that were granted financial support with comparable firms that also applied but were unsuccessful, for several years both before and after the bid. By employing a dynamic difference-in-differences setup focused on various firms' performance indicators, we identify positive and persistent effects in firms receiving financial support. Though to varying degrees, firms with backed projects have higher employment, turnover, gross value added, productivity, capital, and exports. These differences vis-à-vis unsupported firms prevail for several years. (JEL: D04 D22 H43)

1. Introduction

The establishment of the Recovery and Resilience Facility (RRF) rekindled interest in the role of structural funds in promoting growth and development across Europe. The RRF and, more broadly, the NextGenerationEU (NGEU) initiative represent important milestones in European integration in many dimensions. However, their overarching objectives of fostering growth, job creation and competitiveness while reducing asymmetries across Member States are not novelties. The EU has been pursuing these goals for the last decades by distributing structural and investment funds financed through national contributions to the Community Budget.

The European Structural and Investment Funds (ESIF) are one of the largest items of the EU Budget, encompassing instruments supporting rural development and the Structural and Cohesion Funds (SCF). The latter are the centrepiece of the

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cohesion policy and comprise three financial instruments: the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund. Each instrument has specific, albeit complementary, strategic objectives focusing on economic, social and territorial cohesion by reducing gaps between EU regions. The ERDF supports programmes addressing regional development, competitiveness and territorial cooperation throughout the EU. The cross-country allocation of the ERDF reflects the level of GDP *per capita* of their regions (defined at level 2 of the common classification of territorial units for statistics - NUTS 2).

The cohesion policy is structured around the multiannual financial frameworks (MFF), spanning seven-year budget cycles. The latest MFF, approved in December 2020, covers the 2021-2027 period. The previous MFF was adopted in December 2013 and, while spanning the 2014-2020 period, the absorption of available resources can be extended up to 2023. Therefore, the most recent closed MFF is the one referring to 2007-2013, whose commitments could be extended up to 2015. In the 2007-2013 programming period, the EU made EUR 347 billion available through SCF.

The cohesion policy is jointly implemented through Partnership Agreements between the European Commission and national authorities. Considering the eligible regions and the guidelines set at the EU level, Member States allocate the funds to Operational Programmes (OP), which co-finance projects aligned with priorities and targets agreed upon by European and national (or sub-national) managing authorities.

Portugal has been a net beneficiary of European funds since EU accession. Starting with the 1989-1995 programming period, Portugal is estimated to have received SCF amounting to 1.7% of GDP per year, on average, until 2021. Within the 2007-2013 MFF, Portugal received EUR 21.4 billion worth of Cohesion Funds (1.2% of GDP per year), of which approximately half was channelled through the ERDF: EUR 11.5 billion (0.7% of GDP per year), well above the EU average.

At the national level, the implementation of the cohesion policy for the 2007-2013 programming period was framed by QREN - a Portuguese acronym for the National Strategic Reference Framework, *Quadro de Referência Estratégico Nacional*. QREN established three policy priorities: strengthening the potential of human resources; fostering national competitiveness; and reinforcing territorial development. These were implemented through seven regional OP, three multi-region thematic OP (Human Potential, Competitiveness Factors and Territorial Valorisation), and a Technical Assistance OP. Regarding specifically the ERDF, 88% of the resources were directed to the regional OPs and the Competitiveness Factors OP - the COMPETE Programme.[1] These are complementary in co-financing projects focusing on the following dimensions: technological R&D; innovation; and the qualification and internationalisation of micro, small and medium firms (SMEs). Each of these dimensions corresponds to a system of incentives (SI) among which the proposed projects were framed. Approximately 32%

1. In practice, COMPETE was jointly managed by the Competitiveness Factors OP (in charge of projects by medium and large firms) and the regional OPs for mainland Portugal (in the case of micro and small firms).

of total ERDF resources distributed under QREN were channelled for the purpose of enterprise support and innovation (European Commission 2016).

Despite the relevance of EU funds for the Portuguese economy and their focus on business support, research on their actual impacts is scarce, especially at the firm-level. This can be explained by the lack of proper granular data allowing for micro-level counterfactual impact evaluations. This article complements the existing evidence for Portugal by combining firm-level data from the Central Balance Sheet Harmonised Panel (CBHP) from 2006 to 2019 with a new project-level dataset, the Incentives Systems data. The latter includes information for projects submitted to the three SI backed by the ERDF within QREN and under the scope of the COMPETE programme, covering both successful and unsuccessful applications.

We take advantage of the longitudinal nature of CBHP to follow for several years firms applying for funding, both before and after the decision on whether to grant support or not. We perform event-study analyses focusing on key firm outcomes — employment, turnover, gross value added (GVA), the capital-to-assets ratio, labour productivity (GVA per worker) and export intensity (exports over turnover) — checking for an empirical relationship between successful applications and changes in these outcomes over time.

Results suggest that having at least one project financed by COMPETE has a positive and persistent impact on firms' performance. Though it is not possible to distinguish the effect of the funding *per se* from that arising from the selection of the best projects, it is clear that, after a successful application, employment, turnover and GVA are higher than in firms whose bids were unsuccessful. Positive effects of EU funds are also found for export intensity and the capital ratio. The impact on labour productivity, though positive, is relatively small. The effects are also found to be persistent, lasting in most cases for 5 to 7 years after the funding decision. Capital has the shortest lasting effect, as it begins to fade after three years. All in all, our results show that funding from COMPETE contributed to job creation, the internationalisation of firms and the expansion of their productive capacity.

The article is organised as follows. Section 2 discusses the related literature that frames this study. Section 3 describes the data sources and provides a description of the sample and relevant variables. Section 4 outlines our identification strategy and econometric framework. Section 5 presents the baseline results and a summary of robustness checks. Finally, Section 6 presents some concluding remarks.

2. Related literature

A number of papers have examined the causal impact of public subsidies on investment, employment, and economic activity over the years, especially in the context of the EU SCF. Assessing the effectiveness of these types of stimulus is an empirical question, but evaluating the impacts is a challenging task. The main problems are due to the difficulties faced in isolating the effects of the subsidies from the confounding effects induced by other factors and in controlling for the high selection bias (see Criscuolo

et al. (2022) for a discussion). There is no consensus on the empirical literature, but most micro-econometric evaluations find that economic development schemes – in particular EU programmes – have a growth-stimulating effect.

The EU provides grants to disadvantaged regions of Member States to help them to catch up. Hence, a stream of the literature exploits causal methods to assess the economic impact of EU funds at the regional level, investigating the effect of transfers on beneficiary regions with respect to untreated regions. The majority of these studies find evidence of a positive impact of EU funds on the growth of lagging areas (e.g., Becker *et al.* 2010, Pellegrini *et al.* 2013, Ferrara *et al.* 2017, Gagliardi and Percoco 2017). Another insight is that EU transfers tend to display immediate effects but they do not show much longevity beyond a programming period, failing to push treated regions into a higher growth path (Barone *et al.* 2016 and Becker *et al.* 2018). Taking into account the treatment intensity of EU regional transfers, Becker *et al.* (2012) and Cerqua and Pellegrini (2018) conclude that there is a maximum efficiency level of funds beyond which they do not generate stronger growth effects, implying that some reallocation of funds between regions would lead to higher aggregate growth in the EU. Moreover, regional heterogeneity also matters as a determinant of the policy effectiveness of EU funds, as a region's capacity to take advantage of the funds is found to be related to the local economic structure, human capital endowment and institutional quality (Becker *et al.* 2013, Percoco 2017).

As richer datasets become available, micro-level impact evaluation explicitly examining the firms' utilisation of EU funds represents a promising empirical approach. Mouqué (2012) summarises some of the early results on the firm-level impact of the 2007-2013 MFF using standard methods from the programme evaluation literature. The studies reviewed suggest that EU financial support is an effective way of increasing investment, production and employment in SMEs, but not in large firms. Bachtrögler and Hammer (2018) exploit a cross-country firm-level database on beneficiaries of EU funds during the 2007-2013 MFF. Using propensity score matching techniques, the authors find mixed effects on the performance of a sample of manufacturing firms in six European countries. On average, firms that receive financial assistance hire more workers and increase their capital stock to a larger extent, but there is little evidence of additional positive total factor productivity (TFP) effects. Bachtrögler *et al.* (2020) analyse the impact of the EU cohesion policy on firm growth in the programming period 2007–2013 in seven European countries. Results show that EU support promotes firm growth in size (value added and employment) more than in productivity. Dvouletý *et al.* (2021) provide a review of 30 recent studies on the effects of EU public grants on SMEs performance, covering 13 countries with various methodological approaches and databases. The summarised findings show mostly positive outcomes of the grants on firm survival, employment, fixed assets, and turnover, with mixed findings for labour productivity and TFP.

Since the late nineties, Italy has been one of the main subjects of counterfactual programme evaluation investigating EU policy measures undertaken to support the investment activities of private firms. Cerqua and Pellegrini (2020) and Bocci *et al.* (2021) provide recent overviews, showing that there is considerable heterogeneity in

the evaluation methods and in the results. However, in most cases, these policies have enhanced economic growth in Italy, especially for weaker firms and outcomes that are directly targeted by public programmes. Nevertheless, these policies are less likely to trigger changes in the long run. Some examples of recent studies on the impact of Law 488/1992 (L488), the largest EU subsidy program implemented in Italy, using regression discontinuity design (RDD) models are Cerqua and Pellegrini (2022) and Cingano *et al.* (2022). Both papers confirm the positive effect of L488 subsidies on the employment of funded firms. Also using RDD, Cerqua and Pellegrini (2014) find that the impact of L488 subsidies on employment, investment, and turnover is positive and statistically significant, while the effect on productivity is mostly negligible.

Several studies for other European countries investigate the causal impact of public support programmes, using longitudinal firm-level datasets that allow the estimation of the effects of grants after the end of the intervention. However, the literature is still limited considering the importance of the topic. Criscuolo *et al.* (2019) exploit exogenous changes in the area-specific eligibility criteria for an employment support program in the UK. Controlling for endogeneity with instrumental variables, the authors find positive effects on employment and investment but not on TFP. They also find that the program effects are confined to smaller firms.

Focusing on Latvia, Benkovskis *et al.* (2019) study the effect of EU regional support received in the context of the EU programming period 2007–2013, using a sample of around 500 beneficiaries. The authors find that participation in projects co-financed by the ERDF increases firms' employment, turnover and capital intensity immediately, while it raises productivity only two years after the launch of the projects. Selebaj and Bule (2021) analyse the impact of EU grants on firms' performance in Croatia. The results show that the use of EU funds has a strong and positive effect on employment, operating income, labour productivity, TFP and capital intensity.

Banai *et al.* (2020) and Muraközy and Telegdy (2022) use a combination of propensity score matching and difference-in-differences (DiD) regressions to evaluate the impact of SCF subsidies on Hungarian firms. Banai *et al.* (2020) focus on SMEs in the 2007–2013 programming period and find that EU funds had a significant positive effect on the number of employees, sales revenue, gross value added and, in some cases, operating profit, but not on labour productivity. Muraközy and Telegdy (2022) investigate the effects of EU grants between 2004 and 2014 and conclude that, compared to unsuccessful applicants, subsidised firms increase their employment, sales, total assets, capital-to-labour ratio and labour productivity, but not TFP.

There are some studies with micro-level data using impact evaluation methods to assess the effect of EU grants on Portuguese firms. The results of Bondonio *et al.* (2016) indicate that firm-level support co-financed by EU structural funds in Portugal in 2003-2006 contributed to improving job quality and increase average remuneration per hour in treated firms. Santos (2019) uses a small sample of around 300 subsidised and non-subsidised firms, finding a positive effect of an innovation subsidy during 2007-2011 on employment, sales, investment and TFP. More recently, Martins (2021) examines the effects on firm performance of a large training programme supported by the ESF from 2007 to 2011. Using DiD models and a large longitudinal dataset, the author finds

significant positive effects on training hours and expenditure; and that such additional training led to increased sales, value added, employment, productivity, and exports. These effects tend to be of at least 5% and, in some cases exceed 10%, and are robust in multiple dimensions.

Alexandre (2021) uses a database similar to the one utilised in this article and provides a thorough description of the characteristics of the Portuguese firms that applied for ERDF funds within QREN (2007-2013) and PT2020 (2014-2018).[2] His empirical results suggest a positive and statistically significant impact of ERDF funding on firms' investment, employment, value added, exports and productivity. Alexandre *et al.* (2022) implement a RDD to investigate the impact of a second investment grant for the same firm, showing that it has positive and significant additional effects on firms' productivity. Finally, Gabriel *et al.* (2022) examine the impact of widening the regional eligibility to EU funds on firm performance between 2003 and 2010. Their results uncover a positive causal effect on firms' sales, while employment and labour productivity do not seem significantly influenced by the reform.

We contribute to this literature by exploring a new detailed dataset, recently made available at Banco de Portugal, combined with rich longitudinal firm-level data. In particular, we provide new evidence on the effects of a specific EU-funded programme — COMPETE — leveraging on a long time span that allows contrasting successful and unsuccessful applicants both before and after the bid. By relying on a dynamic setup, we provide results not only as to the level of the impact on several firms' outcomes but also as regards its persistence over time.

3. Database and exploratory analysis

This article uses two micro-level databases available at the BPLIM - Banco de Portugal Microdata Research Laboratory.[3] The first database is the Central Balance Sheet - Harmonised Panel (CBHP), comprising firm-level balance sheet annual data from 2006 to 2019 (BPLIM, 2021). CBHP is based on the Central Balance Sheet database, which virtually covers the universe of non-financial corporations operating in Portugal. This dataset is mostly based on information reported through *Informação Empresarial Simplificada* (IES, Simplified Corporate Information), the system through which corporations report mandatory information to the tax administration and statistical authorities. Under IES, firms provide detailed annual balance sheet, profit and loss accounts. It further contains information on firms' characteristics such as number of employees, age and main sector of economic activity according to the Portuguese industrial classification Revision 3 – *Classificação Portuguesa das Actividades Económicas* (CAE).

2. PT2020 is the designation of the Partnership Agreement between the European Commission and Portugal for the period between 2014 and 2020.

3. `https://bplim.bportugal.pt/`

The second source is the Incentives Systems data (BPLIM, 2022). This is a project-level dataset made available by BPLIM that compiles information produced by the Development and Cohesion Agency (*Agência para o Desenvolvimento e Coesão*) and the Managing Authority for the COMPETE programme. These data comprise information for projects submitted to COMPETE to be financed by the ERDF under QREN, covering both successful and unsuccessful applications. It further covers applications under the PT2020 framework, in which case it also includes projects financed by the ESF. The reference date for information on QREN projects is September 2017 and it will no longer be updated, while for PT2020 the latest data freeze refers to May 2020 and it will be updated on an annual basis. The data cover a myriad of information on the projects, including details on the call for applications and the tender, an anonymised identifier for the submitting firm, the relevant OP and the specific measure within the SI under which the application was made. Importantly, the data include a set of variables allowing the identification of the different stages in the lifecycle of each project: application; first review by an intermediate body; evaluation by the selection committee; first and subsequent decisions on whether or not to grant support; signing of the incentives contract; and closure of the investment and the project. This makes it possible to clearly distinguish unsuccessful from successful applications and, among these, ongoing from closed projects.

This article focuses on QREN, which is the most recent closed framework, hence data on the PT2020 are discarded. Although applications for QREN are restricted to 2007-2013, dates of decisions and the signing of the incentives' contracts span a longer period. Originally, the Incentives Systems data covered around 28,000 applications. We dropped all which were de-committed or withdrawn.[4] Moreover, we only kept projects for which a decision is taken and that fall into one of three distinct statuses: not supported; approved; and closed (referring to either investment or project closure). This leaves us with 20,341 applications, out of which 9,524 projects were granted financial support. This covers most of the universe of projects backed by COMPETE.

The sample used in this article results from a merge between CBHP and the Incentives System data, thus comprising only firms present in both. As such, the final sample excludes most of the banking and insurance sector which is absent from CBHP.[5] In addition, all sole proprietors and independent workers and business associations are also dropped as they are not present in CBHP.

The project-level nature of the Incentives System data implies that firms are not uniquely identified as the same firm can submit multiple applications. The data were converted into firm-level by keeping only one project per firm. More precisely, if firms

4. The withdrawal occurs before the funding decision at the initiative of the beneficiary, while the de-commitment occurs after the communication of the funding decision at the initiative of the beneficiary or the OP.

5. Most corporations in section K - Financial and insurance activities (divisions 64 – 66), like banks and insurance companies, are excluded from CBHP, since they have specific accounting reporting requirements and a distinct balance-sheet structure. However, other financial and insurance intermediaries and auxiliaries are available in the dataset.

apply several times but are always unsuccessful, we keep only the first application. [6] If firms apply multiple times and are successful at least once, we only keep their first approved application. These options have implications in terms of the analysis herein presented, as it relies on a treatment effects setup based on the comparison between successful and unsuccessful applicants. On the one hand, this procedure may render an overestimation of the persistence of the effects we aim to capture if they also reflect subsequent successful applications. However, it also ensures that the control group clearly excludes firms that have received support for some project within COMPETE (see Martins 2021 for a similar reasoning). In order to mitigate the risk that results are affected by successful applications to PT2020 funding, we further exclude from the sample all firms with approved projects under this framework in the 2015-2019 period.[7]

The final sample is an unbalanced panel of 8,741 distinct firms with 95,081 observations from 2006 to 2019, with about half of the firms followed throughout the whole 14 years. All of these firms submitted at least one project between 2007 and 2013. Although we keep only one application for each firm, approximately 25% of the applicants in our sample submitted more than one project.

The first decisions on the relevant applications were issued between 2008 and 2014. Combining this with the 2006-2019 coverage of CBHP implies that we can observe firms ahead of the decision for a period between two and eight years: for firms with a decision in 2008, we observe 2006 and 2007; for those with a decision in 2014, we observe 2006-2013. Similarly, the post-decision period for a firm with a decision in 2008 corresponds to 2009-2019 (eleven years), whereas for one with a decision in 2014 it corresponds to 2015-2019 (five years).

Based solely on the relevant project submitted by each firm, the overall success rate across the period stands at 45%: 3,943 firms were granted EU funding and these represent our treatment group. This is about 40% of the total number of projects supported by COMPETE. The remaining 4,798 firms, which were unsuccessful in all their applications, represent our control group. The number of decisions covered in the data hovers around 1000 per year except in 2013, when it exceeds 3000, and 2014, when it falls below 700 (Figure 1). The treatment and control groups are fairly distributed across the treatment cohorts defined as the year in which the relevant decision was issued.

Compared to their counterparts with unsuccessful bids, the sub-sample of successful applicants features only a slightly higher share of small and medium firms (Figure 2). The distribution of firms across sectors and age cohorts is also fairly similar among the two groups in the year of the decision.

6. An alternative definition of the control group would be to keep all applications of always unsuccessful firms. That would mean that the same outcomes of a firm that applies (unsuccessfully) more than once would be used as a counterfactual in different periods for distinct treatment cohorts. Given that we have a large sample of firms, we decided to keep only one unsuccessful application per firm, thus mirroring the option taken for the treatment group.

7. Unfortunately, we lack data on whether a firm received EU funding during the previous MFF 2000–2006. We also do not know if a given firm has received funding under other EU financial instrument within the QREN 2007-2013 framework. Hence, we cannot rule out that some of the results presented in Section 5 reflect funding obtained previously or contemporaneously from a different EU fund.

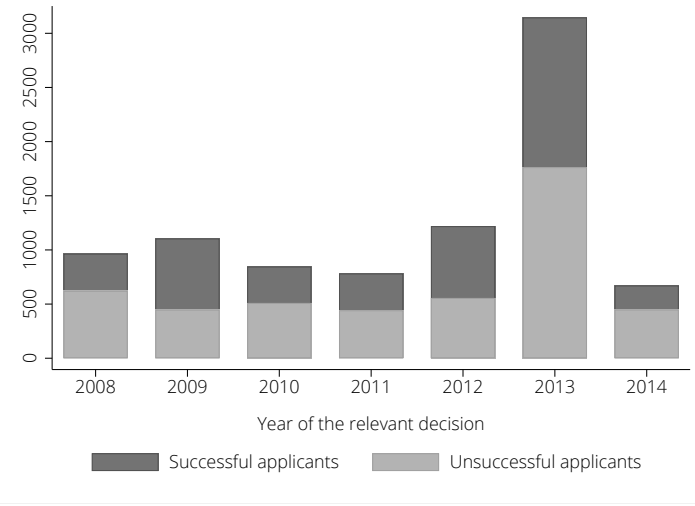

FIGURE 1: Number of applications by year of the relevant decision

Note: The chart depicts the number of applications for which a relevant decision was made between 2008 and 2014, split between successful and unsuccessful firms. For sucessful firms, it is the first favourable decision (though not necessarily corresponding to the first nor the last project submitted). For unsuccessful bidders, it is the first negative decision for a firm which never receives a favourable outcome.

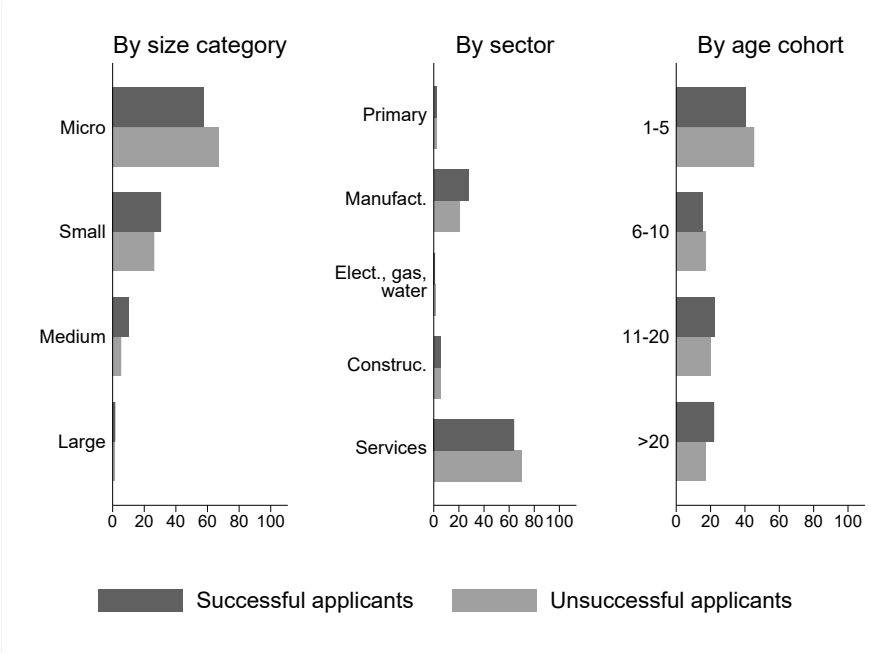

FIGURE 2: Distribution of successful and unsuccessful firms by size category, sector and age cohort

Note: The charts depict the distribution of applicant firms across size categories, sectors, and age cohorts in the year of the relevant decision. The size categorisation is in line with the definition adopted by the European Commission: micro-firms employ less than 10 persons with an annual turnover or annual balance sheet total not exceeding EUR 2 million; small firms employ less than 50 persons with an annual turnover or annual balance sheet total not exceeding EUR10 million; medium-sized firms employ less than 250 persons with an annual turnover not exceeding EUR 50 million or an annual balance sheet total not exceeding EUR 43 million. All other firms are considered as large. The sectors are defined as the broader sections of CAE rev.3.

Ahead of the treatment, successful firms are larger, both in terms of employment and turnover, and more productive than their unsuccessful counterparts. They also feature higher export intensity but lower capital over assets (Table 1). With the exception of the capital ratio, these differences are found to be statistically significant, which can be explained by several factors. For instance, smaller firms may have fewer resources invested in the application process making them less prone to put forward a successful bid. Stronger credit constraints may also limit incentives to put efforts into the application for co-financed projects, which, together with a learning curve as regards the procedural details, may give older firms an advantage when submitting applications.[8] In any case, an analysis focusing on 2006-2013 shows that, despite these *unconditional* differences in terms of levels, the evolution of firms' pre-treatment attributes was essentially parallel in the two groups. Moreover, as shown in Section 5 below, the inclusion of relevant controls in the regressions virtually eliminates the differences between the two groups in the pre-treatment period.

These pieces of evidence leave us confident that the control group corresponds to a reasonable proxy for the counterfactual dynamics of successful applicants had they not received EU funding. This supports our option for a DiD setup to frame the analysis. Still, this identification strategy has a limitation stemming from the fact that selection into treatment is not random. However, given that we are using a sample of applicants, assignment to treatment is essentially exogenous to the firm and results from the *ex-ante* project evaluations carried out by public bodies (see Santos *et al.* (2019) for a detailed analysis of the *ex-ante* selection process of applications submitted to one of the incentives system included in our sample). Besides the characteristics of the projects, their approval is also influenced by the circumstances of each call, including the availability of funds, the number of applicants, and the binding (or non-binding) character of the minimum scores. Nevertheless, our analysis cannot distinguish the effect of EU funding *per se* from the effect of an efficient *ex-ante* selection of the best projects. What we aim at evaluating is if, conditional on the selection process of each tender, firms that were previously comparable have distinct *ex-post* evolutions depending on their treatment status.

8. Indeed, a simple linear model regressing the probability of having a successful application on a set of firms' observables shows that age and multiple applications have a statistically significant positive impact, whereas the impact of leverage is negative. All other observables are not statistically significant determinants of success probability.

	Mean	Std. Deviation	25th perc.	75th perc.
Treatment group				
Age (years)	15	13	5	20
Capital/assets (%)	30.2	24.4	9.9	46.0
Export intensity (exports/turnover, %)	13.0	26.7	0.0	8.1
Gross value added (EUR, million)	0.8	2.0	0.1	0.6
Labour costs (EUR million per worker)	0.01	0.01	0.01	0.02
Labour productivity (EUR million per worker)	0.02	0.02	0.01	0.03
Leverage (financial debt/assets, %)	24.2	23.5	4.0	37.5
Return on assets (EBITDA/assets, %)	7.4	28.1	4.0	15.4
Total employment (#)	26	53	3	25
Total assets (EUR, million)	3.4	9.9	0.2	2.2
Turnover (EUR, million)	3.3	8.8	0.2	2.2
Control group				
Age (years)	13	12	4	18
Capital/assets (%)	30.7	25.9	8.4	47.6
Export intensity (exports/turnover, %)	9.3	22.9	0.0	2.3
Gross value added (EUR, million)	0.5	1.5	0.0	0.4
Labour costs (EUR million per worker)	0.01	0.01	0.01	0.02
Labour productivity (EUR million per worker)	0.02	0.02	0.01	0.03
Leverage (financial debt/assets, %)	25.9	26.4	2.7	40.1
Return on assets (EBITDA/assets, %)	4.9	32.3	2.4	14.6
Total employment (#)	18	41	2	16
Total assets (EUR, million)	2.3	8.3	0.1	1.4
Turnover (EUR, million)	2.0	6.5	0.1	1.3
Total sample				
Age (years)	13	13	4	19
Capital/assets (%)	30.4	25.3	9.0	46.9
Export intensity (exports/turnover, %)	11.0	24.8	0.0	4.3
Gross value added (EUR, million)	0.6	1.8	0.0	0.5
Labour costs (EUR million per worker)	0.01	0.01	0.01	0.02
Labour productivity (EUR million per worker)	0.02	0.02	0.01	0.03
Leverage (financial debt/assets, %)	25.2	25.1	3.4	38.8
Return on assets (EBITDA/assets, %)	6.1	30.5	3.2	15.0
Total employment (#)	22	47	3	20
Total assets (EUR, million)	2.8	9.1	0.1	1.7
Turnover (EUR, million)	2.6	7.6	0.1	1.7

TABLE 1. Summary statistics for selected firm characteristics in the pre-treatment years

Notes: To minimise the effects of outliers in terms of the variables, the top and bottom 1 percentiles in each calendar year were winsorised.

4. Econometric strategy

The DiD identification strategy used in this article relies on a setup based on binary, single treatment effects. However, the strategy differs from the conventional approach in several dimensions (see Martins (2021) and Muraközy and Telegdy (2022) for similar strategies). Treatment is staggered as it does not occur simultaneously for all firms. Instead, it depends on a specific decision on whether to grant EU funding for a certain project. We denote the year of this relevant decision by t_0^i for both winners and losers. The treatment group refers to firms which applied successfully at least once, and these are treated when their first favourable decision is issued; the control group corresponds to always unsuccessful applicants, and their treatment cohort is that of the first unfavourable decision.

The fact that we are using a detailed sample of applicants (rather than beneficiaries) bears two important advantages: first, it eliminates any potential problem of selection into applying while also implying a high degree of homogeneity across candidate firms, with an effect similar to matching on unobservable characteristics; second, since we observe the relevant dates for both successful and unsuccessful firms, we can control for common trends of the dependent variables between treated and untreated firms.

The treatment effect is estimated over time, on the basis of the following event-study equation at the firm-year level for the period 2006-2019:

$$Y_{ijt} = \sum_{\tau=-8}^{11} \beta_\tau D_{i\tau} + \gamma_\tau + \gamma_i + \gamma_{jt} + \varepsilon_{ijt}, \quad (1)$$

where Y_{ijt} is the dependent variable of interest for firm i in sector j in calendar year t, representing the firms' performance indicators on which we check for an impact of EU funding. More precisely, Y_{ijt} corresponds to total employment, turnover, gross value added (GVA), labour productivity (defined as GVA per employee), capital as a percentage of total assets, and export intensity (defined as exports as a percentage of turnover). To minimise the effects of outliers in terms of these variables, we winsorised the top and bottom 1 percentiles in each calendar year.

Subscript τ denotes the number of years relative to the relevant decision, i.e., $\tau = t - t_0^i$. Since t_0^i ranges from 2008 to 2014 and t covers 2006-2019, τ varies between -8 and $+11$: $\tau = -8$ denotes the 8$^{\text{th}}$ period prior to the decision, corresponding to year 2006 for firms that had a decision in 2014; similarly, $\tau = +11$ corresponds to the 11$^{\text{th}}$ year after the treatment, referring to 2019 for firms with a relevant decision in 2008. As such, γ_τ represents a set of dummies for each relative-time period centred around t_0^i. It is important to note that these dummies are defined for successful and unsuccessful applications since our data provide this information in both cases. These dummies account for potential common trends similarly affecting treated and untreated firms around the relevant decision year. This would eliminate, for instance, possible common anticipation behaviours in the period just prior to the decision that could affect the outcomes denoted by Y_{ijt} .

$D_{i\tau}$ is a set of dummy variables that identify the relative-time *only* for treated firms, i.e., they equal 1 for each relative-time period τ for treated firms and are constant on 0 for control firms. These dummies should therefore be interpreted as the standard treatment indicator in dynamic DiD analyses.

Category $\tau = 0$ is omitted in Equation (1), which means that all coefficients are evaluated with respect to the benchmark year of the decision t_0^i. Omitting this category is intuitively equivalent to expecting results to show up one year after the decision on whether to grant funding is taken. This would account for implementation lags, as an investment can only start after the signing of the incentives' contract, which typically occurs a few months after the actual decision but within the same calendar year.

The coefficients of interest are β_τ. At each relative-year τ, they provide a measure of the systematic differences in Y_{ijt} between firms that receive funding and those that do not (relative to period t_0^i). For $\tau < 0$, non-statistically significant coefficients imply the

absence of systematic differences between the two groups prior to the decision. This evidence indicates that the group of firms that did not receive funding can be used as a reasonable comparison group, thus providing information on what would have happened to the successful firms had they not been granted funding (the counterfactual scenario). For $\tau > 0$, significant β_τ imply systematic differences after the funding decision between previously similar groups of firms, the only difference being that the control group has not been supported. As such, β_τ can be interpreted as providing an estimate for the impact of funding on firms' outcomes.

In addition to the relative-time fixed effects, two other controls were added to the regression: γ_i, which are firm fixed effects controlling for firm-specific time-invariant characteristics; and γ_{jt}, which are sector-calendar year fixed effects that control for sector-specific shocks over time.[9] The error term is ε_{ijt}. Robust standard errors are clustered at the firm-level.

5. Empirical results

Figure 3 summarises our baseline results, depicting the point estimate of each β_τ parameter of Equation (1) and its confidence intervals, both before ($\tau < 0$) and after ($\tau > 0$) the decision year.

The identification strategy outlined above and the interpretation of the results hinge on a number of assumptions, most of which are not directly testable. Critically, the parallel trends assumption requires that, bar the effects of EU funding, the outcomes of successful firms would have evolved in the post-treatment period similarly to those of the control group. This counterfactual scenario is not observable. However, Figure 3 shows that, ahead of the decision, coefficients β_τ are generally not statistically different from zero.[10] This means that, by including in Equation (1) firm-fixed effects, controls for sector-specific shocks over time, and relative-time dummies for each treatment cohort, we eliminated any systematic differences between successful and unsuccessful firms in the pre-treatment period. Though this is not proof of the parallel trends assumption, it supports the similitude of the pre-treatment trends in the two groups, which is reassuring as regards its plausibility.

We are also confident as regards other conditions. Visual inspection of the relevant distributions confirms the common support requirement, which is facilitated by using a sample exclusively made of applicant firms. In order to minimise endogeneity problems, we use an agnostic specification exclusively relying on fixed effects as defined in Equation (1).

9. Sector is herein defined on the basis of CAE - rev.3 classification, at the two-digit level, comprising 78 distinct sectors of activity.

10. Significance tests further show that, in the pre-treatment period, the β_τ coefficients are also jointly not different from zero for most variables under analysis. The only exceptions refer to GVA and turnover, which is consistent with insight provided by the visual inspection of Figure 3. Moreover, similar significance tests of the parameters β_τ in the post-treatment period reveal that they are jointly significant for all variables.

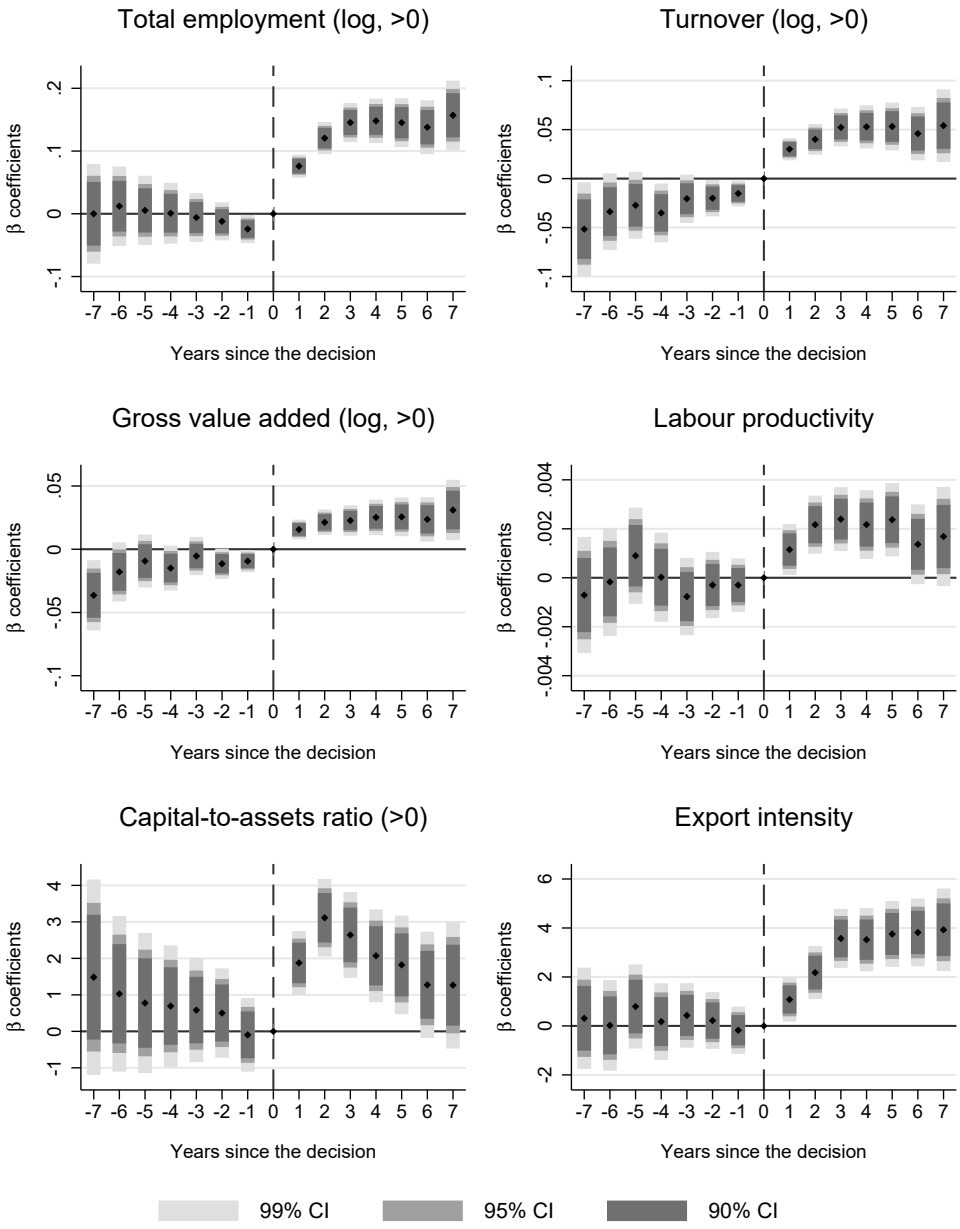

FIGURE 3: Baseline results: event-study analysis for selected firm outcomes

Notes: All regressions include relative-year dummy variables (γ_τ), firm and sector-calendar year fixed effects as specified in Equation (1). Sectors are defined at the two-digit level of CAE rev. 3 classification. The point estimates take as benchmark the year in which the relevant decision regarding the funding was taken. The confidence intervals are derived from robust standard-errors clustered at the firm-level. Significance tests show that, in the pre-treatment period, the coefficients are jointly not different from zero for all variables, except for GVA and turnover. Similar significance tests of the parameters β_τ in the post-treatment period reveal that they are jointly significant for all variables. For total employment, turnover and GVA, the natural logarithm is considered. For these dependent variables, as well as for the capital-to-assets ratio, zeroes and negative observations are discarded. Although included in the regressions, coefficients for relative-time periods before -7 and after 7 are not depicted as the large confidence intervals would hamper the legibility of the charts.

The results of Figure 3 point to a statistically significant positive and persistent effect of having at least one project supported under COMPETE on firms' performance. The estimated impacts on employment are especially large and long-lasting. Three years after the decision, total employment is, on average, 15.7% higher in successful firms compared to their counterparts which got a negative decision. As highlighted in Section 2, the positive effect on employment is a common result in most previous studies on the firm-level effects of EU funding. This favourable impact on employment is also consistent with QREN's emphasis on job creation.

The effects on exports are substantial and persistent over time. As a ratio to turnover, they stand, on average, 3.6 percentage points (pp) higher than in unsuccessful firms by the third year after the decision. This impact on exports is not immediate, building up within the first years after treatment. This is consistent with the progressive nature of firms' internationalisation, which involves a learning curve in terms of destination markets, global marketing and promotion, and the access to distribution networks abroad. The positive effect on exports is also compatible with QREN's focus on external competitiveness and internationalisation, particularly in the case of SMEs.

The capital-to-assets ratio of beneficiary firms is higher, thus reinforcing the link between receiving EU funding and the widening of the productive capacity of companies. However, the effects on capital appear to be particularly short-lived: marginal effects start decaying as of the third year after the decision. This could be explained by planned projects that were not granted EU support still being implemented later on, at least to some extent. In addition, for one-off projects, the depreciation of fixed assets would imply an over time decline in their value.

Positive effects are estimated for GVA and turnover as well. However, for these variables, there seems to be an upward trend in the estimated parameters even in the pre-treatment period. Also, for more stringent levels of significance, the plausibility of similar pre-treatment trends is weaker even controlling for firm fixed effects, relative-time periods and sector-specific shocks over time. While this hampers the causality claim on the impact of EU funding on these variables, the charts do still show an increase in GVA and turnover compared to unsuccessful firms in the years following the decision.

The treatment effect on labour productivity is statistically significant but small. This can be explained by GVA and employment being both affected by EU funding: first, as discussed, the programme achieved its job creation goal; second, the effects on GVA are found to be small and do not cumulate over time. Impacts on firms' productivity could anyway be expected later on, as a more efficient use of new capacity should build up over time. Still, even focusing on a longer horizon, productivity gains compared to non-beneficiary firms remain low and quickly converge to zero. The milder effects estimated for productivity than for other variables is a recurring finding in this literature. We further checked for the effects of funding on other firms' outcomes, including different measures of profitability and leverage, but found no evidence of a significant impact.

For most variables, the effect of EU funding seems to prevail for at least 5 to 7 years. The impacts are particularly persistent in the cases of employment and exports, and short-lived in the case of capital. However, it should be mentioned that, because we only kept the first favourable decision for each firm and several have submitted further

successful projects, the persistence insights from the charts may be reflecting the impact of the latter. In the outer years following the decision, the point estimates somewhat decline and the smaller number of observations contribute to larger confidence intervals, yielding statistically nil treatment effects.

The analysis was replicated on a number of differently defined sub-samples based on sector, firm size and age cohorts, allowing us to examine the heterogeneity of the baseline results across firms' characteristics. The results are qualitatively unchanged for all dependent variables considered, except for labour productivity. Overall, the effects of having at least one supported project appear to be stronger in the case of firms in the manufacturing sector and of those with less than 5 years of activity. In the case of productivity, we find no evidence of significant effects once we focus on sub-samples of manufacturing firms, non-micro corporations, or firms older than 5 years. By contrast, effects on this variable are larger in the case of micro firms, those in the younger age cohorts or in services.

We have also replicated the analysis on an alternative sample of applicant firms considering only those which are present across all the 14 years covered by CBHP. By focusing on this balanced panel, results are unchanged only in the cases of turnover and GVA. The effects on total employment and export intensity remain significant but are milder, while they become virtually nil as regards the capital ratio and labour productivity.

Another robustness check concerns the role of firms that also successfully applied to funds under the PT2020 framework. Recall that, in the definition of our sample, we excluded all firms that had also approved PT2020 projects in the 2015-2019 period. We reproduced the analysis keeping all these beneficiaries in the sample and the results are very similar to those presented in Figure 3. The estimated coefficients for all variables are slightly higher, except for the capital intensity ratio for which the parameters are a bit smaller.

Finally, it should be acknowledged that the results in Figure 3 can be affected by the way we define the treatment and control groups. By focusing only on the first favourable decision for a successful firm, we are disregarding the possibility of subsequent supported projects, which would imply an upward bias both in the level and the persistence of the effects. Similarly, by selecting for the control group firms which are always unsuccessful in their bids (regardless of the number of applications), we may be inducing negative selection effects. In order to improve the comparability of the two groups and check whether different definitions would yield differences in the estimates, we replicated the baseline analysis: 1) restricting the treatment group to firms with only one approved project; 2) further restricting the control group to firms with only one application (unsuccessful); and 3) restricting both groups to firms with a single application. The results in Figure 3 are quantitative and qualitatively robust to these alternative definitions. In the Appendix, we illustrate this fact by showing the estimation results considering the sub-sample of single applicants, the most restrictive

robustness check as it excludes all firms (successful and unsuccessful) that applied more than once.[11]

6. Concluding remarks

NGEU, the large scale EU-wide response to the pandemic shock and to the long term challenges of the European economy, renewed interest in the effective impacts of EU funding. Portugal has been a net beneficiary of structural funds since EU accession. The most recent closed programming period under which EU funds were distributed spanned 2007-2013 and, in the case of Portugal, it was framed by QREN — the National Strategic Reference Framework. QREN had a strong focus on Portuguese firms, notably through COMPETE, a specific programme supporting business R&D, innovation and the internationalisation of SMEs.

This article provides a first take on the assessment of the effects of receiving funding under COMPETE on a set of firms' performance indicators in 2006-2019. In particular, we focus on employment, turnover, GVA, the capital ratio, labour productivity and export intensity of firms which submitted a successful bid and contrast them with firms that also applied but did not obtain the funding. We draw on a rich longitudinal firm-level dataset and combine it with new project-level data on all projects submitted in 2007-2013. We implement a DiD strategy considering a binary treatment that is determined by the relevant decision on whether to grant EU support for some project. Firms that succeed are our treatment group; the unsuccessful applicants, which never receive funding, are the control group.

We provide evidence of statistically significant positive effects on firms' performance of having a supported project. It is not possible to disentangle the contribution of the funding *per se* from that of a selection effect stemming from the *ex-ante* approval of the best projects. Still, before the funding decision was made, and controlling for relevant fixed effects, the two groups were broadly indistinguishable. In the years after the decision, successful firms feature higher employment, turnover, GVA, productivity, capital-to-assets ratio and export intensity than their counterparts in the control group. Although statistically significant, the effects on labour productivity are smaller than on the other variables. We also show that the effects are persistent, as the analysed outcomes remain higher in successful firms for several years after the bid. The impact on capital is the least persistent, starting to decay after three years. The results are robust to alternative definitions of the treatment and control groups and also broadly hold in different sub-samples of firms.

As firms' support via EU funding becomes increasingly prominent, it is essential to properly evaluate the effectiveness of such policies. The analysis herein represents a first step in exploring the potentialities of the project-level Incentives Systems data, recently made available at BPLIM, for counterfactual impact evaluation. In particular, it could be interesting to explore how the impacts change depending on the number of supported

11. All detailed results are available from the authors upon request.

projects, or on the magnitude of the incentives provided. Other possible sources of variability in the effects include different kinds of financial support (repayable vs non-repayable), the different nature of each system of incentives, or the regional distribution of the supported projects. These are avenues to be explored in future research.

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Appendix: Robustness test

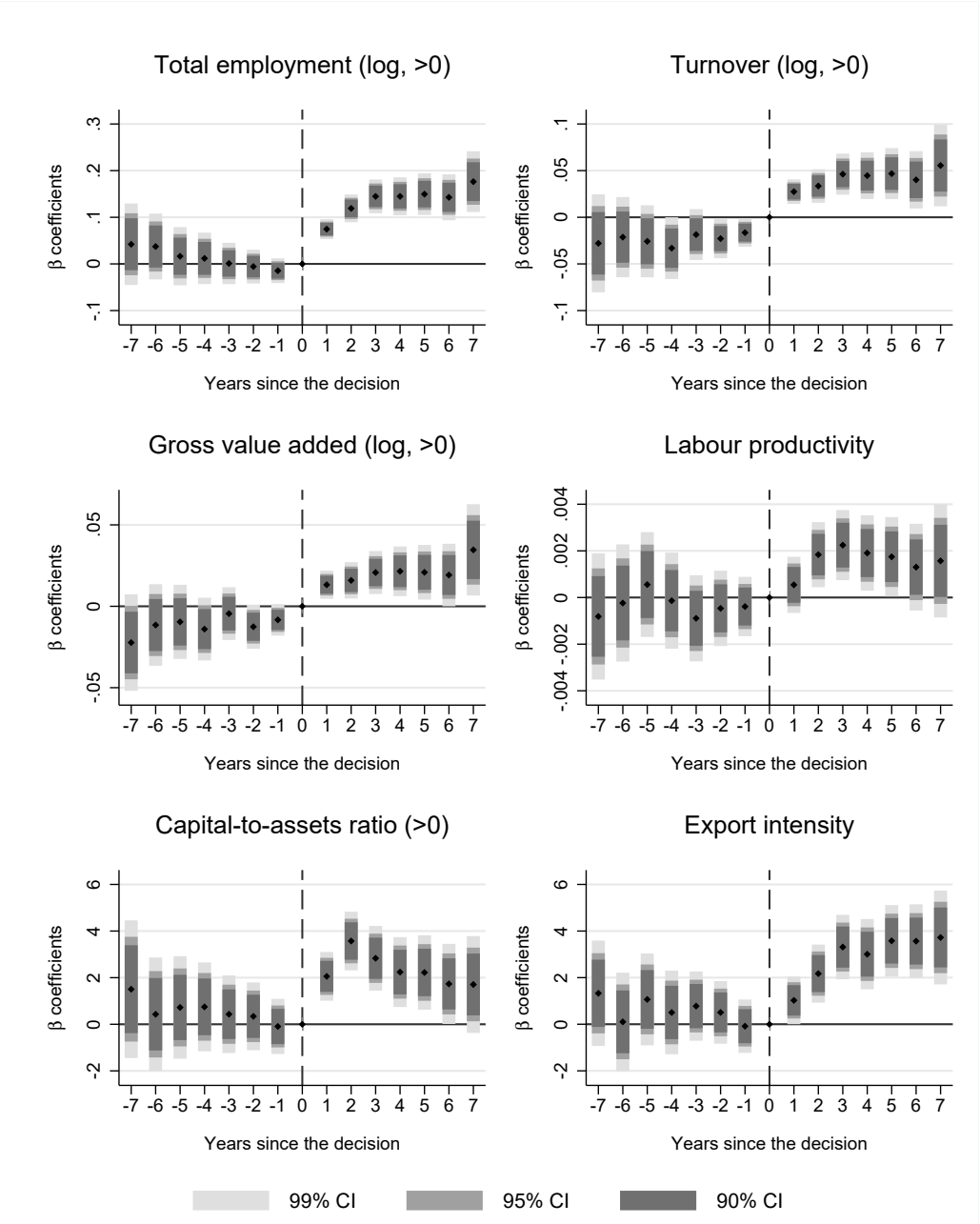

FIGURE A.1: Sub-sample of firms that apply only once: event-study analysis

Notes: All regressions include relative-year dummy variables (γ_τ), firm and sector-calendar year fixed effects as specified in Equation (1). Sectors are defined at the two-digit level of CAE rev. 3 classification. The point estimates take as a benchmark the year in which the relevant decision regarding the funding was taken. The confidence intervals are derived from robust standard-errors clustered at the firm-level. Significance tests show that, in the pre-treatment period, the coefficients are jointly not different from zero for all variables, except for GVA and turnover. Similar significance tests of the parameters β_τ in the post-treatment period reveal that they are jointly significant for all variables. For total employment, turnover and GVA, the natural logarithm is considered. For these dependent variables, as well as for the capital-to-assets ratio, zeroes and negative observations are discarded. Although included in the regressions, coefficients for relative-time periods before -7 and after 7 are not depicted as the large confidence intervals would hamper the legibility of the charts.