The effect of the 2019 minimum wage hike on Spanish firms

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Abstract

This paper estimates the impacts of the Spanish 2019 reform that raised the minimum wage on firms' capital investment and total factor productivity. While a large literature has studied the impacts of minimum wage policy on employees, much less research has focused on potential impacts on businesses. A smaller literature on such impacts is experiencing a surge in recent years—yet remains small, with effects on firm productivity particularly scarce. This paper therefore contributes to the large literature on minimum wage effects by exploring impacts that have been relatively under-studied. By employing causal regression analysis techniques, this paper provides robust evidence that the minimum wage increases the investment ratio and firm productivity growth. While the finding that minimum wages (a restriction on businesses) increase firm productivity may seem counter-intuitive at first, I am able to provide evidence regarding one such mechanism for this to occur—increased investment. Finally, this work emphasizes the need to further explore the impacts of the minimum wage on outcomes beyond employment.

Keywords: *Minimum Wage, Productivity, Capital Investment.*

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1 Introduction

This study estimates the impact of an increase in the minimum wage on changes in fixed capital stock (net investment) and in total factor productivity (TFP). This paper adds to the growing but still relatively small literature that examines the impact of minimum wage policies on firm behavior. Minimum wage policies have long been a subject of debate and analysis in labor economics and applied microeconometrics over the past three decades. The effects of minimum wage hikes on employment have received significant attention in the academic literature, with seminal studies by Card and Krueger (1994, 2000), followed by a prolific subsequent academic debate on this topic (e.g. (Neumark & Wascher, 2000)). This academic debate sheds light on the complexities of the relationship of minimum wage to market outcomes and establishes a field of research that is still open to new findings (e.g. see recent studies, such as Cengiz, Dube, Lindner, and Zentler-Munro (2022) or Engbom and Moser (2022)). Nonetheless, the impact of minimum wage policies on firms has been relatively overlooked despite its potential significance in understanding the broader implications of such policies. However, in recent years there is a growing recognition of the need to consider the consequences for companies (Drucker, Mazirov, & Neumark, 2021; Harasztosi & Lindner, 2019).

Building upon this prior research, this study focuses on two important potential firm outcomes that could result from minimum wage policy—firm investment and firm productivity. Theoretically, minimum wage policy could lead to a rise in capital stock due to a substitution effect from labor to capital. Simultaneously, the minimum wage hike can create incentives for companies to allocate resources towards research and development (R&D) endeavors, potentially resulting in an increase in TFP. However, it is worth noting that despite the compelling factors that suggest potential for a significant effect of the minimum wage in stimulating productivity enhancements and promoting investments in R&D, the literature investigating the impact of the minimum wage on firms has paid relatively limited attention to this specific aspect.

I take the case of the 2019 Spanish reform to evaluate these hypotheses. Spain has witnessed a large increase in its minimum wage, thereby presenting a compelling backdrop to investigate the implications of such policy measures on enterprises. Between 2018 and the present, the minimum monthly remuneration in Spain has experienced a substantial increase from €735 to the current €1,080 (distributed over 14 payments throughout the year). This noteworthy increase offers a valuable prospect to explore the ramifications of minimum wage hikes on companies and elucidate the mechanisms by which firms adapt to increased labor expenses.

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature on the effects of minimum wage hikes on both workers and firms. Section 3 outlines the policy details of the 2019 reform of the minimum wage in Spain. Section 4 presents a discussion of the data. Section 5 details the econometric strategy used. The results are detailed in Section 6. Finally, Section 7 concludes.

2 Background Literature

The literature on the impact of the minimum wage on employment is extensive (for some reviews see de Linde Leonard, Stanley, & Doucouliagos, 2014; Schmitt, 2015). These articles usually use data at the worker level to evaluate minimum wage effects. From this literature, most studies have concluded that there are negative effects on employment, especially for the most affected groups such as teenagers (Neumark & Shirley, 2022). However, the disparity of results—with abundant evidence also pointing to positive or zero employment effects—has led to the conclusion that the effect of minimum wages on employment is elusive (Manning, 2021).

In the case of Spain, the increase in the minimum wage implemented in 2019 is significant enough to warrant a comprehensive analysis of this policy. Several recent research studies have specifically focused on this reform[1] and its impact on employment using the rich data set Muestra Continua de Vidas Laborales (MCVL), or Continuous Working Lives Samples (e.g. Arranz, García-Serrano, & Silva, 2022; Barceló et al., 2021; Fernández-Baldor Laporta, 2022; Gorjón, de Lafuente, & Romero, 2022). These studies address the question of the probability of job loss, short-term effects or inequality. Usually, these papers find moderate effects of job destruction in the medium term, although this conclusion is not unanimous in all analyses. Other studies related to the 2019 reform are those carried out by the Autoridad Independiente de Responsabilidad Fiscal (AIREF) or Comisiones Obreras (CCOO), with mixed results and methodologies (AIREF, 2020; CCOO, 2019).

Looking at this large body of literature, there is notably less evidence regarding impacts on businesses relative to the direct impacts on low wage workers. However, there are several theoretical arguments that motivate the study of the impact of the minimum wage on companies[2]:

i) Understanding who pays: since labor is a cost at the firm level, it is possible that an increase in labor costs may result in a change in profit margins if companies are unable to transfer the cost increase to higher prices. Some business closures could also result in this case. Alternatively, firms may be more able to pass on cost increases to price increases in markets with more inelastic demand. Therefore, increases in the minimum wage can have a redistributive effect among consumers[3], owners, and workers—depending on whether we observe effects on employment and prices[4].

ii) The substitution effect: The canonical neoclassical model of factors of production predicts that when the cost of labor increases, there will be a substitution between labor and capital, leading firms to increase their investment. As growth theory would predict, these increases in business investment can have long-term growth effects.

iii) Innovation: the increase in the relative cost of labor is also a factor that can incentivize the pursuit of productivity gains and innovation incentives. Thus, minimum wage increases can affect TFP

[1] Minimum monthly wages rose from €735 to €900.

[2] This has also been acknowledged by Barceló et al. (2021), who underscored the necessity of addressing this concern, proposing the possibility of investigating it using company accounting data or by studying the wage tables of collective agreements.

[3] When cost increases translate into price increases.

[4] These arguments are present in studies that attempt to analyze who pays for the minimum wage, such as the works of Harasztosi and Lindner (2019) or Drucker et al. (2021).

if firms invest in intangible assets such as R&D or allocate more funds to employee training to address the increase in wage costs (Riley & Bondibene, 2017). Productivity gains can also be stimulated by improvements in human capital resulting from the displacement of less skilled workers by skilled workers, due to the increase in the cost of hiring the former.

iv) Worker productivity: there are other possible explanations for productivity gains when wages increase, such as the efficiency wage hypothesis (Shapiro & Stiglitz, 1984). In terms of productivity, the increase in wage costs could also be translated into increases in labor intensity as a strategy by companies to compensate for lower profits resulting from cost increases (Stigler, 1946). In such cases, one could potentially observe increased firm productivity even without a substitution effect.

In this work, I explore these theoretical motivations through the study of the influence of minimum wage increases on total factor productivity, and test for investment as a potential mechanism. Despite the different theoretical elements that justify considering the influence of the minimum wage at the company level, applied studies in this regard are not as prolific as those that focus on the effects on employment. However, there are several exceptions to this trend, and this literature has been expanding in recent years. In the following paragraphs, I present a series of studies that have analyzed the impacts on companies and their main results. Much of this literature has focused on elements related to who pays for minimum wage, exploring outcomes such as profits, cost pass through and distributional impacts.

There is an early attempt to carry out an evaluation on firms by Card and Krueger (1995) using the impact of minimum wage increases on stock prices in the United States. However, since the companies with the most workers subject to the minimum wage are not the most likely to be publicly traded, the results are not generalizable to the affected companies (Drucker et al., 2021).

Draca, Machin, and Van Reenen (2011) analyze the effects of the minimum wage on firm profitability using a balance sheet dataset similar to the one I use in this paper (FAME, Bureau Van Dijk's version for the United Kingdom, equivalent to Sabi in Spain) and cross-checking with data from the Labour Force Survey in the UK to take into account the wage structure. Wage structure data allow them to conclude that the measure to determine the degree to which firms are affected by the increase in the minimum wage (average wages) is a consistent measure when compared with the data obtained with the wage distribution. The authors conclude that firms reduce their profitability, especially in those industries with relatively high market power.

More recently, there have been analyses focused on the idea of who pays for the minimum wage[5]. Harasztosi and Lindner (2019) study the case of Hungary using firm-level information from Corporate Income Tax data combined with the Hungarian Structure of Earnings Survey. They conclude that around 75% of the minimum wage increases were borne by consumers, while the remaining 25% was borne by employers. Regarding the response of companies, they find evidence of a trade-off between capital and labor, among other conclusions.

Studying the case of Israel, Drucker et al. (2021) emphasizes the distributional effects of increasing the minimum wage, specifically focusing on its impact on the incomes of business owners. The authors

[5]The idea behind the words "who pays for" is to evaluate if there is a redistribution of income between consumers, owners, and workers.

use tax records of owners and workers and company records to analyze the allocation of costs resulting from a substantial minimum wage hike. The study reveals that an increased minimum wage results in reduced profits for companies, especially those with lower initial profitability. This study also emphasizes that owners of businesses employing a higher proportion of minimum-wage workers tend to rank among the lowest income brackets within the spectrum of business owners.

A recent paper for Portugal with worker and firm level data, using the rich administrative database Quadros do Pessoal together with balance sheet information, (Alexandre, Bação, Cerejeira, Costa, & Portela, 2022) concludes that minimum wage increases have a positive impact on the probability of exiting the market, especially for firms with more financial problems. These authors also suggest that there may be effects that contribute to productivity growth by displacing less productive firms out of the market.

From the management literature, some recent papers address this issue too. First, a case study focused on assessing the impact of the minimum wage on a sample of U.S. hotels (Agarwal, Ayyagari, & Kosová, 2023), shows that doubling the minimum wage would reduce average hotel revenues by 6 percent. On the other hand, another recent study concludes, also for the United States, that increasing the minimum wage reduces the financial health of small and labor-intensive companies (Chava, Oettl, & Singh, 2023).

Regarding the effects of the minimum wage on workers' productivity, studies are still scare. However, there are several recent studies in this area. For example, the study by Ku (2022), which focuses on a case study in Florida and finds a positive response of labor effort to the increase in the minimum wage. Another example is the study by Coviello, Deserranno, and Persico (2022) using state borders discontinuities in the US and finding that workers become more productive after a minimum wage increase.

Within this literature related to business impacts of minimum wage, this study focuses on the impacts of minimum wage policy on firm productivity (TFP) and the role of investment. Total factor productivity has only been explored in a few cases, such as Hau, Huang, and Wang (2020) or Mayneris, Poncet, and Zhang (2018) for the case of China. These articles conclude that minimum wages increases in China tend to accelerate productivity growth. Analyzing the case of the United Kingdom with the FAME database, Riley and Bondibene (2017) find that firms tend to respond to minimum wage increases through gains in total factor productivity. We extend this limited evidence by testing the impacts of minimum wage policy on total factor productivity using the case of Spain, and extending this analysis to also test the mechanism of net investment in productivity gains. We find that minimum wage increases result in increased firm productivity gains and that investment plays a role in this effect.

3 Policy Details

In 2019, there was a significant increase in the minimum wage from €735.9 to €900 in 14 payments. Subsequently smaller increases have been carried out up to the current €1,080 in 14 payments. The measure was approved in the Official State Gazette on December 21, 2018, and entered into force on

January 1, 2019. Figure 1, shows the evolution of the minimum wage in 14 payments in Spain since 2004. The relative economic stability during this period prior to the COVID-19 pandemic justifies that the measure was carried out through a political negotiation process among different parties rather than as a response to the macroeconomic situation.

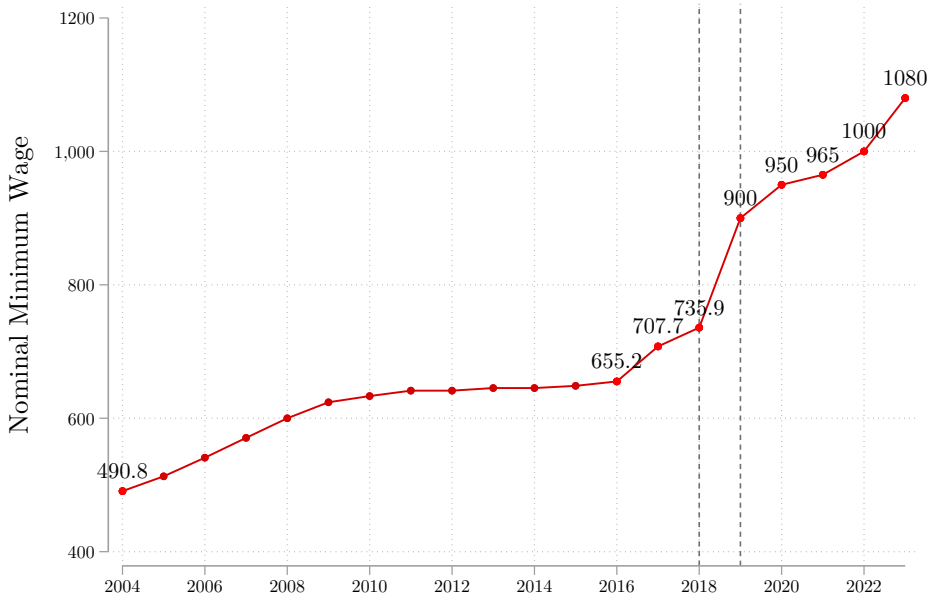

Figure 1: Evolution of the minimum wage in Spain. *Note*: Data from Spanish Ministry of Economic Affairs and Digital Transformation.

Before 2017, the minimum wage had been around €640 with minor increases in the previous years. This low minimum wage meant that the population subject to these minimum wages was relatively insignificant before 2017. However, with subsequent increases, the impact of the minimum wage started to become much greater. For example, Gorjón et al. (2022) estimate that the proportion of wage earners subject to the minimum wage that began to be implemented in 2019 was around 9% of the entire working population.

4 Data

The objective of this paper is to evaluate the impact of the increase in the minimum wage (SMI from now on[6]) in 2019 on key variables of Spanish companies such as on capital investment and total factor productivity. The identification strategy is based on carrying out a difference-in-differences type study where I compare the effect on the variables of interest between more intensely treated groups —with more workers below the minimum wage pre-reform—and less intensely treated groups before and after the policy implementation.

To do so, I identify the companies by proportion of workers affected by the policy using wage structure information, and then I merge that information with accounting data of the individual companies.

[6]SMI stands for Salario Mínimo Interprofesional.

With these data sources, it is possible to measure the economic impact of the reform depending on the degree of workers below the minimum wage.

To carry out the analysis I have used disaggregated data from the Structure of Earnings Survey (SES) to delimit the proportion of workers who in 2018 were below the minimum wage that was implemented as of 2019. With this data, I have been able to compute ratios of proportions of workers affected by the increase in the SMI in 2019 based on their wages in 2018 by Autonomous Community and sector division (NACE European classification at two digits). These ratios allow for identifying the types of companies that are affected by the minimum wage to a greater or lesser degree.

Once I obtained the degree to which the increase in the minimum wage affects each type of company, I combine this information with accounting variables collected from the Orbis database. With this information, I am able to evaluate the different responses of the variables of interest to the 2019 reform.

4.1 Orbis Database

Orbis is the database from which the accounting information is obtained at the company level to carry out the analyses. I obtained the financial information for all companies with information for the total assets variable in 2018 and 2019. For these companies, I then obtained all the information for all the financial variables available between 2015 and 2021. Additionally, to calculate total factor productivity, I also obtained information on the stock of fixed capital, the wage bill, the number of workers and material cost since 2012.

I prepared and cleaned the database following the recommendations of Kalemli-Ozcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas (2015). Following this guide, only non-consolidated accounts are taken into account to avoid double accounting of business groups. Quantitative variables have been expressed in real terms using the GDP deflator of 2015. Values with simultaneous missing values in the main variables have been removed. Companies are eliminated if assets, sales, or employment are negative in any year, or if the company has implausible values in the number of employees. Employee-to-asset ratios and sales-to-total-assets ratios have also been calculated, and the company is excluded if any of these ratios have extreme values in any year—specifically, the company is removed if in any year, any of these ratios is higher than the 99.9th percentile. Finally, following Fons-Rosen, Kalemli-Ozcan, Sørensen, Villegas-Sanchez, and Volosovych (2021), the variables have been winsorized at 1% each year.

Orbis database is a very rich source of information. It contains both financial information and information related to the sectors of activity or the specific location of each company. One of the benefits of having this database is that the information is more extensive than other databases that focus only on listed companies, such as Compustat for the United States, as there is a wealth of information available on small and medium-sized companies. However, in terms of wage structure information, it is a deficient source, as only information on the number of employees and total wage costs is available. In this regard, we cannot determine the composition of the wage structure at the company level. Furthermore, average wages can be influenced by higher earnings of managerial and technical staff within the companies. Additionally, total wage costs also include non-wage costs such as severance payments, making it an imprecise measure of average wages if only salaries were considered. Due to this lack of information

on the wage structure and the possible inaccuracies of the average wage measures in Orbis, I resolve this by turning to another source of information: the Structure of Earnings Survey data.

4.2 Structure of Earnings Survey

In order to obtain a measure of the salary structure to determine the proportion of workers at the company level who were below the minimum wage established in 2019 as of 2018 (1 year prior), the chosen solution was to use microdata from the 2018 Structure of Earnings Survey from 2018 and then impute those values by sector (at a two-digit level) and Autonomous Community with the data from Orbis[7].

The available microdata from the latest SES corresponds precisely to the year 2018, the pre-policy year. However, since the public microdata from the SES only provides information at the NUTS 1 level (aggregated into 7 broad regions) and by sections of the CNAE classification (very broad sectors), we made a special request for microdata disaggregated by two-digit sector and by region at the NUTS 2 level (Autonomous Communities) in order to have more detailed information to compute the hourly wage in 2018.

The hourly wage has been calculated taking into account the base salary and ordinary salary supplements, excluding extraordinary payments, and considering prorated salaries equivalent to 12 payments. A worker is considered to be below the minimum wage in force in 2019 if their equivalent hourly wage, based on 12 monthly payments, was less than €6.034 per hour in 2018. The calculation of the hourly wage includes extra payments to consider them as monthly wages considering 12 payments instead of 14. Additionally, salary supplements have been included in the base salary since technically the legislation allows for base salaries below the minimum wage in certain sectors, and legally what matters is that the sum of the base salary and the basic salary supplement per occupation equals the minimum wage. Using this measure, I find that the proportion of workers below the 2019 minimum wage, using the 2018 wage structure, was 9.27%. This proportion is very similar to the calculation by Gorjón et al. (2022) using the Muestra Continua de Vidas Laborales (MCVL).

Once this calculation has been done, the proportion of workers affected by the minimum wage increase in 2019 has been imputed into the Orbis database by two digits sectors and Autonomous Community. In Table 1, a descriptive summary of some of the variables available in the combined database is shown. As can be seen in the table, the number of observations varies significantly, especially in the case of TFP, as it requires prior estimation and relies on information from other variables for estimation over several consecutive years. Another interesting element of this table is that capital investment can be negative. This is because this variable is defined as the change in net fixed capital stock so, when companies decide not to invest, they assume the cost of depreciation, resulting in a decrease in the capital stock. However, this measure of investment is standard in articles with corporate accounting data (Kalemli-Özcan, Laeven, & Moreno, 2022). In the next section, the calculation of net investment and TFP is explained in more detail.

[7]Consideration was also given to disaggregating the calculation by company size, but it was discarded in the final work due to the lack of representativeness of the data. By excessively disaggregating the calculation, there were very few companies in some cases with the SES data.

Table 1: Descriptive summary of the main variables

Variables	N	Mean	s.d.	p.25	p.50	p.75
Fixed capital stock	4,029,150	365,866	1,081,099	5,525	40,564	217,298
Capital investment	2,990,705	27.23%	178.95%	-16.44%	-4.08%	2.23%
Sales	3,709,850	1,300,754	3,806,580	87,186	253,802	780,879
Net income	4,245,527	51,623	245,719	-2,056	4,366	26,906
Number of employees	3,118,008	10	20	2	4	8
Wage bill	3,368,907	285,014	696,664	32,950	84,374	219,389
Material cost	3,169,462	825,856	2,628,296	22,620	108,655	415,354
Productivity growth	594,516	0.20%	41.09%	-12.02%	0.36%	12.64%

Notes: Capital investment is defined as the growth ratio of net fixed capital stock. The total factor productivity estimation is defined in the next section. p.25, p.50 and p.75 are the different percentiles of the variables. Information is available since 2015 for most variables except for fixed capital investment and productivity growth, which are available from 2016.

4.3 Outcome Definitions

Among the various outcomes that can be proposed to analyze the impact of the minimum wage on businesses, in this study, we focus on analyzing changes in the stock of capital (net capital investment) and total factor productivity (TFP) of the companies. Additionally, other outcomes are discussed for future analyses.

4.3.1 Change in Capital Stock: Net Investment

Investment can be measured in net or gross terms. In this analysis, I have focused on studying investment measured as the change in capital stock over initial capital in net terms. Following (Kalemli-Özcan et al., 2022), net investment is more relevant in explaining future productivity as it does not consider investments that only replace capital depreciation[8].

Given this decision regarding the net investment variable, in this work, when I refer to investment, net investment, or investment rate, I will be referring to the same concept: the rate of change of net capital stock.

4.3.2 Total Factor Productivity

The literature on estimating production functions identifies three main approaches: instrumental-variables, fixed-effects, and control function approaches (Rovigatti & Mollisi, 2018). The control function approach is the most widely used method for production function estimation. Olley and Pakes (1996), Levinsohn and Petrin (2003) and (Ackerberg, Caves, & Frazer, 2015) proposed different widely used methodologies. Furthermore, (Wooldridge, 2009) has shown how to implement the control function approach in a system GMM framework.

In order to compute total factor productivity at the firm level, it is usually assumed that the firm's production is determined by a Cobb-Douglas function.

[8]Studying gross investment would pose the additional challenge of analyzing investment decisions with a censored regression model. This possibility could be explored in future analyses.

$$Y_{it} = TFP_{it} L_{it}^{\beta_l} K_{it}^{\beta_k}, \tag{1}$$

where Y_{it} is value added at the firm level, TFP_{it} is total factor productivity, L_{it} is labor input, K_{it} is capital input and β_l and β_k are labor and capital elasticities, respectively.

Taking logs in both sides and adding a constant and an error term, we have the following:

$$\log(Y_{it}) = \alpha + \beta_\ell \log(L_{it}) + \beta_k \log(K_{it}) + \underbrace{(TFP_{it} + e_{it})}_{\text{TFP + Shock}}, \tag{2}$$

Simply estimating the Cobb-Douglas function by taking logarithms through ordinary least squares would be an incorrect way to calculate labor and capital elasticities and would make it impossible to extract the idiosyncratic total factor productivity (TFP) of each company. Since TFP is not an observable variable, an explicit modeling of the TFP form must be carried out. The idea is to look for an observable variable that is a function of unobservable TFP to allow estimating it. Olley and Pakes (1996) strategy uses as an observable variable investment while since Levinsohn and Petrin (2003) it is most common to use material cost. During the last years, the most common estimation strategies lays in one-step Generalized Method of Moments (GMM) estimations Wooldridge (2009) or two-step GMM equations Ackerberg et al. (2015). Following the one-step GMM procedure, we can assume that TFP is a function of capital and material cost:

$$TFP_{it} = g(K_{it}, M_{it}) \tag{3}$$

Following Wooldridge's proposal, a specific functional form is typically assigned to TFP, for example, a polynomial form, and then the estimation of the different parameters of the transformed Cobb-Douglas is performed using the GMM with lagged variables as instruments.

In practice, in order to estimate this type of function, it is necessary to measure real value added, which, following Fons-Rosen et al. (2021), is computed by dividing nominal value added by the two-digit industrial price deflators because prices are not collected at company level[9]. Labor is measured as the wage bill deflated as well by the two digit producer price deflator, while capital is deflated by the investment goods deflator[10].

TFP at the firm level is obtained as a residual after estimating the different parameters of the Cobb-Douglas function in the following way:

$$\log(TFP_{it}) = \log(Y_{it}) - \hat{\beta}_\ell \log(L_{it}) - \hat{\beta}_k \log(K_{it}) \tag{4}$$

estimating capital and labor elasticities by sector at two digits sector level and following Wooldridge's methodology.

[9]Since, unlike the article cited above, in our case we have companies beyond the manufacturing sector, I use also the Services Producer Price Index and Construction Producer price index at two digits sector level. Since TFP will be studied in rates of variation in the regression analysis, the disparity of deflators used in its calculus don't matter for the interpretation of the results. All these data are collected from the Spanish Instituto Nacional de Estadística (INE).

[10]In this case the data is obtained through the OECD.

Following a recent study by Fons-Rosen et al. (2021), who used data from Orbis, in this work, the calculation has been carried out based on the methodology proposed by Wooldridge as the fundamental strategy, although in future analyses additional robustness estimations can be carried out following other methodologies[11].

4.3.3 Other Possible Outcomes

In addition to the mentioned outcomes that will be analyzed in this study, the influence of the minimum wage on the following variables could also be explored for future studies:

Profits: In order to replicate existing studies that analyze the redistribution among entrepreneurs, consumers, and workers, an interesting outcome would be to examine the influence of minimum wage increases on profits. In this regard, if we assume that companies can pass on the increased costs to prices, real profits would remain relatively stable. On the other hand, if nominal profits decrease more in heavily affected sectors, it would indicate that companies are not fully transferring the effects of the minimum wage increase to prices.

Capital-Labor Substitution: Harasztosi and Lindner (2019) have previously analyzed the substitution effect between capital and labor both empirically and theoretically. Following this line of research, another interesting outcome would be to examine the impact on the capital-labor ratio by estimating models with this variable as the dependent variable.

5 Econometric Strategy

The identification strategy of this paper is based on carrying out a difference-in-differences type study, where I compare the effect on the variables of interest between more intensely treated groups and less intensely treated groups before and after the policy implementation.

A basic regression model that could allow estimating the effect of the minimum wage on different outcomes would be a simple difference-in-differences model, introducing the variable "Fraction of Minimum Wages workers" (FMW) in the regression model as a continuous variable between 0 and 1 (Drucker et al., 2021). For example, to estimate the impact of the minimum wage on the net investment rate, I estimate the following model:

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{it} = \alpha + \beta \text{FMW}_i + \gamma \text{POST}_t + \delta \text{FMW}_i \times \text{POST}_t + X_{it}\lambda + \mu_i + \varepsilon_{it} \tag{5}$$

FMW is the fraction of workers paid below the post-hike minimum wage the year before (2018). POST is a dummy variable equal 1 for the years after the minimum wage increase[12] an X_{it} is a vector of covariates. Following Drucker et al. (2021), I include sector and sector interaction with the POST dummy to control for post-reform sectoral changes (e.g. disparate COVID-19 effects by sector). I also include as additional robustness tests the level of capital stock variable and its interaction with the POST dummy variable to control for the baseline effect on growth rates.

[11] In the baseline estimation of TFP I have computed as well Levinson and Petrin's method.
[12] Given the data availability, this variable takes the value 1 for 2019, 2020, and 2021, and 0 between 2015 and 2018.

As is well known, the Difference-in-Differences (DID) model relies on the assumption of parallel trends between the treatment group and the control group. To explore the plausibility of this assumption, I have also employed the strategy of conducting estimations within an event study framework. Following this procedure, I estimated different effects each year of the treatment variable (FMW) on the variables of interest. The objective is to determine that there is no significant difference between the estimates for the years prior to the event (before 2019) but that these differences become significant after 2019. The proposed model for the event study on fixed capital investment is as follows:

$$\left(\frac{\text{Investment}}{\text{Capital}}\right)_{it} = \mu_i + \phi_t + \sum_{s \neq 2018} 1[s = t] \times FMW_i \times \beta_s + \varepsilon_{it} \tag{6}$$

In this model ϕ represents the time fixed effects, α the individual fixed effects and ε the error term. As is common in event studies, the year prior to the reform, i.e., 2018, is taken as the baseline year.

Similarly, I have also carried out the estimation of similar models for total factor productivity, both in the form of a simple difference-in-differences model:

$$\log\left(TFP_{it}\right) - \log\left(TFP_{it-1}\right) = \alpha + \beta \text{FMW}_i + \gamma \text{POST}_t + \delta \text{FMW}_i \times \text{POST}_t + X_{it}\lambda + \mu_i + \varepsilon_{it} \tag{7}$$

And, in order to evaluate parallel trends, the following event study:

$$\log\left(TFP_{it}\right) - \log\left(TFP_{it-1}\right) = \mu_i + \phi_t + \sum_{s \neq 2018} 1[s = t] \times FMW_i \times \beta_s + \varepsilon_{it} \tag{8}$$

In addition to the model with the FMW variable measured as a continuous variable between 0 and 1, estimations have been made considering models similar to those presented above but dividing the variable FMW into quartiles. The first quartile includes companies with less than 3.97% of workers below the minimum wage, the second quartile those with between 3.97 and 9.46%, the third quartile those with between 9.46 and 15.27% and the fourth quartile those with more than 15.27% of workers above the minimum wage.

With this split version of the FMW variable, I have estimated a simple difference-in-differences model and an event study, following the same procedure as the one used for the continuous FMW variable.

6 Results

6.1 Results on Capital Investment

The baseline regressions models in the simple Differences-in-Differnces setting are shown in Table 2. The first regression shows that the estimated coefficient of the interaction between FMW and POST is not significant without controlling for firm fixed effects. However, after including firm fixed effects, more significant and positive coefficients are obtained in the subsequent tests.

Once firm fixed effects are introduced, the coefficients indicate that for those companies that are more

affected by the reform, the net investment rate is estimated to be between 6.86 and 11.79 percentage points higher after the reform compared to those companies that are less affected by the reform[13].

Table 2: Estimates for the increase in the minimum wage on net investment: Baseline

Variables	(1)	(2)	(3)	(4)	(5)	(6)
FMW	-0.2022	...	...	...	...	...
	(0.0186)					
POST	-0.1477***	-0.2514***	-0.3529***	-0.3486***	-0.4459***	-0.3316***
	(0.0033)	(0.0035)	(0.0047)	(0.0070)	(0.0076)	(0.0420)
FMW x POST	0.0437*	0.0754***	0.0686***	0.1179***	0.1163***	0.0606**
	(0.0228)	(0.0239)	(0.0239)	-0.0238	(0.0238)	(0.0281)
Year fixed effects	No	No	Yes	No	Yes	Yes
Initial K dummies and initial K x POST	No	No	No	Yes	Yes	Yes
Sector dummies and sector dummies x POST	No	No	No	No	No	Yes
Firm fixed effects	No	Yes	Yes	Yes	Yes	Yes
N	2,990,705	2,990,705	2,990,705	2,990,705	2,990,705	2,990,705

Notes: The dependent variable is the growth ratio of net fixed capital stock (net investment over previous stock of fixed capital). 10%*, 5%**, 1%*** levels of significance. Clustered standard errors are calculated at the firm level. FMW takes values between 0 and 1, representing the proportion of workers below the minimum wage at the firm level.

It is important to note that these coefficients are relatively high due to the scale of the variables, which provides higher marginal effects than what would be an average impact for most companies. This is because the interpretation of the estimated coefficients implies that FMW changes from 0 to 1 after the policy, meaning we are comparing completely affected companies with companies that are not affected at all by the policy. Since this is an extreme case, the coefficient is higher in this scenario than it would be for an average company—given that the majority of companies are affected by the policy to much lesser extents. To estimate more common effects in the business population, we will conduct an analysis disaggregating the FMW variable into categories later on.

These results are robust to the introduction of various robustness tests in columns 3 to 6. Introducing year fixed effects slightly reduces the estimated coefficient but does not affect its significance. Testing the interaction of the capital stock with the POST dummy variable—to account for the fact that it is more challenging to grow when reaching a high capital stock—also yields significant results and even shows a larger impact. Lastly, testing the interaction of the sector with the POST dummy variable to examine sector-specific trends after the reform results in similar findings as those in models 2 and 3 in this table.

Once the regression analysis of a simple difference-in-differences model has been conducted, an event study has been carried out to evaluate the feasibility of the parallel trend assumption as proposed in Equation 6. The estimated coefficients and their confidence intervals for this model are shown in Figure 2. This figure clearly demonstrates that there is no significant difference in the growth rates of the capital stock for those companies most affected by the minimum wage increase in 2019 during the years 2016 and 2017. However, this difference becomes slightly significant at the 5% significance level in 2019, and the significance becomes more evident during 2020 and 2021. This evolution supports the

[13]This interpretation is based on the fact that the dependent variable represents a proportion of growht of the fixed capital stock and that the FMW variable is limited between 0 and 1.

idea that it is plausible, to rely on the parallel trend assumption. The graph shows, consistent with the simple differences-in-differences model, a positive effect of the minimum wage on the net investment rate. Those companies most affected experience substantially higher growth rates in their capital stock, especially during the year 2020. This effect also appears to have a delay (it is smaller and less significant in 2019) and seems to partly diminish in 2019.

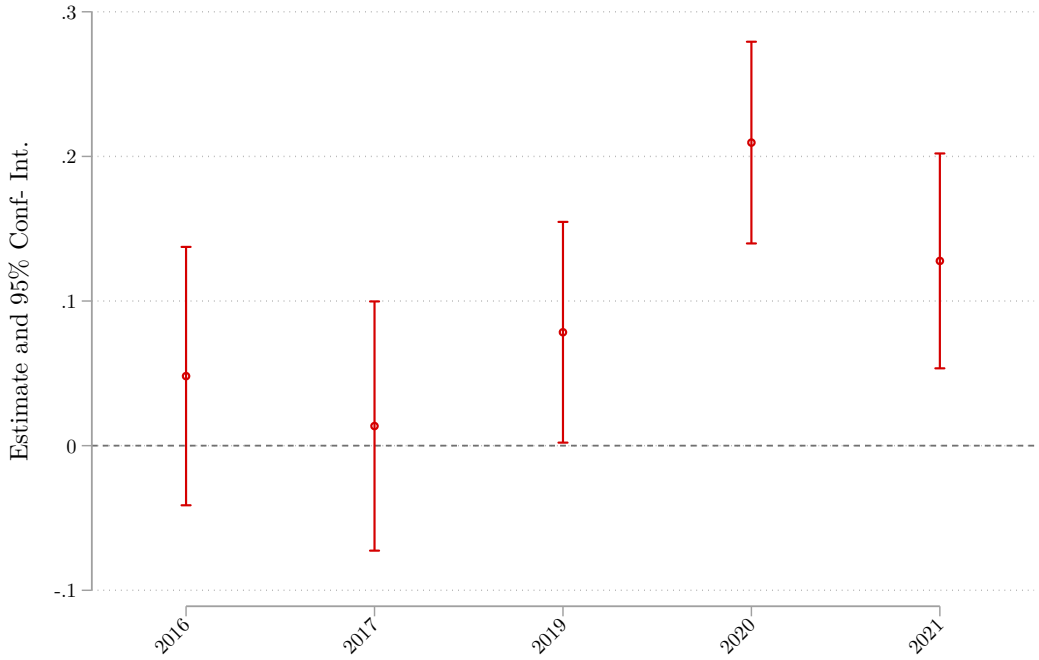

Figure 2: Event Study. Baseline results. Dependent variable: net capital investment rate.

In the case of the model estimated with the FMW variable divided into quartile categories of companies based on their proportion of workers affected by the 2019 minimum wage increase, the results of the different estimations are presented in Table 3. In this table, it is shown that the results are more variable and disparate depending on the quartiles. First, without including firm fixed effects, there is no clear result regarding the relationship between net investment and the interaction between FMW quartiles using the POST dummy variable. The coefficient is negative and significant for the second quartile, and non-significant for the rest. However, when we add fixed effects, we observe that it is also significant for the 4th quartile at 10% significance level. By adding year fixed effects and the baseline effect, which addresses the issue that growth is lower in companies with a high initial capital stock, we find that the interaction of FMW with the dummy variable POST is significant and positive. The effect is 1.91 percentage points. This implies that the companies in the most impacted quartile have a net capital stock growth rate that is 1.91 percentage points higher compared to the less affected companies (those in the 1st quartile).

Finally, in order to analyze the dynamic effects and the credibility of the parallel trend assumption, I have estimated an event study model with the quartiles of the variable FMW interacted for each year. The results of these estimates are shown in Figure 3. In this figure, once again taking the year 2018 and

the 1st quartile as a reference, it appears that there is a negative trend before the policy implementation regarding the investment rate for the 2nd and 3rd quartiles, but the parallel trends seem more evident for the 4th quartile. For the 2nd quartile, there is no effect of the minimum wage increase after 2019 (which makes sense since these are companies that are already less affected by the policy). For the 3rd quartile, although the parallel trend assumption is not fulfilled, there seems to be a change in trend after 2019: while in the previous years the higher investment rate of the 3rd quartile seemed to be declining, after a non-significant 2019, the trend reverses in 2020 and 2021.

The results obtained for the 4th quartile are more evident. In this case, there is stronger evidence in favor of the parallel trend assumption, as long as the coefficients for the years 2016 and 2017 are not significant, meaning there is no difference in the net investment rate between the companies in the 4th quartile and those in the 1st quartile before the policy. In 2019, the coefficient remains non-significant, which could indicate a certain delay in companies adjusting their capital stock. The coefficient becomes significant and positive in 2020 and 2021, indicating net capital stock growth rates for the companies in the 4th quartile that are around 4 percentage points higher in 2020 and 2 percentage points higher in 2021.

Table 3: Estimates for the increase in the minimum wage on net investment: Quartiles

Variables	(1)	(2)	(3)	(4)	(5)
FMW x q2	0.0168***	...	...	...	...
	(0.0049)				
FMW x q3	-0.0128***	...	...	...	...
	(0.0048)				
FMW x q4	-0.0386***	...	...	...	...
	(0.0048)				
POST	-0.1378***	-0.2429***	-0.3443***	-0.3399***	-0.4372***
	(0.0043)	(0.0045)	(0.0055)	(0.0076)	(0.0081)
FMW x q2 x POST	-0.0190***	-0.0143**	-0.0153**	-0.0072	-0.0073
	(0.0061)	(0.0064)	(0.0063)	(0.0064)	(0.0064)
FMW x q3 x POST	-0.0053	0.0024	0.0016	0.0071	0.0071
	(0.0060)	(0.0062)	(0.0062)	(0.0062)	(0.0062)
FMW x q4 x POST	0.0039	0.0113*	0.0095	0.0197***	0.0191***
	(0.0060)	(0.0062)	(0.0062)	(0.0062)	(0.0062)
Initial K dummies and initial K x POST	No	No	No	Yes	Yes
Year fixed effects	No	No	Yes	No	Yes
Firm fixed effects	No	Yes	Yes	Yes	Yes
N	2,990,705	2,990,705	2,990,705	2,990,705	2,990,705

Notes: The dependent variable is the growth ratio of net fixed capital stock (net investment over previous stock of fixed capital). Significance levels: 10%*, 5%**, 1%***. Clustered standard errors at the firm level. FMW is now split into 4 dummy variables based on quartiles of that variable. The first quartile is the reference point and includes firms with less than 3.97% of workers below the pre-policy minimum wage. The second quartile (q2) includes firms with 3.97 to 9.46% of workers below the 2019 minimum wage according to the 2018 wage structure. The third quartile (q3) includes firms with 9.46 to 15.27% of workers below the minimum wage, and the fourth quartile (q4) includes firms with more than 15.27% of workers below the 2019 minimum wage.

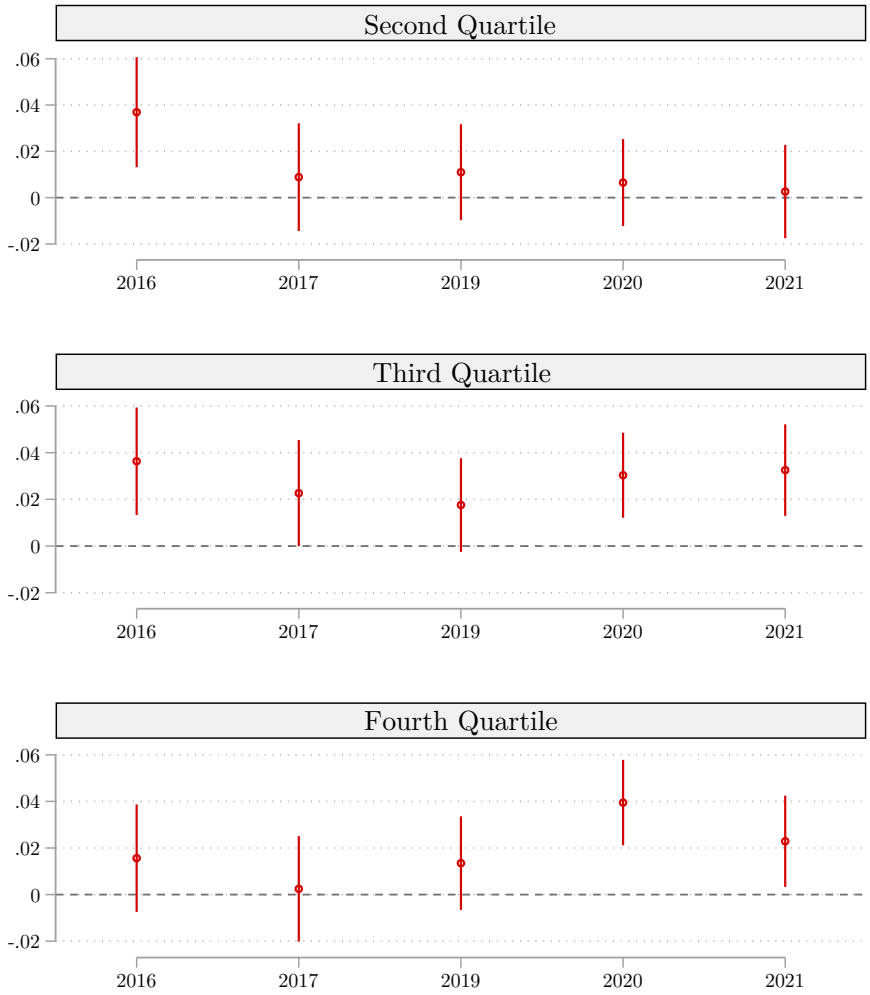

Figure 3: Event Study. Splitting FMW in quartiles. Dependent variable: net capital investment rate.

6.2 Results on Total Factor Productivity

Once the evidence in favor of an increase in capital stock has been reviewed, we proceed to analyze how companies may have adjusted their productivity following the reform by measuring the impact of this policy on total factor productivity (TFP).

In Table 4 the coefficient of interest is the interaction between FMW with the POST dummy variable. I have done several tests in columns 1 to 5. For example, I have tried with the interaction of the initial TFP in levels with the POST dummy—following the cited paper by Drucker et al. (2021).

As in the previous subsection, given that no company is really completely affected by the SMI (FMW with value equal to 1), the marginal effect of interest actually is in a scale that shows higher marginal effects than the real standard impact for a regular company. That's why I also consider splitting the variable in categories following the same criteria as in previous section.

In Table 4, with the variable in levels, when the interaction term FMW x POST goes from 0 to 1, i.e. for firms fully affected with the minimum wage, the change in logarithms of the TFP is 0.04 units.

If we interpret the difference in logarithms to approximate the TFP growth rate, the coefficient would indicate that the TFP growth rate grows by about 0.04 units after 2018 for fully affected firms compared to unaffected firms. That 0.04 indicates that the TFP growth rate is about 4 percentage points higher for fully treated companies compared to not at all treated (FMW=0)[14]. When I add the change in sector after 2018 the results are no longer significant, but I interpret that it may be causing problems because it correlates with the FMW variable and is not significant in the regressions I run, so it does not explain TFP but misrepresents the coefficient of interest[15]. Other than this case, the results seem robust in the different regressions, significant and always positive.

Table 4: Estimates for the increase in the minimum wage on TFP: Baseline

Variables	(1)	(2)	(3)	(4)	(5)
FMW	-0.0242***	...	...	...	...
	(0.0072)				
POST	-0.0210***	-0.0266***	0.0233***	-0.0495***	-0.0056***
	(0.0012)	(0.0013)	(0.0021)	(0.0067)	(0.007)
FMW x POST	0.0439***	0.0482***	0.0481***	0.0476***	0.0479***
	(0.0111)	(0.0113)	(0.0113)	(0.0114)	(0.0114)
Initial TFP dummies and initial TFP x POST	No	No	No	Yes	Yes
Year fixed effects	No	No	Yes	No	Yes
Firm fixed effects	No	Yes	Yes	Yes	Yes
N	594,516	594,516	594,516	594,516	594,516

Notes: The dependent variable is the difference of logarithms of TFP. 10%*, 5%**, 1%*** levels of significance. Clustered standard errors are calculated at the firm level. FMW takes values between 0 and 1, representing the proportion of workers below the minimum wage at the firm level.

The event study estimates for this continuous variable as in Equation 8 is plotted in Figure 4. This graph indicates an apparent downward trend between 2016 and 2017. In 2019 the variable for the proportion of workers under the minimum wage is not significant after 2019. This probably indicates that in the short run, productivity has not been able to adapt to the increase in the minimum wage. Subsequently, it shows that in 2020 and 2021 there is indeed a larger effect on productivity growth for firms with more workers under the minimum wage in 2018. One possible concert could be that in this period, the Spanish economy suffered strongly the COVID-19 pandemic shock. However, the COVID-19 pandemic effect would be partly corrected by doing the study event and correcting the effect of each of the years in this Two Way Fixed Effects setting.

[14]This 0.04 mean that if the mean growth of TFP for the less affected firms is 2%, mean growth for those firms completely affected after the policy would be 6%.

[15]This last results are not presented in this paper.

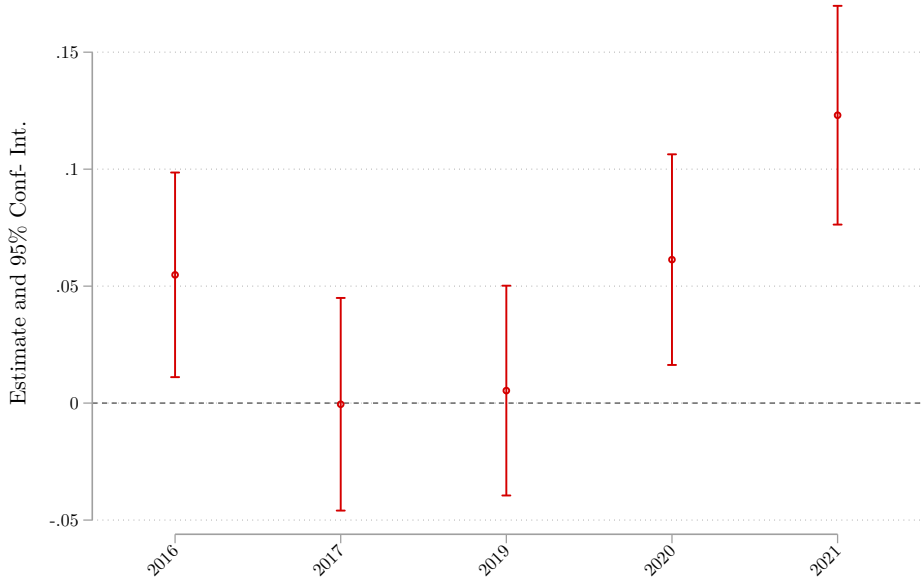

Figure 4: Event Study. Baseline model. Dependent variable: Log Change in TFP.

Finally, I present the estimates for the regression analysis with the interaction of the POST dummy variable and the division of the FMW variable into different categories based on quartiles of firms, according to the extent of workers below the post-policy minimum wage. The results are presented in Table 5. In this table, the base model, which does not include firm fixed effects, indicates a positive effect of the minimum wage on the productivity growth of the second and fourth quartiles compared to the first quartile. This effect is larger in the model with fixed effects. In this model, we find that for firms in the fourth quartile of the FMW variable, the productivity growth rate increases by 1.11 percentage points compared to the productivity growth rate of firms in the first quartile. This effect is statistically significant and slightly lower for firms in the third quartile (0.093 percentage points).

In the case of the second quartile, the results are not significant, meaning that there doesn't seem to be an effect of the minimum wage on productivity growth except in the case of the model including the interaction of initial TFP levels to address the baseline effect on growth rates. However, the effect on productivity growth rate for these firms is substantially lower compared to the rest of the quartiles. This result makes sense given that this quartile is significantly less affected by the increase in the minimum wage. For the second, third, and fourth quartiles, the results are significant and robust, both including time fixed effects and the baseline effect. These results range from 0.8 percentage points to 1.11 percentage points increase in the productivity growth rate attributable to the minimum wage increase.

To evaluate the dynamic effects and the parallel trends assumption, I have conducted an event study using the variable FMW divided into quartiles. The results of this analysis are shown in Figure 5. This graph displays the different estimated coefficients and their confidence intervals for each year, based on the quartile of the FMW variable, indicating the degree of impact of the minimum wage increase. We considered a model that includes the baseline effects, similar to Model (5) in Table 5.

The results of this study indicate evidence supporting the parallel trends assumption in the case of

Table 5: Estimates for the increase in the minimum wage on TFP: Quartiles

Variables	(1)	(2)	(3)	(4)	(5)
FMW x q2	-0.0029**	...	...	...	...
	(0.0014)				
FMW x q3	-0.0045***	...	...	...	...
	(0.0018)				
FMW x q4	-0.0059***	...	...	...	...
	(0.0019)				
POST	-0.0208***	-0.0267***	0.0232***	-0.0261***	0.0230
	(0.0014)	(0.0014)	(0.0022)	(0.0067)	(0.0026)
FMW x q2 x POST	0.0024	0.0034	0.0034	0.0027**	0.0028
	(0.0021)	(0.0022)	(0.0022)	(0.0022)	(0.0021)
FMW x q3 x POST	0.0079***	0.0093***	0.0093***	0.0079***	0.0080***
	(0.0025)	(0.0026)	(0.0026)	(0.0026)	(0.0026)
FMW x q4 x POST	0.0099***	0.0110***	0.0111***	0.0093***	0.0096***
	(0.0029)	(0.0030)	(0.0030)	(0.0030)	(0.0030)
Initial TFP dummies and initial TFP x POST	No	No	No	Yes	Yes
Year fixed effects	No	No	Yes	No	Yes
Firm fixed effects	No	Yes	Yes	Yes	Yes
N	594,516	594,516	594,516	594,516	594,516

Notes: The dependent variable is the difference in logarithms of TFP. Significance levels: 10%*, 5%**, 1%***. Clustered standard errors at the firm level. FMW is now split into 4 categories based on quartiles of that variable. The first quartile is the reference point and includes firms with less than 3.97% of workers below the pre-policy minimum wage. The second quartile (q2) includes firms with 3.97 to 9.46% of workers below the 2019 minimum wage according to the 2018 wage structure. The third quartile (q3) includes firms with 9.46 to 15.27% of workers below the minimum wage, and the fourth quartile (q4) includes firms with more than 15.27% of workers below the 2019 minimum wage.

the second quartile. This suggests that there is no significantly different outcome in productivity growth for the firms in the second quartile compared to the first quartile before the minimum wage increase. However, in 2021, the effect becomes significant, indicating that there is a certain lagged effect for these firms with a smaller number of workers below the minimum wage.

For the third quartile, we observe that before the implementation of the policy, the trend appears to be decreasing rather than parallel. However, this situation is reversed after the approval of the minimum wage increase, and the result becomes significant and positive in 2021. When comparing the results of the third quartile and the fourth quartile, it is interesting to note that the impact on productivity growth is higher for the former. However, the results are not significantly different when comparing between these quartiles.

In the case of the fourth quartile firms, similar to the results of capital investment, the outcome appears to be clearer. There is evidence supporting the assumption of parallel trends, although in 2016 the coefficient is close to being significant, indicating that there would be a substantial difference in investment growth for fourth quartile firms compared to those in the first quartile. In 2019, the result is not significant, which reinforces the idea that productivity gains occur with a certain delay. Finally, in 2020 and 2021, the result for this quartile indicates a higher growth rate of Total Factor Productivity after the policy implementation compared to the firms in the first quartile.

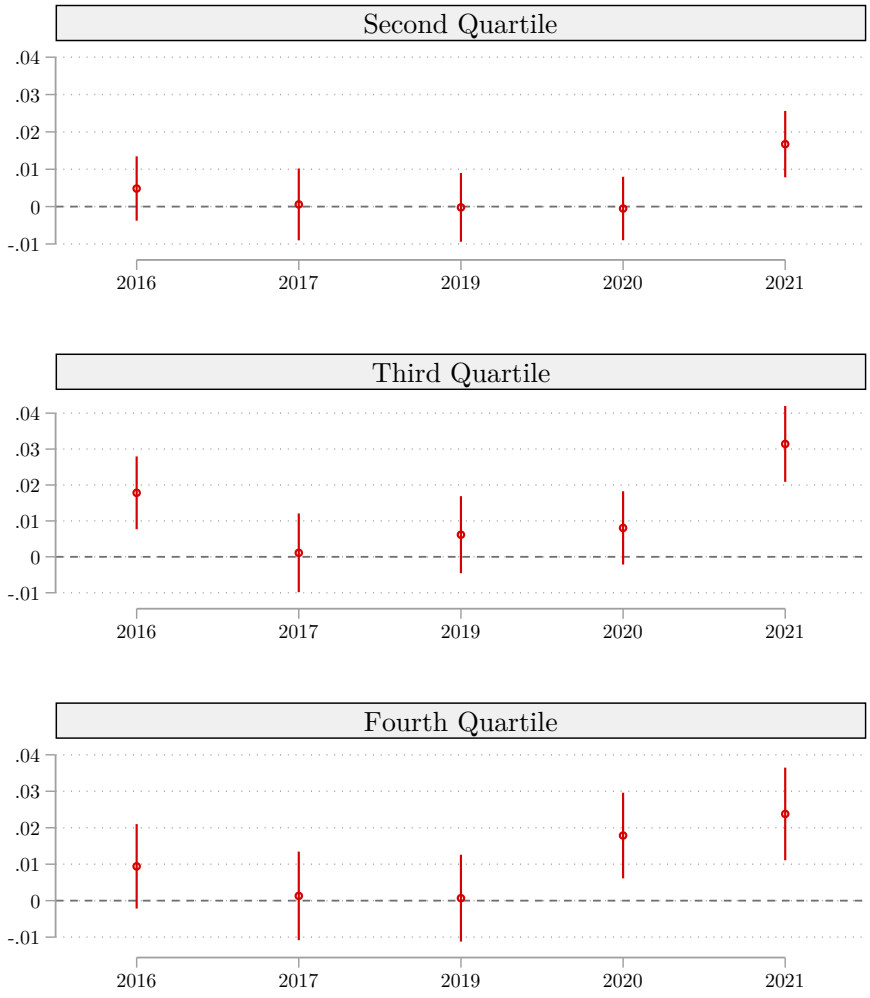

Figure 5: Event Study. Splitting FMW in Quartiles. Dependent variable: Log change in TFP.

7 Conclusion

This paper contributes to an area of study that has not yet been extensively explored but has experienced a surge in recent years: the impact of minimum wage increases on companies. Specifically, this study contributes to a topic that has received less attention within this literature: the influence of minimum wage policy on total factor productivity. In this regard, despite solid theoretical arguments, empirical studies at the firm level that assess the impact of the minimum wage on TFP are still scarce. I add evidence in this regard and extend the literature by estimating firm investment as a potential mechanism of increased firm productivity. I find that minimum wage policy does lead to greater firm productivity and that investment plays a role.

I use causal applied microeconometric analysis techniques to evaluate the impact of the minimum wage increase in Spain on total factor productivity and fixed capital investment of Spanish companies. To do this, I use data from the financial statements of a large sample of Spanish companies combined with calculations from the Spanish Wage Structure. As far as I am aware, this study is the first to estimate

the effect of the 2019 minimum wage reform on Spanish firms.

This paper provides evidence in favor of the hypothesis that the minimum wage increase in 2019 has led to an increase in fixed capital investment, likely due to higher incentives for investment or the substitution effect between capital and labor. On the other hand, I also find evidence supporting the idea that companies face higher wage cost increases resulting from minimum wage hikes expanding their total factor productivity, probably increasing R&D expenditures, workforce training, or employing more skilled workers.

Given the influence that minimum wage increases have on productivity and investment, this type of public policy can have long-term effects on economic growth and the business fabric that go beyond their short-term employment effects. These findings imply that minimum wage reforms should be viewed from a perspective focused on their potential long-term effects on the economy.

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UNIVERSIDAD COMPLUTENSE DE MADRID
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SECCIÓN DEPARTAMENTAL DE DERECHO
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PROOF OF THE STUDENT CONDITION

To Whom It May Concern:

This letter is to verify that Rubén Gonzálvez Samerón is currently enrolled as a PhD student in good standing within the Doctoral Program in Economics at Complutense University of Madrid.

He is also currently serving as a Teaching Assistant for the in Economics Section of the School of Law, which is part of the Department of Applied, Public and Political Economics of Complutense University.

Sincerely,

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