The Supply-Side Effects and Incidence of Investment Stimulus Policies*

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Abstract

Who benefits from investment subsidies: the firms that invest, or the capital-goods producers that supply them? We study the supply-side effects and incidence of the French *suramortissement* (2015–2017), a temporary extra-depreciation allowance that mechanically reduced the user cost of eligible industrial equipment by about 12%. We first confirm that beneficiary firms significantly increase their stock of subsidized capital in response to the policy. Turning to the supply side, we show that domestic capital-goods producers respond to the resulting demand shock by raising prices by 3% on average, offsetting one quarter of the mechanical cost reduction. This also implies that only three quarters of the value-based response reflects real capital accumulation. Their domestic sales increase by 11%, which, after accounting for the endogenous price response, implies an elasticity of capital flows with respect to the user cost close to unity. Their exports are unaffected, confirming that their expansion is driven by the domestic demand shock due to the subsidy. We embed these findings in a supply-chain incidence framework with imperfect competition and show that at least 35% of the surplus going to firms is captured by capital-goods producers. Their employment grows by 4% on average and dividend payouts rise substantially, while wages remain flat, suggesting that the upstream gains accrue primarily to shareholders rather than to workers.

Keywords: Investment subsidies, tax incidence, supply chain, imperfect competition, pass-through, depreciation allowances.

JEL Codes: D22, D43, H22, H25, H32, L13.

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1 Introduction

Governments frequently resort to investment stimulus policies, especially during economic downturns. Who are the strongest proponents of such policies? Potential investors, of course, but not only them. Among the lobbying declarations filed with the French transparency agency that mention "extra depreciation," an investment subsidy commonly used in France, more than one third clearly originate from producers of capital goods rather than from potential investing firms.[1] For instance, a major truck manufacturer lobbied in 2023 to reinstate the scheme in order to subsidize firms purchasing electric trucks. Domestic suppliers therefore actively advocate for these policies.

This pattern is unsurprising. By lowering the user cost of capital for investing firms, investment subsidies generate a positive demand shock for capital goods and may therefore benefit their producers. In particular, when the supply of these goods is not perfectly elastic, the price of capital goods may increase. These supply-side effects raise two fundamental questions about investment stimulus policies. First, they affect whether the policy effectively reduces the user cost of capital faced by investing firms: if capital-goods producers raise prices, the effective reduction in the user cost will be smaller than the one mechanically implied by the tax incentive alone. Second, they affect the incidence of the policy, as part of the policy-generated surplus may accrue to capital-goods producers rather than to investing firms. These questions are particularly important given the prevalence and fiscal importance of such policies. Steinmüller, Thunecke, and Wamser (2019) document the use of investment tax incentives in 98 countries between 2004 and 2016. In addition, these policies often involve substantial fiscal costs: in the United States alone, the investment incentives introduced under the Tax Cuts and Jobs Act of 2017 were estimated to exceed $1 trillion.

Despite this widespread use, empirical research provides sparse and somewhat contradictory answers to these questions. A dense literature, including Zwick and Mahon (2017) and Curtis et al. (2021) on bonus depreciation in the United States, evaluates the effects of policies that reduce the cost of capital, but these studies typically focus on the behavior of investing firms. Recent contributions find that the value of investment substantially increases following such reforms. Yet the pass-through into the pre-tax price of capital goods remains poorly understood. Goolsbee (1998) finds that a 10% investment tax credit raises the price of capital by 3.5 to 7%, but this result has been questioned by House, Mocanu, and Shapiro (2017), who show that data revisions and the addition of more recent observations substantially reduce the estimated price responses. Separately, House and Shapiro (2008) finds no effect of bonus depreciation on prices. More broadly, the upstream price response is

1. Data from the French High Authority for Transparency in Public Life (hatvp.fr).

typically not observed but instead assumed away or calibrated.[2] Beyond prices, the broader responses of upstream firms, including sales, employment, assets, and dividend distribution, have received essentially no attention, even though they are crucial for assessing whether the subsidy meets policy-makers' objectives.

In this paper, we study the supply-side effects and incidence of a temporary investment subsidy adopted in France between 2015 and 2017: extra depreciation (*suramortissement*). This policy allowed firms to deduct an additional 40% of the cost of eligible industrial equipment from their taxable income, spread linearly over the asset's tax life. Calibrating the user cost of capital under standard assumptions, the policy reduced the after-tax cost of eligible capital by approximately 12%.

Our empirical analysis proceeds in two steps. We first document the effects on direct beneficiaries (downstream firms), establishing that the subsidy successfully stimulated investment. Then, we turn to the producers of eligible capital goods (upstream firms) to study how they responded to the resulting demand shock.

To study direct beneficiaries, we construct a proxy for industry-level exposure to the policy based on the pre-reform share of eligible assets in total tangible assets. Within broader sectors, we compare firms in more exposed industries to those in less exposed industries using a dynamic difference-in-differences event study. More exposed firms significantly increased their stock of eligible capital after 2015. They also exhibit increases in employment and sales, and shift their workforce composition toward a higher share of engineers and R&D workers. As we exploit local variation in exposure to the reform and firms in our control group also take up the subsidy to some extent, this analysis does not aim to estimate the magnitude of overall investment responses. Rather, it verifies that the policy did generate a positive demand shock for capital goods, which motivates the study of upstream responses.

Having established that the subsidy successfully stimulated investment, we turn to capital producers. Our identification exploits continuous firm-level variation in the pre-reform share of eligible goods in total sales, comparing manufacturers of subsidized goods with manufacturers of other goods in the same narrow industries. Domestic sales of capital producers increase by approximately 11%, while exports are unaffected, consistent with the subsidy generating a positive demand shock only in France. Crucially, the prices of industrial goods sold by these producers rise by about 3%. The capital producers also exhibit increases in employment, total assets, and dividend distribution, while wages are unaffected. This

2. For instance, Chen et al. (2023), studying China's 2009 VAT reform, assume a constant pre-tax capital price in their baseline model and explore price responses as a robustness exercise. Depending on the assumed elasticity, the upstream price adjustment can substantially reduce the estimated investment effect.

suggests that the additional revenue accruing to suppliers from the demand shock benefits primarily shareholders rather than employees. Finally, since manufacturers may also benefit from the subsidy as investing firms, we verify that all supply-side estimates are robust to controlling for each manufacturer's own exposure to extra depreciation as a direct beneficiary.

Our most significant result is the 3% increase in the pre-tax price of capital goods. It bears three implications. First, the upstream price increase offsets roughly one quarter of the 12% mechanical reduction in the user cost of capital faced by downstream firms, so that the effective reduction in the user cost is substantially smaller than the one mechanically implied by the tax incentive alone.

Second, the estimated price increase calls for caution in interpreting the large existing literature that estimates the effects of investment subsidies on capital accumulation. Studies in this literature typically measure investment in value terms, that is, as expenditure on capital goods (price $\times$ quantity). This is natural given the available data: administrative records typically report the acquisition cost of assets, not the number of physical units purchased. If capital-goods producers raise prices, however, part of the observed increase in the value of investment may reflect higher prices rather than greater physical capital accumulation.

Third, our setting offers two advantages for a causal assessment of the elasticity of investment with respect to the user cost of capital. By accounting for changes in the pre-tax price of capital, our estimate is robust to the two opposite biases discussed above: the over-statement of the user-cost reduction and the over-statement of the quantity response. Comparing the producers of subsidized capital goods with the other manufacturers in the same industries also relaxes the locality of our empirical strategy for direct beneficiaries. We obtain an elasticity of capital flows with respect to the user cost of capital of slightly less than 1.

Next, we translate our empirical results into a measure of incidence : how much of the policy-generated surplus ultimately accrues to capital producers versus investing firms? The simplest application of the canonical incidence framework would treat the direct beneficiaries of extra depreciation as final consumers and assume perfect competition in the market for capital goods. Then, up to a first-order approximation, capital producers would be capturing $3/12 = 25\%$ of the total surplus generated by the policy. We go further than this naive benchmark along two dimensions.

First, we account for market power in the downstream and upstream markets. We adopt the approach of Weyl and Fabinger (2013), summarizing the degree of imperfect competition

in each market with a single conduct parameter, which acts as a sufficient statistic regardless of the exact nature of the competitive game (Cournot, Bertrand, or else). The conduct parameter takes value 0 under perfect competition and 1 under monopoly. Allowing for imperfect competition is empirically motivated: the upstream price response is concentrated among firms with above-median pre-reform markup proxies, for which prices increase by 5%, while remaining unchanged in the rest of the sample. We interpret this heterogeneity as suggestive evidence that market power plays a role in shaping the incidence.

Second, we account for multiple specificities of our setting. We build a supply- chain architecture, extending the work on upstream retail markets of Adachi (2020). We model the subsidy as an input tax as in Ganapati, Shapiro, and Walker (2020), and define it ad valorem as in Adachi and Fabinger (2022). We further account for the corporate income tax borne by all firms. On the upstream side, we estimate a market conduct parameter of 0.3, combining our computed demand elasticity with markup estimates. This value is indicative of significant imperfect competition among capital-goods producers. On the downstream side, we do not observe the pass-through of capital costs into consumer prices. To bound the upstream share of incidence, we set the downstream conduct parameter to 1, its monopoly value, which maximizes the change in downstream surplus and thus yields a lower bound on the upstream share. Under this conservative assumption, We find that *at least* 35% of the surplus accruing to firms is captured by capital producers. Therefore even our lower bound largely exceeds the naive measure.

Related literature. These findings contribute to several strands of the literature. First, we add new evidence to the scarce work on the pass-through of investment subsidies into the pre-tax price of capital goods (Goolsbee (1998); House and Shapiro (2008); House, Mocanu, and Shapiro (2017)). As discussed above, this literature remains somewhat limited and has produced mixed results. We contribute by documenting a positive and significant price effect at producer-level. This matters both for assessing the effective user-cost reduction faced by investing firms and for the interpretation of value-based investment responses throughout the literature. Second, to our knowledge no prior study has documented the broader firm-level responses of capital producers to investment subsidies. By showing that these producers also expand employment and assets and increase dividend distribution while wages remain flat, we shed light on how producers expand and how the surplus generated by the policy is distributed within upstream firms. Third, we extend the theoretical incidence framework of Weyl and Fabinger (2013) and Adachi and Fabinger (2022) to a supply-chain setting with a corporate income tax, and provide an empirical quantification of the upstream share of

surplus. Finally, our results speak more broadly to the large empirical literature estimating the elasticity of capital accumulation with respect to the user cost of capital (Hall and Jorgenson (1967); Cummins, Hassett, and Hubbard (1994); Chirinko, Fazzari, and Meyer (1999); Bloom, Bond, and Van Reenen (2007); Hassett and Hubbard (2002)). They speak notably to the more recent literature studying the effects of investment stimulus policies such as accelerated depreciation and bonus depreciation on firm investment (House and Shapiro (2008); Edgerton (2010); Zwick and Mahon (2017); Ohrn (2018); Giroud and Rauh (2019)). Observing the price response of capital-goods producers allows us to estimate an elasticity of capital accumulation with respect to the user cost that is robust to the two biases discussed above. We find an elasticity close to unity. This estimate falls within the consensus range of 0.5 to 1 surveyed by Hassett and Hubbard (2002), and is consistent with the findings of Cummins, Hassett, and Hubbard (1994), Chirinko, Fazzari, and Meyer (1999), and Edgerton (2010). It is smaller than the baseline estimate of Zwick and Mahon (2017), whose user-cost elasticity of about 1.6 is driven by the strong responses of small firms; when they focus on the largest firms, their elasticity falls back into the consensus range. Our supply-side approach provides a natural counterpart, since the domestic sales of capital-goods producers implicitly weight each downstream firm's investment response by its value. An advantage of our empirical strategy is that it is not purely local: our control group, manufacturers of non-subsidized goods in the same industries, faces no direct demand shock from the policy. Combined with the correction for the endogenous price response, this makes our elasticity particularly suited to calibrating aggregate investment responses to changes in the user cost of capital.

The remainder of the paper is organized as follows. Section 2 describes the institutional context. Section 3 presents the data. Section 4 analyzes the effects on direct beneficiaries. Section 5 studies the responses of capital producers. Section 6 develops the incidence framework and presents our quantification. Section 7 concludes.

2 Institutional Context

2.1 Corporate Taxation and Depreciation

Firms operating in France are subject to the corporate income tax, levied on the difference between revenue and deductible costs. During the period we study, the standard statutory rate was 33.33%, among the highest in Europe at the time. As in most corporate tax systems, the acquisition cost of capital goods cannot be expensed immediately. Instead, firms recover

this cost gradually over the asset's tax life through annual depreciation deductions. French tax law permits both straight-line and declining-balance depreciation, depending on the nature and tax life of the asset. The present value of these deductions is a key determinant of the effective after-tax cost of capital.

2.2 The Extra Depreciation Allowance

The extra depreciation allowance (*suramortissement*) was introduced against the backdrop of prolonged economic weakness. Following the European sovereign debt crisis, French real GDP growth had averaged well below 1% between 2012 and 2014. Business investment was a particular source of concern: corporate capital expenditure had been weak in the years preceding the reform, and industrial production remained well below its pre-crisis level. Prior policy efforts to support firms, most notably the CICE (*Crédit d'impôt pour la compétitivité et l'emploi*), a payroll tax credit introduced in 2013, had targeted labor costs rather than the cost of capital. In April 2015, the government introduced extra depreciation as a targeted instrument to reduce the cost of industrial equipment and stimulate productive investment.

The policy allowed firms to deduct an additional 40% of the acquisition cost of eligible capital goods from their taxable income, on top of standard depreciation. This supplementary deduction was spread on a straight-line basis over the asset's tax life, regardless of the method used for ordinary depreciation. It was purely fiscal: it reduced the corporate income tax liability without affecting accounting profits or reported asset values.

To illustrate, consider a firm purchasing a machine for €100 with a five-year tax life. Assuming straight-line depreciation for simplicity, the firm deducts €20 per year absent the policy, yielding €6.67 in annual tax savings at the 33.33% rate. With the extra depreciation allowance, the firm claims an additional €8 per year (40% of €100, spread over five years), reducing its tax bill by a further €2.67 per year, or €13.33 over the life of the asset.

Because depreciation deductions reduce taxable income, the after-tax cost of one euro of investment is less than one euro: it equals one minus the product of the tax rate and the present value of all future deductions. The extra depreciation allowance increases this present value, and therefore lowers the after-tax cost of capital. Under standard assumptions, a net present value computation detailed in Appendix D shows that the policy reduces the user cost of eligible capital by approximately 12%. The fiscal cost amounted to approximately €2 billion per year (Figure 7 in Appendix A).

2.3 Eligibility

The policy applied to new industrial equipment eligible for declining-balance depreciation under French tax law. Eligibility was defined in terms of the nature of the asset, not the characteristics of the purchasing firm: any firm subject to the corporate income tax could claim the deduction, regardless of size or sector. The eligible categories can be grouped into nine broad classes: (i) equipment and tools used in industrial manufacturing or transformation; (ii) handling equipment; (iii) water and air pollution abatement installations; (iv) installations producing steam, heat, or energy; (v) R&D equipment; (vi) cable transportation equipment; (vii) optical fiber equipment; (viii) industrial software inherently linked to eligible equipment; and (ix) supercomputers. The last three categories were only covered after the April 2016 extension.

2.4 Timeline

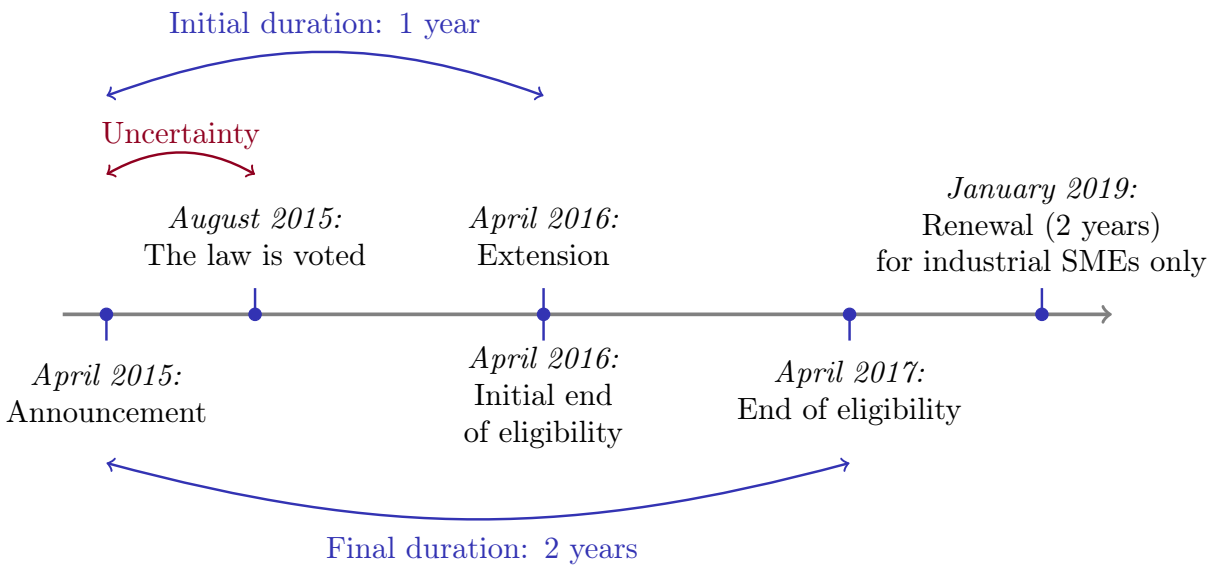


Figure 1: Timeline of the extra depreciation policy

Notes: The figure displays the timeline of the *suramortissement*. The policy was announced in April 2015, enacted into law in August 2015 with retroactive effect to April 2015, extended for a second year in April 2016, and expired in April 2017. A narrower version restricted to industrial small- and medium-sized enterprises (SMEs) and to a narrower set of capital goods was reinstated in 2019.

The extra depreciation allowance was announced in April 2015 but only formally enacted into law in August, with retroactive effect. This creates a period of uncertainty between the

announcement and the vote. During this window, firms were aware of the policy but the measure had not yet been passed into law, and large investments with long lead times may have been delayed. We therefore expect effects to appear starting in late 2015.

The policy was initially designed as a one-year measure but was extended for an additional year in April 2016, so that the final eligibility period ran until April 2017. A version of the scheme was reinstated in 2019, but restricted to small- and medium-sized enterprises (SMEs) with an industrial activity, making the resulting demand shock for capital goods producers considerably weaker than that of the original policy.[3] Figure 1 summarizes this timeline.

3 Data

Our analysis combines five data sources: a product eligibility dataset that we construct, two surveys conducted by the French statistical agency (INSEE), corporate income tax returns, and matched employer-employee records. In this section, we describe each source and the construction of our two analysis samples.

3.1 Data Sources

Product Eligibility Dataset. We construct a dataset that maps each manufactured good, classified according to the European PRODCOM nomenclature, to an eligibility variable. The PRODCOM classification covers all goods produced by the manufacturing sector at a fine level of detail (over 3,800 product codes). For each code, we determine whether the corresponding good falls within the scope of the extra depreciation allowance based on the precise eligibility rules set forth in the tax instructions and on detailed product descriptions.

Annual Production Survey (EAP). The *Enquête annuelle de production* is conducted annually by INSEE and provides a detailed decomposition of each manufacturer's sales by product category at the PRODCOM level. Approximately 36,000 firms in the industrial sector are surveyed each year: the survey is exhaustive for firms with more than 20 employees and relies on random sampling for smaller firms, ensuring coverage of approximately 90% of French industrial output in value for each sector. For each product, the survey notably records the value of sales, distinguishing between goods produced in-house and goods purchased for resale.

3. SMEs meet two requirements: their workforce gathers less than 250 employees, and either their annual turnover does not exceed 50 million€ or their total balance sheet size does not exceed 43 million€. In the SME-specific scheme, the set of eligible industrial goods was also narrowed, covering only robotics and digital transformation equipment rather than the broad range of industrial capital originally targeted.

Production Price Survey (OPISE). The *Observation des prix de l'industrie et des services aux entreprises* is a monthly price survey conducted by INSEE covering both industry and services. We use only its industrial component, whose sample is drawn from the EAP database described above. It covers approximately 3,700 firms at any point in time, which together provide around 23,000 monthly price observations. Within each four-digit product class, firms are ranked by descending turnover and selected until a target coverage rate of 40% to 70% is reached (cut-off sampling); firms with less than €3 million in branch-level turnover are excluded from the sampling frame. Each sampled firm is visited by an INSEE field engineer who identifies a set of reference products whose transaction prices are then tracked longitudinally. The sample is renewed approximately every five years. The survey measures producer prices excluding VAT and transport costs, and reports them as price indices with base 100. The reference year is 2010 for the early part of our sample and 2015 from 2017 onward. Because the survey targets fewer firms than the EAP, the resulting price sample is smaller. We aggregate monthly prices to the quarterly level and match the price data with the production survey at the firm level.

Corporate Income Tax Returns (BIC-IS). The BIC-IS database consists of corporate income tax returns filed by firms subject to tax on business profits in France. Maintained by the French tax administration, it provides detailed firm-level information drawn from official balance sheets and income statements. The database covers variables such as tangible and intangible assets, sales, value added, profits, depreciation deductions, taxes paid, and dividends distributed.

Matched Employer-Employee Data (DADS). The *Déclarations annuelles des données sociales* is a matched employer-employee administrative database based on mandatory social security filings. It covers the universe of private-sector employment relationships in France. For each job spell, the data record the employer, wages, hours worked, occupation, and employment conditions. We aggregate these records at the firm-year level to obtain measures of total employment, average hourly wages, and the occupational composition of the workforce.

3.2 Sample Construction

Direct Beneficiaries. We build a panel running from 2009 to 2019 from BIC-IS data. We then restrict the sample to firm-year pairs observed in DADS data with more than 5 employees, in order to focus on the relatively large firms targeted by policymakers and to reduce the computational burden of estimating our econometric specifications. Finally, we

balance the panel by removing firms that either appear or disappear during the period. The final sample contains 76,000 firms observed continuously from 2009 to 2019.

Capital Producers. We construct a panel of manufacturing firms covering the period 2010 to 2019 using data from the EAP. We merge this dataset with corporate income tax returns from BIC-IS and employment information from DADS. We focus on pure manufacturers, excluding retailers, defined as firms that never produce the goods they sell. Finally, we drop firms that are always classified as micro-enterprises (less than 2 million€ in annual sales). The final main sample contains 18,048 firms and is used for most supply-side analyses. We separately pair this panel with OPISE price data. Because the OPISE survey is conducted at a smaller scale by the statistical agency, the price sample contains 2,223 unique firms, with prices aggregated at the quarterly level from Q2 2013 to Q4 2019.

4 Direct Beneficiaries

4.1 Empirical Strategy

We define each firm's exposure to the policy at the narrow (five-digit) industry level. Specifically, we compute the share of eligible tangible assets in total tangible assets in 2009 for each five-digit industry:

$$\text{Instrument}_{S(i)} \equiv \frac{\sum_{j \in S(i)} \text{Eligible } \widehat{\text{Tangible}} \text{ Assets}_{j,\,2009}}{\sum_{j \in S(i)} \text{Tangible Assets}_{j,\,2009}} \in [0,1]. \tag{1}$$

The hat on eligible tangible assets reflects the fact that, unlike on the supply side for which the PRODCOM nomenclature provides a precise classification of eligibility, we do not directly observe which assets are eligible in the tax filings of investing firms. We therefore proxy for eligible tangible assets using the balance-sheet item *installations techniques, matériel et outillage industriels* (technical equipment, machinery, and industrial tools), which should closely correspond to the eligible asset categories defined by the policy (see Section 2). We aggregate at the industry level so that our measure of exposure reflects the industry's technological reliance on eligible capital rather than firm-level asset ratios, which may be contaminated by transitory fluctuations and mechanical mean reversion. Tangible assets are the type of capital subject to depreciation deductions, so this ratio predicts both the intensity of use of eligible goods and the increase in depreciation deductions due to the extra depreciation allowance.

We discretize our industry-level measure of exposure into a treatment dummy. Within

each three-digit sector, we rank five-digit industries by exposure. Then, the top quartile of exposure is allocated to the treatment group while less exposed five-digit industries form the control group. Because the number of firms varies across five-digit industries, this results in roughly equally-sized treatment and control groups at the firm level. We apply the discretization within three-digit sectors to maximize variation once we control for flexible sector-specific trends.

Our baseline specification is a dynamic event study design with broader (three-digit) sector-by-year fixed effects:

$$Y_{it} = \sum_{\substack{l=2010 \\ l \neq 2014}}^{2019} \beta_l \left[D_{S(i)} \times \mathbb{1}\{t = l\} \right] + \gamma_i + \eta_{S^{3d}(i),t} + \varepsilon_{it}, \tag{2}$$

where $D_{S(i)}$ is an indicator for belonging to the more exposed group, γ_i are firm fixed effects, and $\eta_{S^{3d}(i),t}$ are three-digit sector-by-year fixed effects. The base year is 2014 since the policy started in 2015, but we do not expect strong responses in the first year given the initial uncertainty around the passage of the law in Parliament . The sector-by-year fixed effects absorb any time-varying shock common to all firms in a given three-digit sector, so identification comes from within-sector variation in exposure. The key identifying assumption is that, absent the policy, more and less exposed firms within a three-digit sector would have followed parallel trends.

Table 1 in Appendix B reports descriptive statistics for the two groups in 2014. More and less exposed firms are broadly comparable: both groups have similar average sales (around 13.7 million €), headcount (66 to 72 on average), and hourly wages (around 16 €). More exposed firms have a slightly higher instrument value by construction (36% versus 25%) and somewhat larger total assets. The two groups account for roughly equal shares of the sample (52% more exposed, 48% less exposed).[4]

4.2 Results

Investment. The primary goal of this section is to establish that the extra depreciation policy generated a positive demand shock for capital goods, before turning to the study of upstream responses. Figure 2 shows the event-study estimates for the logarithm of the stock of eligible capital. More exposed firms significantly increase their stock of eligible capital

4. The split is not 25/75 because the instrument is defined at the five-digit industry level, so all firms within a given five-digit industry share the same value. We rank five-digit industries within each three-digit sector by decreasing instrument value and assign entire five-digit industries to the more exposed group until the cumulative number of firms exceeds 25% of the three-digit sector. The more exposed group therefore often accounts for more than one quarter of firms.

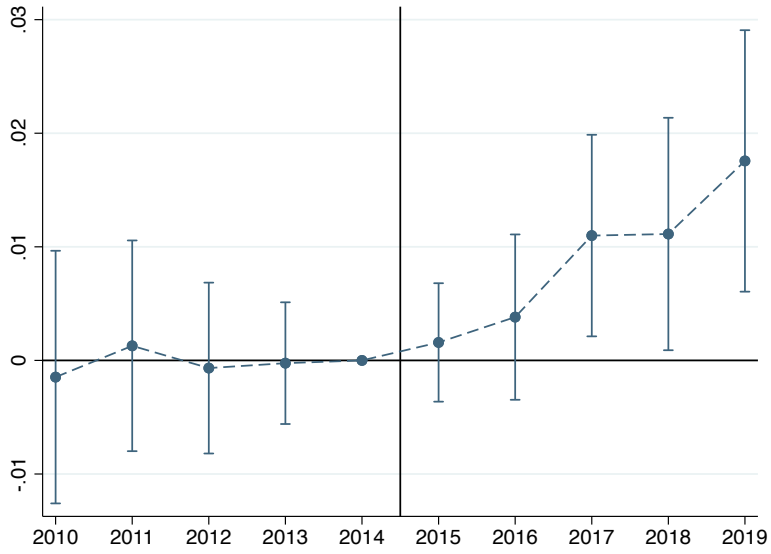


Figure 2: Effect on the stock of eligible capital (log)

Notes: The figure plots event-study estimates $\{\hat{\beta}_l\}_{l \neq 2014}$ from Equation (2). The outcome is the logarithm of the stock of eligible capital (tangible assets classified as equipment, machinery, and industrial tools). Treatment is an indicator for firms in five-digit industries belonging to the top quartile of the industry-level eligibility instrument within their three-digit sector (Equation (1)). The specification includes firm and three-digit sector-by-year fixed effects. The base year is 2014, normalized to zero. Vertical bars represent 95% confidence intervals based on standard errors clustered at the firm level. The sample comprises 76,000 firms observed continuously from 2009 to 2019. *Sources:* BIC-IS.

after 2015, with no evidence of differential pre-trends. The dynamic pattern closely tracks the policy timeline: the effect builds up gradually from 2015 through 2017, the final year of the eligibility window, stagnates in 2018 once the policy has expired, and resumes in 2019 when the scheme is reintroduced for industrial SMEs. This alignment is reassuring, as it suggests that the observed capital accumulation responds to the policy rather than to unrelated trends. Given that we exploit a very local variation in exposure to the reform, we do not use these results to conclude about the overall magnitude of investment responses. Yet, our findings corroborate our prior that the subsidy successfully stimulated investment in eligible goods and that capital producers faced a positive demand shock.

Other Outcomes. We examine a range of additional outcomes, which may serve as a sanity check that our specification captures the effect of the extra depreciation policy. More exposed firms exhibit higher employment and sales after the reform (Figures 8 and 9 in Appendix B). The differential evolution in sales and in production factors results in an increase in a proxy for total factor productivity in the treatment group relative to the control

group (Figure 10 in Appendix B).[5] The composition of the labor force shifts toward engineers and R&D workers (Figures 11 and 12), with a corresponding decline in the share of blue-collar workers (Figure 13). We find no statistically significant effect on wages after residualizing on occupation-specific trends (Figure 14). These patterns are consistent with existing empirical evidence on the effects of capital deepening on employment (Aghion et al. (2023); Curtis et al. (2021); Acemoglu, Koster, and Ozgen (2023); Acemoglu and Restrepo (2020)).

5 Capital Producers

5.1 Empirical Strategy

We turn to the producers of eligible capital goods. We construct a firm-level measure of exposure as the pre-reform share of subsidized goods in total sales:

$$\text{Share}_i = \sum_{g \in \Omega} \mathbb{1}\{g \text{ eligible}\} \times \text{Sales}^g_{i,\,2010} \Big/ \sum_{g \in \Omega} \text{Sales}^g_{i,\,2010}, \tag{3}$$

where the exposure of firm i (Share_i) corresponds to the value share of eligible capital goods in the firm's total sales in 2010. We measure the firm's sales of a given good g ($\text{Sales}^g_{i,\,2010}$) in the annual production survey, and eligibility of the good ($\mathbb{1}\{g \text{ eligible}\}$) comes from our own product eligibility dataset. Our baseline specification leverages this measure of exposure in a dynamic difference-in-differences with a continuous treatment:

$$Y_{it} = \sum_{\substack{l=2010 \\ l \neq 2014}}^{2021} \delta_l \Big[\text{Share}_i \times \mathbb{1}\{t = l\}\Big] + \gamma_i + \eta_{S^{4d}(i),t} + \varepsilon_{it}, \tag{4}$$

We also estimate a static version that collapses the post-reform period into a single coefficient:

$$Y_{it} = \delta \Big[\text{Share}_i \times \mathbb{1}\{t \geq 2015\}\Big] + \gamma_i + \eta_{S^{4d}(i),t} + \varepsilon_{it}, \tag{5}$$

In both specifications, γ_i stands for a firm fixed effect and $\eta_{S^{4d}(i),t}$ for a four-digit sector-by-year fixed effect. The coefficients $\{\delta_l\}$, or δ in the static version, are the key parameters of interest. They capture the differential outcome for a manufacturer that produced only eligible goods in 2010 ($\text{Share}_i = 1$) relative to one that produced none ($\text{Share}_i = 0$). In the

5. We define $\widehat{\text{TFP}} = \text{Sales} / \left[(0.16 \times \text{Tangible assets})^{0.3} \times \text{Wagebill}^{0.7}\right]$, where the 16% depreciation rate is the standard rate used by the French tax authorities to convert the stock of tangible assets into an approximate flow of capital services, and the exponents correspond to standard capital and labor shares in a Cobb-Douglas production function.

dynamic difference-in-differences, the base period is 2014 for annual outcomes and the first quarter of 2015 for quarterly price series.

This is a continuous difference-in-differences design. Identification requires two assumptions. First, conditional on firm and sector-by-year fixed effects, the outcomes of firms with different values of Share_i would have evolved in parallel absent the reform. Second, the treatment effect is linear in the dose Share_i: a firm with twice the share of eligible goods experiences twice the effect. This is a natural assumption in our setting, since a firm's demand shock is proportional to the share of its output that is subsidized.

Table 2 in Appendix C reports descriptive statistics in 2014. Firms with a positive pre-reform share of eligible goods in sales ($\text{Share}_i > 0$) account for 15% (2,636 firms) of the sample. On average before the reform, these firms display a somewhat higher employee headcount and higher annual wages. The firms that were not selling any eligible good in 2010 have slightly higher sales, tangible assets, and balance-sheet size. Firms in both groups report positive profits with a similar probability (around 65 to 70%).

5.2 Results

Table 3 in Appendix C collects all our supply-side estimates, including baseline results, robustness to controlling for direct exposure as an investing firm (see Section 5.2.5), and heterogeneity by markup proxy. We discuss each set of results in turn.

5.2.1 Domestic Sales and Exports

Figure 3 presents the event-study estimates for the logarithm of domestic sales. The static difference-in-differences coefficient is 0.115, significant at the 1% level ($p < 0.001$). The sales of eligible capital producers in France increase by approximately 11% after the reform.

The dynamic pattern of the domestic sales response closely tracks the policy timeline described in Section 2. The effect is smaller and barely significant in 2015, consistent with the period of legislative uncertainty. The differential evolution of domestic sales is most acute in 2016 and 2017, before dropping in 2018 when the subsidy no longer applies to newly-ordered capital goods. Interestingly, the effect reappears in 2019 at a lower magnitude, consistent with the reinstatement of the policy that year for industrial small and medium-sized enterprises only. Because this renewed scheme was narrower in scope than the original, it naturally generated a weaker demand shock for manufacturers of eligible capital goods.

In contrast, exports are not significantly affected (coefficient -0.025, $p = 0.63$; Figure 15 in Appendix C). This is reassuring, as the subsidy generates a demand shock only within France and should not directly affect foreign demand. The event-study coefficients for ex-

ports do suggest a small negative effect in 2015, which, if taken at face value, could reflect production capacity constraints: facing or expecting a sudden surge in domestic orders, producers may have temporarily prioritized French customers at the expense of export markets. Total sales, which combine domestic and foreign revenue, increase by 7.7% ($p < 0.01$).

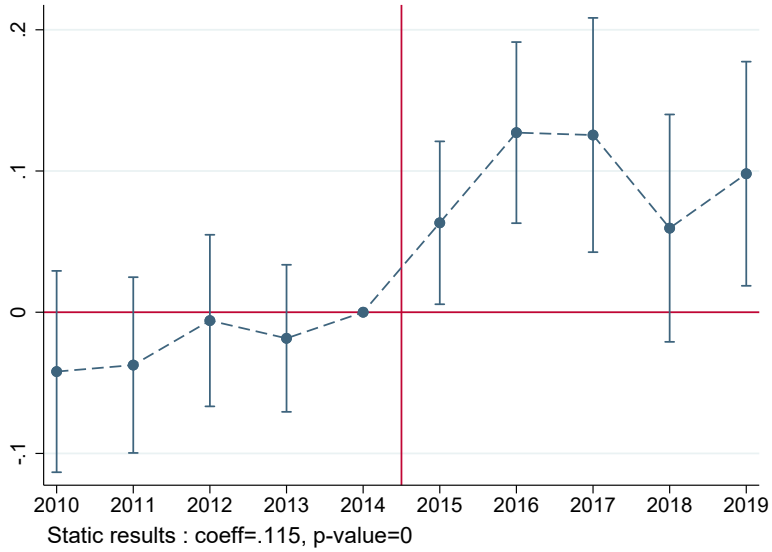


Figure 3: Effect on domestic sales (log)

Notes: The figure plots event-study estimates $\{\hat{\delta}_l\}_{l \neq 2014}$ from Equation (4). The outcome is the logarithm of domestic sales. Treatment intensity Share_i is the pre-reform share of eligible goods in total sales in 2010 (Equation (3)). Each coefficient $\hat{\delta}_l$ measures the log domestic sales differential between a fully-exposed producer ($\text{Share}_i = 1$) and an unexposed producer ($\text{Share}_i = 0$) in year l relative to 2014. The specification includes firm and four-digit sector-by-year fixed effects. The base year is 2014, normalized to zero. Vertical bars represent 95% confidence intervals based on standard errors clustered at the firm level. The sample comprises 18,048 manufacturing firms observed from 2010 to 2021. *Sources:* EAP; BIC-IS.

5.2.2 Price Responses

The evolution of capital producers' sales reflects the positive demand shock that they faced with extra depreciation. How do they respond to this demand shock and, in particular, how does the price of capital goods change? Figure 4 shows that the price of industrial goods sold by eligible capital producers in France increases by 2.9% (coefficient 0.029, $p = 0.02$).[6] The timing of the price response is informative: prices begin to rise in the quarter immedi-

6. The price variable is not log transformed. The OPISE survey reports producer price indices on a base-100 scale. We divide by 100 and estimate Equation 4 in level, so that a coefficient of 0.029 can be interpreted as a 2.9% increase, analogous to the log specifications used for other outcomes. Prices are winsorized at the 1st and 99th percentiles by four-digit industry.

ately following the passage of the law in August 2015, consistent with producers adjusting their pricing only once the subsidy was formally enacted. Notably, prices do not revert in 2018, when the policy expires. This is consistent with the asymmetric price adjustment documented by Benzarti et al. (2020), who show that prices respond more strongly to tax increases than to tax decreases.

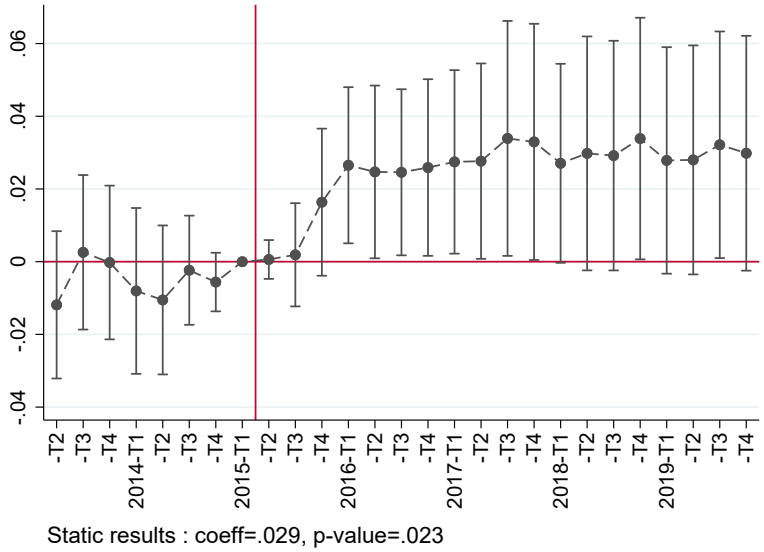


Figure 4: Effect on the price of industrial goods in France

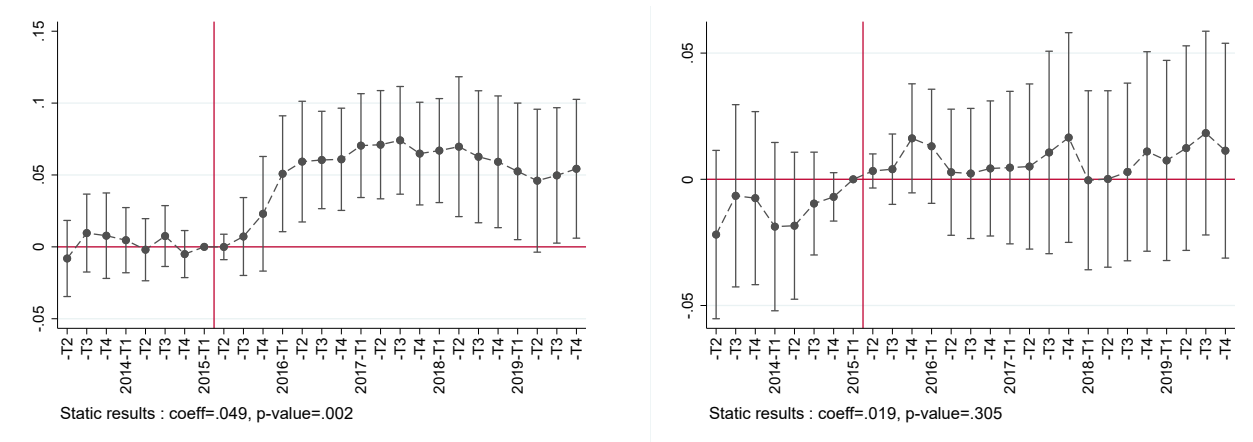
Notes: The figure plots quarterly event-study estimates from Equation (4). The outcome is a producer price index (base 100) divided by 100, so that a coefficient of 0.029 corresponds to a 2.9% price increase. Treatment intensity Share_i is the pre-reform share of eligible goods in total sales in 2010 (equation (3)). Each coefficient measures the price differential between a fully-exposed producer ($\text{Share}_i = 1$) and an unexposed producer ($\text{Share}_i = 0$) relative to Q1 2015. The specification includes firm and four-digit sector-by-quarter fixed effects. Prices are winsorized at the 1st and 99th percentiles by four-digit industry. The base period is Q1 2015, normalized to zero. Vertical bars represent 95% confidence intervals based on standard errors clustered at the firm level. The policy was formally enacted in August 2015 (Q3 2015). The sample comprises 2,223 firms observed from Q2 2013 to Q4 2019. *Sources:* OPISE; EAP.

The estimated price increase offsets roughly one quarter of the 12% mechanical reduction in the user cost of capital, so that the effective reduction faced by investing firms is closer to 9%. Also, since part of the observed increase in domestic sales reflects higher prices rather than additional units sold, the genuine quantity expansion is only about three quarters of the 11.5% sales effect, i.e. approximately 8.5%.

5.2.3 Heterogeneous Price Responses by Profitability

On average, the equilibrium price of subsidized capital goods increases by 2.9% with the reform. We suspect that imperfect competition in the market for capital goods may shape part of this evolution. To assess whether market power may be at play, we estimate the price effect separately for firms with an above-median or a below-median mark-up proxy before the reform. The proxy we consider is the ratio of the value of the firm's sales in 2010 to the sum of materials and payroll costs in that same year.[7]

As shown in Figure 5, the price increase is concentrated among firms with higher markup proxies. The static coefficient for above-median firms is 0.049 ($p < 0.01$), nearly twice the average effect, and strongly significant. For below-median firms, the estimated effect is 0.019 ($p = 0.31$), smaller and not statistically distinguishable from zero. This pattern is consistent with the predictions of models of imperfect competition, in which firms with greater market power pass through a larger share of demand shocks into prices.



(a) Above-median markup proxy

(b) Below-median markup proxy

Figure 5: Heterogeneity of the price response by markup proxy

Notes: The figure replicates the specification of Figure 4 on subsamples split by pre-reform markup proxy. The left panel shows above-median firms and the right panel shows below-median firms, where the median is computed within four-digit sectors. The markup proxy is defined as the ratio of total sales to the sum of material costs and payroll costs in 2010; under constant output elasticity of variable inputs, this proxy is proportional to the true markup and preserves the firm ranking (Grassi, Morzenti, and De Ridder (2022)). All other specification details, including the base period, fixed effects, and confidence intervals, are as described in Figure 4. *Sources:* OPISE; EAP.

7. This proxy equals the true markup divided by the output elasticity of variable inputs (Grassi, Morzenti, and De Ridder 2022). If this elasticity is approximately constant across firms, the proxy preserves the ranking of firms by markup, so that the above- and below-median split correctly identifies high and low markup firms.

5.2.4 Employment, Dividends, and Other Outcomes

The positive demand shock also translates into other firm-level outcomes for capital producers. Since the upstream price increase offsets only part of the reduction in the user cost of capital, downstream firms still face a substantially lower cost, and the demand for capital goods increases in real terms. Capital producers must therefore expand their production and their use of inputs, which rationalizes the positive employment and asset responses we document. Employment increases by 3.9% (coefficient 0.039, $p = 0.01$; Figure 16), and total assets rise by 5.7% (coefficient 0.057, $p < 0.01$; Figure 17). Dividend distribution increases by 12.8 percentage points of pre-reform accounting income, winsorized at the 5th and 95th percentiles (coefficient 0.128, $p < 0.01$; Figure 18), and the share of firms distributing dividends rises by 5.8 percentage points (coefficient 0.058, $p < 0.01$; Figure 19). In contrast, we find no significant effect on the average hourly wage (coefficient 0.001, $p = 0.87$; Figure 20). The combination of rising dividends and flat wages suggests that the surplus captured by capital producers accrues primarily to their shareholders rather than to their workers. All figures are reported in Appendix C.

5.2.5 Robustness

All supply-side estimates are robust to controlling for direct exposure to the subsidy as an investing firm. We compute the same measure of exposure as in Section 4, the ratio of eligible assets to tangible assets, but at the firm level rather than at the industry level, using 2010 values. We form five bins and control for flexible bin-specific time trends. As shown in Figure 21 (Appendix C), the results on prices (coefficient 0.029, $p = 0.02$) and domestic sales (coefficient 0.102, $p < 0.001$) are virtually unchanged.

A separate concern is whether our price effects may reflect changes in the quality of capital goods produced and sold. Eichfelder, Jacob, and Schneider (2023) find that bonus depreciation actually lowers the quality of investment projects, which would work against a quality-driven explanation. We nonetheless investigate this possibility by examining the evolution of capital producers' intangible assets and the share of R&D workers in their workforce (Figure 22 in Appendix C). Neither outcome responds significantly: the coefficient on intangible assets is 0.04 ($p = 0.30$) and that on the share of R&D workers is 0.002 ($p = 0.38$). That said, the confidence intervals for intangible assets are rather wide, limiting the power of this test, and the pre-trend for the share of R&D workers is somewhat noisy. We therefore acknowledge that these proxies cannot fully rule out quality changes.

5.3 Discussion

The results on capital producers yield two key insights for the evaluation of investment stimulus policies.

Effective User Cost Reduction. Investment subsidies reduce the after-tax cost of capital for investing firms. If capital-goods producers raise their pre-tax prices in response to the increase in demand, however, part of the subsidy is absorbed upstream and the effective reduction in the user cost is smaller than the mechanical one.

Our estimates allow us to quantify this offset. The extra depreciation policy mechanically reduces the after-tax cost of eligible capital by approximately 12%. We estimate a pre-tax price increase of approximately 3% among capital producers. Upstream prices therefore absorb roughly one quarter of the subsidy, so that the effective reduction in the user cost faced by investing firms is closer to 9% than to 12%. The remaining three quarters still translate into a lower user cost, effectively stimulating the demand for capital goods. Accordingly, capital producers expand production: their domestic sales rise by 11.5%, employment grows by 3.9%, and total assets increase by 5.7%.

Interpreting Value-Based Investment Responses: Price Versus Quantity. A second implication concerns the large existing literature that estimates the effects of investment subsidies on capital accumulation. Studies in this literature typically measure investment in value terms, that is, as expenditure on capital goods (price $\times$ quantity). This is natural given the available data: administrative records report the acquisition cost of assets, not the number of physical units purchased. If capital-goods prices rise in response to the subsidy, however, part of the measured increase in investment reflects higher prices rather than additional units of capital. Value-based estimates may therefore overstate the real quantity response. The magnitude of this bias depends on the empirical setting.

We can directly decompose the value response into price and quantity components. Domestic sales of capital producers rise by approximately 11%, while prices rise by approximately 3%. Only about three quarters of the observed sales response therefore reflects genuine quantity expansion; the remaining quarter is a price effect. Our findings underscore the importance of complementing value-based investment regressions with direct evidence on upstream prices, whenever such data are available, to properly assess how much of the observed response reflects real capital expansion and how much is absorbed by higher prices.

6 Incidence

6.1 From Reduced Form to Incidence

Next, we translate our empirical results into measures of incidence. How much of the policy-generated surplus ultimately accrues to capital producers versus investing firms? The simplest application of the canonical incidence framework would treat the direct beneficiaries of extra depreciation as final consumers, assume perfect competition in the market for capital goods and full deductibility of capital before the reform. Then, up to a first-order approximation, capital producers would be capturing $0.029/0.12 = 24\%$ of the total surplus generated by the policy.

We go beyond this naive benchmark in two respects. First, we account for market power in the upstream and downstream markets. Empirically, we find that the price response is concentrated among firms with higher markup proxies. We interpret this finding as evidence for the role of upstream imperfect competition in shaping the incidence of the subsidy. We therefore adopt the approach of Weyl and Fabinger (2013) : we summarize the degree of imperfect competition in a market with a single conduct parameter, which acts as a sufficient statistic regardless of the exact nature of the competitive game (Cournot, Bertrand, or otherwise). Second, we account for multiple specificities of our setting. We build a supply-chain architecture, extending the work on upstream retail markets of Adachi (2020), and treat extra depreciation as a shock to a pre-existing ad-valorem subsidy on capital inputs, which relates to the work of Adachi and Fabinger (2022) and Ganapati, Shapiro, and Walker (2020). We further account for the corporate income tax borne by all firms.

6.2 Conceptual Framework

6.2.1 Agents

We consider a vertical supply chain with three layers: upstream firms (capital producers), downstream firms (direct beneficiaries), and consumers of the final good. The key building blocks of the framework are as follows.

Downstream Firm. The representative downstream firm maximizes after-tax profits:

$$\max_{Q,K,L} \pi^D = \max_{Q,K,L} \left\{ p\left(Q\right) Q - rK - wL - t\Big[p\left(Q\right) Q - \lambda rK - wL\Big] \right\},$$

where p is the output price, Q is output, K is capital, L is labor, r is the pre-tax price of capital, w is the wage, t is the corporate income tax rate, and λ is the present value of

depreciation deductions per euro of investment. We assume that the downstream firm is a price-taker in both input markets. The problem comes down to maximizing:

$$FS^D \equiv \frac{\pi^D}{1-t} = pQ - crK - wL, \tag{6}$$

with respect to output, capital, and labor. Here, $c \equiv \dfrac{1-\lambda t}{1-t}$ is the tax shifter that enters the user cost of capital due to the incomplete deductibility of capital costs.

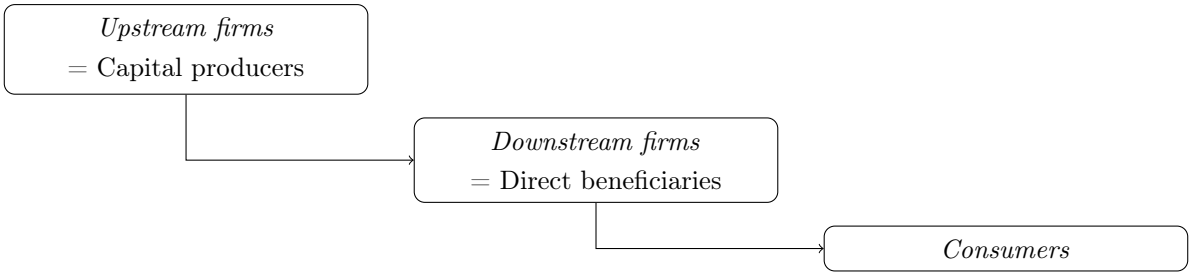


Figure 6: Structure of the supply chain

Upstream Firm. The representative upstream firm maximizes:

$$FS^U = \frac{\pi^U}{1-t} = r\widetilde{K} - C^U(\widetilde{K}), \tag{7}$$

where $\widetilde{K}$ is the quantity of capital goods produced, r is the pre-tax price of capital, and C^U is the upstream cost function. For simplicity, we assume that all upstream costs are fully deductible from the corporate income tax.

Final Consumer. The final consumer takes the output price p as given and chooses the quantity demanded $D(p)$ to maximize utility. Consumer surplus is defined as the integral of demand above the prevailing price:

$$CS(p) = \int_p^\infty D(x)\,dx. \tag{8}$$

Since the consumer is a price-taker, the envelope theorem applies and the change in consumer surplus from any shock that changes the output price by dp is simply $dCS = -Q\,dp$. Our analysis focuses on the division of firm-level surplus between upstream and downstream producers, but the consumer layer is useful to close the supply chain and pin down the downstream demand $D(p)$ that determines equilibrium quantities.

6.2.2 Market Conduct

Market Conduct: Downstream. Consider the downstream firm's quantity choice. When the firm produces one additional unit, two effects arise. The *direct effect* is that the firm sells one more unit at the prevailing price $p(Q)$, earning additional revenue of $p(Q)$. The *indirect effect* is that the additional unit depresses the price on all inframarginal units, reducing revenue by $|p'(Q)|\,Q$. Following Weyl and Fabinger (2013), we introduce the market conduct parameter θ^D as the weight the firm places on the indirect effect in its first-order condition:

$$\underbrace{p(Q)}_{\text{direct effect}} + \underbrace{\theta^D\, p'(Q)\, Q}_{\text{indirect effect}} - MC^D = 0. \tag{9}$$

When $\theta^D = 0$, the firm ignores the price impact of its own output, which corresponds to perfect competition where price equals marginal cost. When $\theta^D = 1$, the firm fully internalizes the effect on all inframarginal units, which corresponds to monopoly. Intermediate values capture oligopolistic conduct: for instance, under symmetric Cournot competition with n firms, $\theta^D = 1/n$. Rearranging the first-order condition, we obtain a relationship between the markup and the demand elasticity:

$$\frac{p(Q) - MC^D}{p(Q)} = \frac{\theta^D}{\varepsilon^D}, \tag{10}$$

where $\varepsilon^D \equiv -\dfrac{p}{p'(Q)\,Q}$ is the price elasticity of demand in the downstream market. The left-hand side is the Lerner index, that is, the relative markup. Under perfect competition it is zero; under monopoly it equals the inverse price elasticity of demand. This relationship will be a building block for the incidence formulas.

Market Conduct: Upstream. The same logic applies to the upstream firm. When the capital producer sells one additional unit of capital $\widetilde{K}$, the direct effect is revenue of $r(\widetilde{K})$ per unit, and the indirect effect is the price depression on all inframarginal units, weighted by the market conduct parameter θ^U:

$$r(\widetilde{K}) + \theta^U\, r'(\widetilde{K})\, \widetilde{K} - MC^U = 0. \tag{11}$$

Crucially, the demand for capital $K(cr)$ that the upstream firm faces is itself a derived demand: it results from the downstream firm's optimal input choice, which in turn depends on the consumer demand $D(p)$ for the final good. As shown by Weyl and Fabinger (2013), the downstream pass-through rate determines how any change in the capital price r trans-

lates into a change in equilibrium quantities, so the elasticity ε^U already embeds both the downstream firm's conduct and the consumer's response. Rearranging:

$$\frac{r - MC^U}{r} = \frac{\theta^U}{\varepsilon^U}, \tag{12}$$

where $\varepsilon^U \equiv -\dfrac{d\ln K}{d\ln(cr)}$ is the elasticity of the demand for capital goods with respect to the user cost cr.

Key Advantages of this Parameterization. A central advantage of this approach is that the market conduct parameters θ^U and θ^D act as sufficient statistics for the degree of imperfect competition in all incidence formulas, without requiring one to specify the precise nature of the competition game (Cournot, Bertrand, or otherwise). The market conduct parameters subsume these distinctions. Moreover, θ can be recovered empirically from the product of two arguably observable objects, the Lerner index and the demand elasticity, as shown in Equations (10) and (12).

6.3 Surplus Variations

Using the framework above, we derive (in Appendix E) the following expressions for the change in upstream and downstream producer surplus in response to a change in the depreciation parameter λ. We assume that this change is infinitesimal, so that the derivations below are first-order approximations.

Proposition 1 (Upstream Producer Surplus)**.** *The change in upstream producer surplus is:*

$$dFS^U = rK\Big[(1-\theta^U)\,d\ln r - \theta^U\,d\ln c\Big]. \tag{13}$$

Proposition 2 (Downstream Producer Surplus)**.** *The change in downstream producer surplus is:*

$$dFS^D = pQ\left[(1-\theta^D)\,d\ln p - \frac{crK}{pQ}\,d\ln(cr) - \frac{wL}{pQ}\,d\ln w\right]. \tag{14}$$

The change in upstream producer surplus depends on the change in the pre-tax price of capital ($d\ln r$), the change in the tax shifter ($d\ln c$), and the upstream market conduct parameter (θ^U). The change in downstream producer surplus additionally depends on pass-through into the consumer price ($d\ln p$), the wage response ($d\ln w$), and the downstream market conduct parameter (θ^D).

It may seem surprising that the surplus formulas depend only on price changes and market conduct parameters. This is because we reason conditional on pass-throughs: the

formulas take the observed price movements as given. Of course, pass-throughs are themselves structural objects that depend on θ, on the elasticities of demand and supply, and on the curvature of demand, but we treat pass-throughs directly as observables precisely because we have estimated them empirically.

Propositions 1 and 2 follow from a simple envelope-theorem logic. Because firms optimally choose quantities and inputs, marginal changes in surplus can be written in terms of price and cost movements, rather than endogenous quantity adjustments. Quantity responses do occur in equilibrium, but they do not appear in the first-order surplus decomposition precisely because firms are already optimizing along those dimensions. The intuition can be seen most clearly by contrasting the polar cases of perfect competition and monopoly in each layer of the supply chain.

Upstream. When the upstream sector is perfectly competitive ($\theta^U = 0$), firms are price takers and cannot strategically adjust markups. The firm takes the equilibrium price r as given, so a change in r directly affects surplus through the inframarginal term $rK\,d\ln r$. Because firms do not choose the price, the envelope theorem does not eliminate this term from the surplus expression. Economically, the policy reduces the downstream user cost of capital and shifts demand for capital goods outward. Because marginal costs are increasing, this higher demand raises the equilibrium price r, which revalues all inframarginal units. The resulting surplus gain comes purely from these inframarginal price effects, not from strategic behavior. In contrast, under monopoly ($\theta^U = 1$), the upstream firm sets its markup optimally. The output price is now a choice variable. By the envelope theorem, marginal profit changes do not depend on variations in the chosen price, and the $d\ln r$ term disappears from the surplus expression. Economically, the downstream policy acts like a demand shifter to which the monopolist responds by adjusting its price in order to maintain the optimal markup. This strategic price adjustment allows the monopolist to appropriate the policy-induced rent.

Downstream. A similar distinction arises. Under perfect competition ($\theta^D = 0$), downstream firms take output prices as given. Because the price p is not a choice variable, the envelope theorem does not eliminate the inframarginal price effect, and the surplus expression contains the term $pQ\,d\ln p$. At the same time, increases in input costs, such as the upstream capital price r or wages w, mechanically reduce surplus through the corresponding cost shares. Economically, competitive firms experience both effects directly because they do not adjust markups strategically. By contrast, under monopoly ($\theta^D = 1$), the downstream firm chooses its markup optimally. The envelope theorem implies that marginal surplus

changes do not depend on variations in the price, so the $d\ln p$ term disappears from the surplus formula. Instead, any price adjustment reflects a strategic move to keep the optimal markup, not a source of extra surplus. As a result, the monopolist does not gain or lose from the output price change itself in the first-order decomposition; only input-cost movements matter. Intuitively, the downstream firm adjusts its price precisely to maintain its optimal markup, so the policy does not alter its surplus through the output-price channel.[8]

Taken together, these results show that, *given pass-through estimates*, market conduct shapes the incidence of the policy. Under perfect competition, price changes generate inframarginal surplus effects. Under monopoly, price changes primarily serve to maintain optimal markups, reallocating the policy-induced rent across the supply chain. Market conduct parameters accomodate virtually any intermediate degree of competition.

6.4 Lower Bound on Upstream Incidence

Our empirical challenge is that the downstream surplus formula involves objects that we do not directly observe: the downstream price pass-through $d\ln p$ and the wage pass-through $d\ln w$. To make progress, we note that dFS^D is maximized, and therefore the upstream share of incidence is minimized, under two assumptions: (i) downstream monopoly ($\theta^D = 1$), which eliminates the consumer price term since $(1-\theta^D)\,d\ln p = 0$; and (ii) no wage increase ($d\ln w = 0$). Under these conservative assumptions, the upper bound of the downstream surplus change simplifies to:

$$\overline{dFS^D} = -crK\,d\ln(cr).$$

The lower bound on the upstream share of firm-level incidence is therefore:

$$\underline{I^U} = \frac{dFS^U}{dFS^U + \overline{dFS^D}} = \frac{(1-\theta^U)\,d\ln r - \theta^U\,d\ln c}{(1-\theta^U)\,d\ln r - \theta^U\,d\ln c - c\,d\ln(cr)}. \tag{15}$$

This formula allows us to compute a lower bound on the upstream share of incidence without needing to observe or estimate the downstream pass-through of capital costs into consumer prices.

8. Note that, for the downstream firm, no market conduct parameter appears on the factor-price terms $d\ln(cr)$ and $d\ln w$. This is a direct consequence of the price-taking assumption in input markets: because the downstream firm treats r and w as given, it exerts no market power over factor prices, and changes in these prices affect its surplus only mechanically, at the initial input quantities.

6.5 Estimating the Upstream Market Conduct Parameter

To implement equation (15), we need to estimate the upstream market conduct parameter θ^U. From Equation 17, the market conduct parameter is the product of the Lerner index and the perceived elasticity of demand faced by the upstream firm:

$$\theta^U = \underbrace{\frac{r - MC^U}{r}}_{\text{Lerner index}} \times \underbrace{\varepsilon^U}_{\text{perceived elasticity}}$$

Lerner index. We rely on external markup estimates from Grassi, Morzenti, and De Ridder (2022), who estimate firm-level markups using a production-function approach on EAP data, the same annual production survey we use to construct our sample of manufacturers, over the 2009–2019 period, which overlaps with our period of study. They therefore estimate markups for the same population of manufacturing firms that we study. Their baseline aggregate markup for manufacturers is 1.45, implying a Lerner index of $1 - 1/1.45 \approx 0.31$. We assume that capital producers' markup is close to the aggregate markup for all manufacturers in the dataset.

Perceived elasticity of demand. The elasticity of demand perceived by the upstream firm measures the responsiveness of the quantity of capital goods demanded to changes in their after-tax cost:

$$\varepsilon^U \equiv -\frac{d \ln \widetilde{K}}{d \ln(cr)}.$$

Our setting is particularly well suited for estimating this elasticity while overcoming the biases that arise from ignoring the price response of capital-goods producers, for two reasons. First, most existing studies compute the elasticity of investment with respect to the user cost by dividing the investment response by the mechanical change in tax incentives implied by the policy. This implicitly assumes that the pre-tax price of capital goods does not adjust. If capital-goods producers raise prices in response to higher demand, the actual reduction in the user cost faced by investing firms is smaller than the mechanical one, and dividing by the mechanical change understates the true elasticity. Because we observe the upstream price response $d \ln r$, we can recover the actual change in the user cost, $d \ln(cr) = d \ln c + d \ln r$, which accounts for both the mechanical tax channel and the endogenous price adjustment. Second, investment is typically measured in value ($r\widetilde{K}$), so that increases in investment may partly reflect higher prices rather than greater real capital accumulation. Since we observe both prices and sales in value on the supply side, we can decompose the quantity change as $d \ln \widetilde{K} = d \ln(r\widetilde{K}) - d \ln r$, thereby isolating real capital accumulation from price effects.

As we show in Appendix F, combining these two corrections and plugging in our estimates yields $\varepsilon^U \approx 0.95$.

Market conduct parameter. Combining the Lerner index and the perceived elasticity:

$$\theta^U = 0.31 \times 0.95 \approx 0.30.$$

6.6 Quantification

We now have all the objects needed to compute the lower bound of upstream incidence. Key empirical inputs are the estimated price effect $d\ln r = 0.029$, the mechanical reduction in the tax shifter $d\ln c = -0.12$. Together, they imply that the user cost of capital for downstream firms changes by $d\ln(cr) = d\ln c + d\ln r = -0.091$. We also need the upstream market conduct parameter, $\theta^U \approx 0.30$.

Plugging these into equation (15), we obtain $\underline{I^U} \approx 0.35$. In other words, at least 35% of the surplus accruing to firms is captured by capital producers. This is a lower bound: the true upstream share is likely higher, since assuming downstream monopoly maximizes the downstream surplus and assuming no wage response ignores a channel through which the downstream surplus would be further reduced.

7 Conclusion

This paper studies the supply-side effects and incidence of investment stimulus policies, exploiting a temporary extra depreciation allowance in France. We document three main findings. First, we confirm that the policy successfully stimulated investment by direct beneficiaries, establishing that it generated a positive demand shock for the producers of eligible capital goods. Consistent with capital deepening, more exposed firms also increase employment and sales, and the composition of their labor force shifts toward engineers and R&D workers.

Second, capital-goods producers significantly respond to the positive demand shock. Their domestic sales increase by 11%, employment grows by 4%, total assets rise by 6%, and dividend distribution increases substantially. Importantly, they also raise prices by approximately 3%, offsetting roughly one quarter of the mechanical reduction in the user cost. This price response has two important implications. It means that the effective reduction in the user cost faced by downstream firms is smaller than what the tax incentive alone would imply. It also means that value-based measures of investment overstate the real quantity response, since prices account for about one quarter of the observed sales increase among

capital producers. Studies that estimate investment effects using expenditure data should account for the possibility that part of the measured response reflects price increases rather than physical capital accumulation.

Third, using an incidence framework that accommodates imperfect competition in both upstream and downstream markets, we show that at least 35% of the surplus accruing to firms is captured by capital producers. This finding moderates the idea, implicitly assumed in much of the policy debate, that investment subsidies primarily benefit the investing sectors.

Several avenues remain for future research. A natural extension is to conduct a marginal value of public funds (MVPF) analysis to assess how supplier responses affect the welfare evaluation of the subsidy. It would also be valuable to examine whether foreign capital producers face similar demand shocks and how their responses reshape our conclusions.

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A Institutional Figures

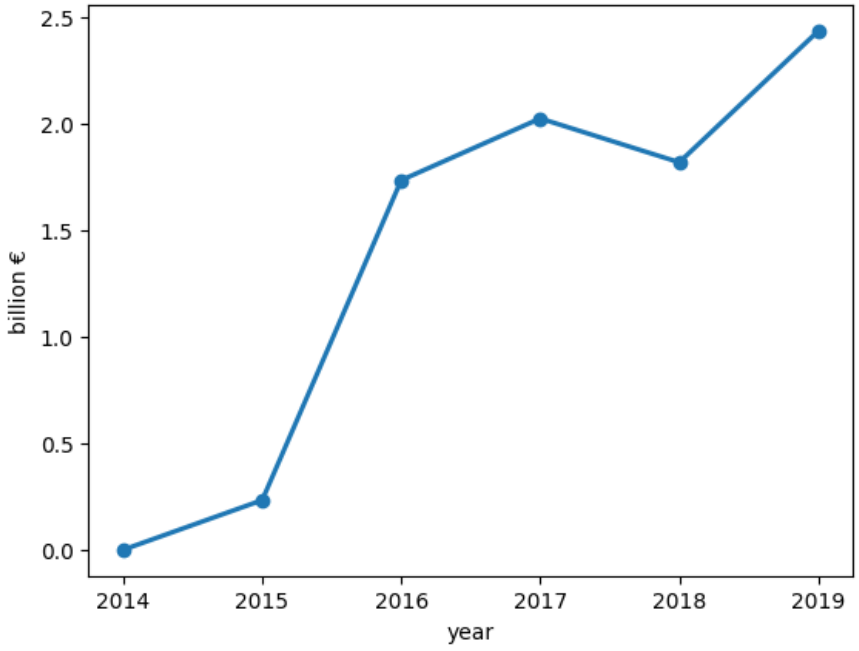


Figure 7: Fiscal cost of the extra depreciation allowance per year

B Direct Beneficiaries

B.1 Descriptive Statistics

	Control		Treated		
	Mean	Median	Mean	Median	
Sales	13.72	2.35	13.61	2.57	m€
Eligible assets	2.95	0.05	3.40	0.09	m€
Tangible assets	8.79	0.34	6.12	0.43	m€
Total assets	20.59	1.31	24.94	1.43	m€
Employee headcount	71.81	16.00	66.06	18.00	.
Hourly wage	16.44	15.12	16.94	15.37	€
Instrument	24.63	22.87	36.39	33.34	%
Share of observations	48		52		%

Table 1: Descriptive statistics for direct beneficiaries in 2014

Notes: This table presents descriptive statistics for our sample of direct beneficiaries in 2014, one year before the reform. The "Treated" group is formed of firms in five-digit industries more exposed to the reform, exposure being defined as per Equation 1, and the "Control" group gathers all other firms in our sample. The discrete criterion ranks five-digit industries according to exposure and selects the top quartile within broader three-digit sectors. *Sources:* BIC-IS, DADS.

B.2 Additional Results

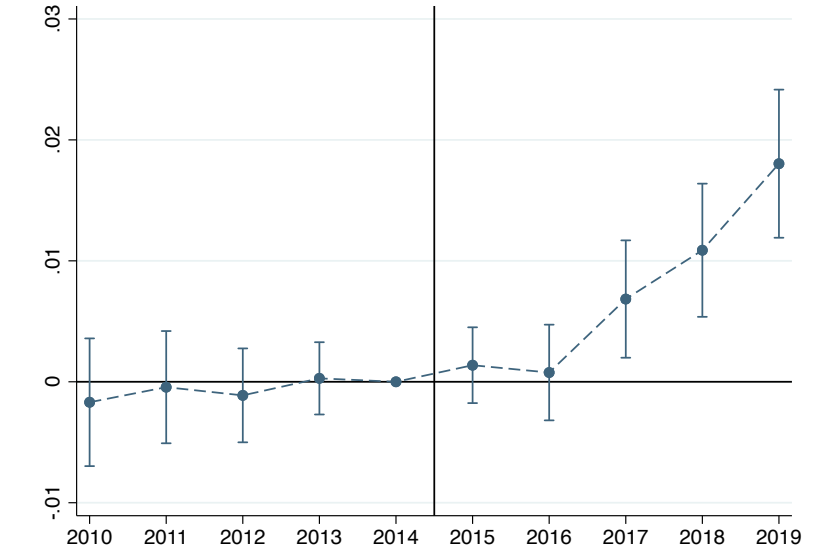


Figure 8: Effect on employee headcount of direct beneficiaries (log)

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the logarithm of employee headcount. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS; DADS.

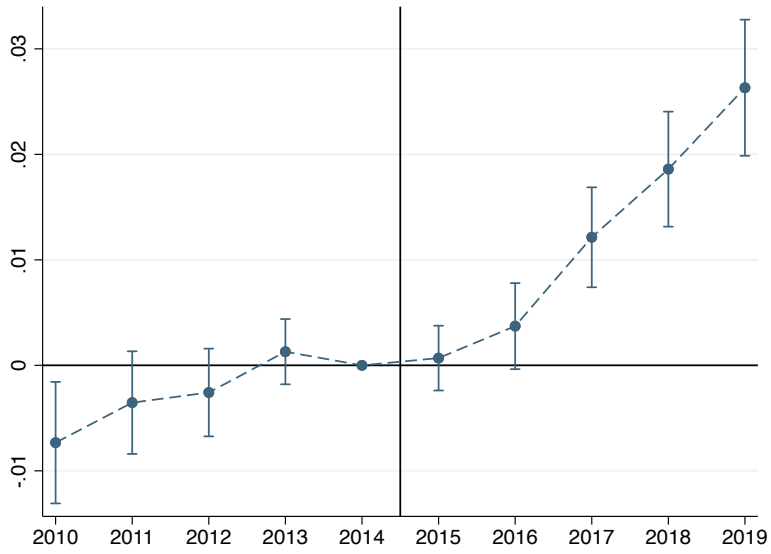


Figure 9: Effect on annual sales of direct beneficiaries (log)

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the logarithm of annual sales. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS.

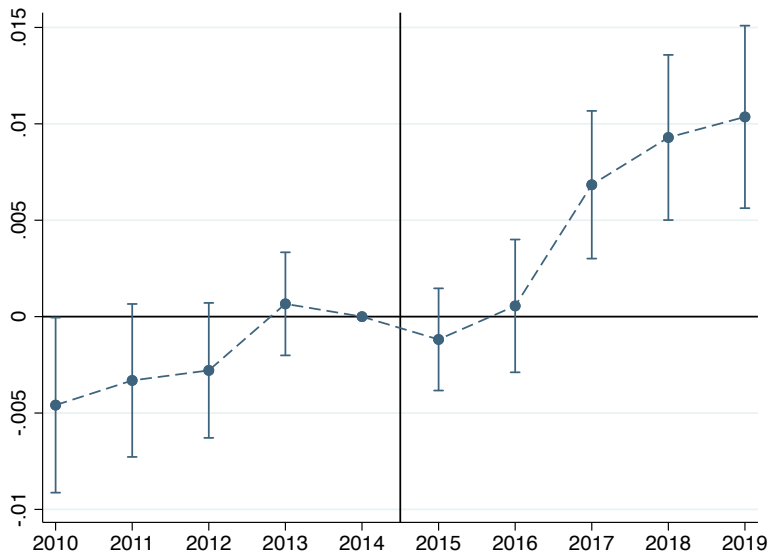


Figure 10: Effect on a proxy for Total Factor Productivity of direct beneficiaries (log)

Notes: The figure plots event-study estimates from equation (2), where the outcome is the logarithm of a TFP proxy defined as $\widehat{\text{TFP}} = \text{Sales} / \left[(0.16 \times \text{Tangible assets})^{0.3} \times \text{Wagebill}^{0.7}\right]$. The coefficient 0.16 is a standard rate of depreciation converting the stock of tangible assets into a flow of capital services; the exponents 0.3 and 0.7 correspond to standard capital and labor shares. Implicitly, this formula assumes a Cobb-Douglas production function. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS.

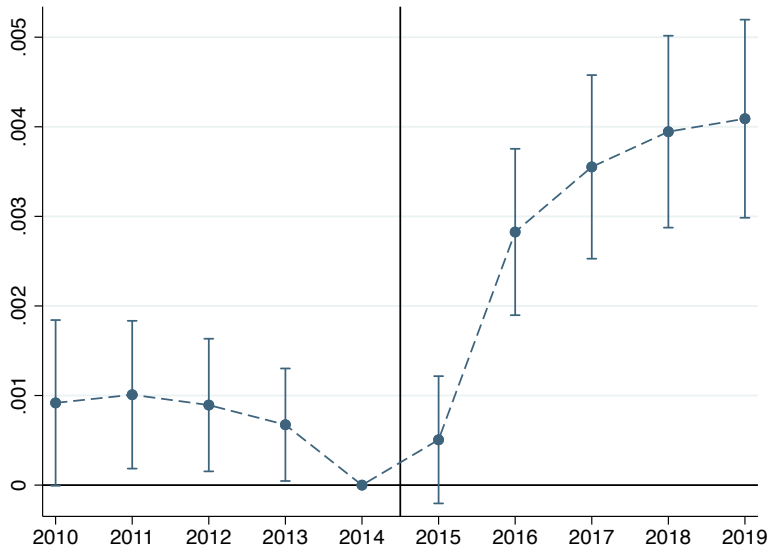


Figure 11: Effect on the share of engineers in headcount of direct beneficiaries

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the share of engineers in total employee headcount. The share is comprised between 0 and 1, so that a 0.003 coefficient corresponds to an increase in the headcount share of engineers by 0.3 percentage points in the treatment group relative to the control group. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS; DADS.

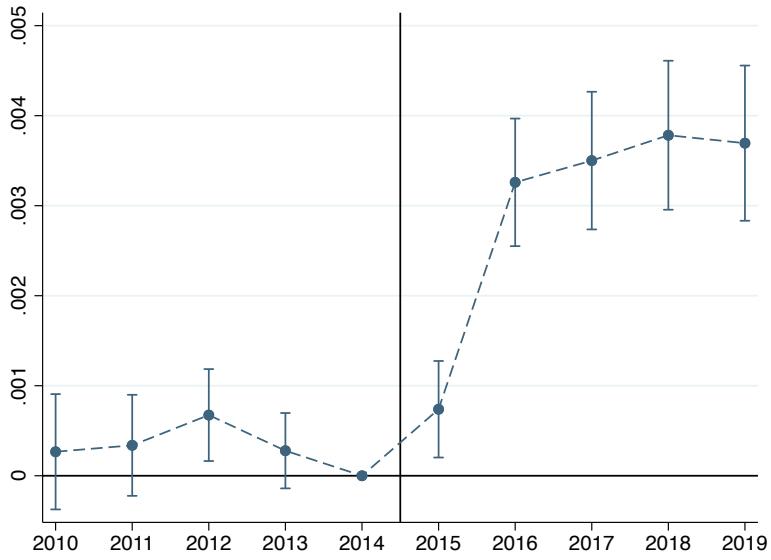


Figure 12: Effect on the share of R&D employees in headcount of direct beneficiaries

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the share of R&D employees in total employee headcount. The share is comprised between 0 and 1, so that a 0.003 coefficient corresponds to an increase in the headcount share of R&D employees by 0.3 percentage points in the treatment group relative to the control group. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS; DADS.

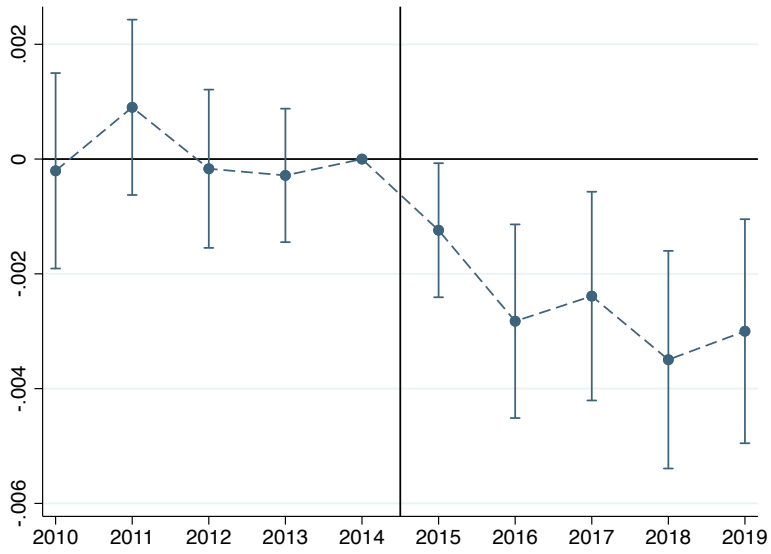


Figure 13: Effect on the share of blue-collar workers in headcount of direct beneficiaries

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the share of blue-collar workers in total employee headcount. The share is comprised between 0 and 1, so that a -0.002 coefficient corresponds to a decrease in the headcount share of blue-collar workers by 0.2 percentage points in the treatment group relative to the control group. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS; DADS.

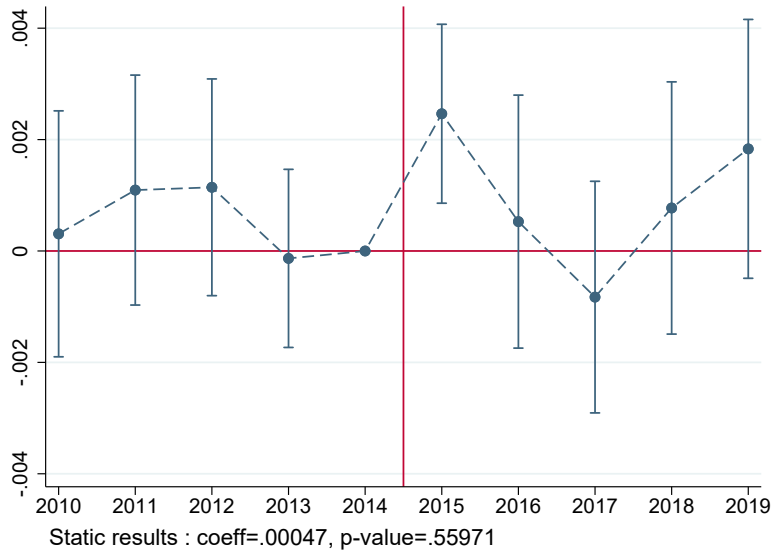


Figure 14: Effect on the average log hourly wage of direct beneficiaries, residualized on flexible occupation-specific trends

Notes: The figure plots event-study estimates from Equation (2), where the outcome is the logarithm of the average hourly wage after residualizing on occupation-specific linear time trends. Residualization is performed at the level of employer-employee pairs by regressing log hourly wages on a full set of occupation-by-year fixed effects. Then, we aggregate the residuals to form the outcome. The treatment indicator, fixed effects, base year, and confidence intervals are as described in Figure 2. *Sources:* BIC-IS; DADS.

C Capital Producers

C.1 Descriptive Statistics

	Control (Share$_{i=0}$)	**Treated (Share$_{i>0}$)**	
	Mean	Mean	
Income statement			
Sales	30.14	25.54	m€
Taxable income	1.40	0.85	m€
$\mathbb{1}\{\text{Profits} > 0\}$	69.40	65.48	%
$\mathbb{1}\{\text{Dividends} > 0\}$	51.97	46.93	%
Balance sheet			
Tangible assets	16.39	10.10	m€
Balance sheet size	27.21	24.30	m€
Labor			
Headcount	91.57	101.06	persons
Mean annual wage	26,893	29,882	€
Number of firms	15,412	2,636	.
Share of firms	85	15	%

Table 2: Descriptive statistics for capital producers in 2014

Notes: This table presents descriptive statistics for our sample of manufacturing firms in 2014, one year before the reform. Both groups only gather manufacturing firms. Control manufacturers did not produce or sell any eligible capital goods in 2010 ($\text{Share}_i = 0$). Treated manufacturers produced at least some eligible goods ($\text{Share}_i > 0$). The binary distinction between the two group is only used for exposition in this table since our preferred specification estimates a difference-in-differences with continuous treatment. *Sources:* BIC-IS, DADS, EAP.

C.2 Summary of Estimates

Table 3: Supply-side effects on capital producers: baseline and robustness

	Panel A: Baseline		**Panel B: Robustness** (controlling for direct exposure)	
	Coefficient	p-value	Coefficient	p-value
Sales				
Domestic sales (log)	0.115***	<0.001	0.102***	<0.001
Exports (log)	−0.025	0.634	−0.032	0.552
Prices				
Industrial goods price (all firms)	0.029**	0.023	0.029**	0.020
— Above-median markup proxy	0.049***	0.002	0.052***	0.001
— Below-median markup proxy	0.019	0.305	0.019	0.296
Employment & Wages				
Employee headcount (log)	0.039**	0.012	0.036**	0.019
Average hourly wage (log)	0.001	0.869	0.002	0.793
Dividends				
Dividends / pre-reform income	0.128***	0.004	0.136***	0.002
$\mathbf{1}\{\text{Dividends} > 0\}$	0.058***	0.003	0.064***	0.001
Assets				
Total assets (log)	0.057***	0.004	0.059***	0.002

Notes: This table reports the static difference-in-differences coefficients from the supply-side event studies on capital producers. Each row corresponds to a separate regression. The dependent variable is listed on the left. Panel A reports the baseline estimates from specification (4), which includes firm fixed effects and four-digit sector-by-year fixed effects. Panel B reports robustness estimates that additionally control for each producer's direct exposure to the subsidy as an investing firm (quintile-specific trends of the ratio of eligible assets to tangible assets in 2010). The coefficient measures the differential effect for a firm with $\text{Share}_i = 1$ (only eligible goods) relative to $\text{Share}_i = 0$ (no eligible goods). Dividends normalized by pre-reform accounting income are winsorized at the 5th and 95th percentiles. Prices are winsorized at the 1st and 99th percentiles by four-digit industry and estimated at the quarterly level; all other outcomes are annual. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.3 Additional Results

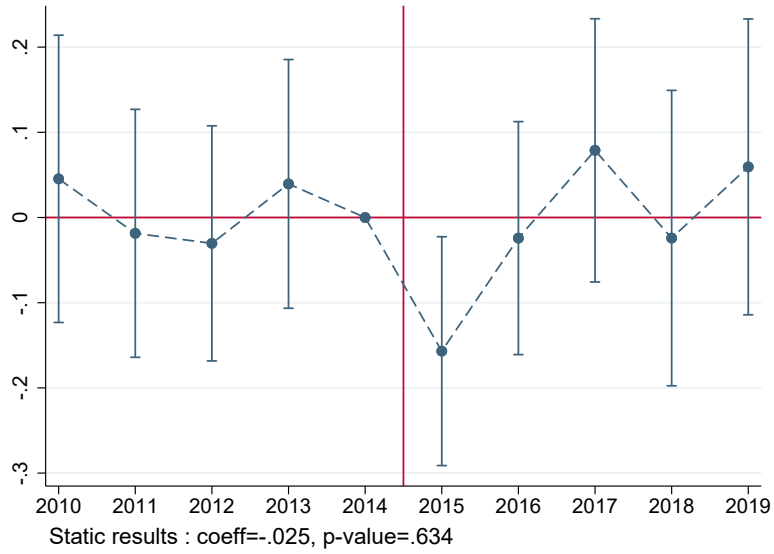


Figure 15: Effect on exports of capital producers (log)

Notes: The figure plots event-study estimates from Equation (4), where the outcome is the logarithm of exports (sales to foreign customers). Each coefficient measures the log exports differential between a fully-exposed producer ($\text{Share}_i = 1$) and an unexposed producer ($\text{Share}_i = 0$). The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS.

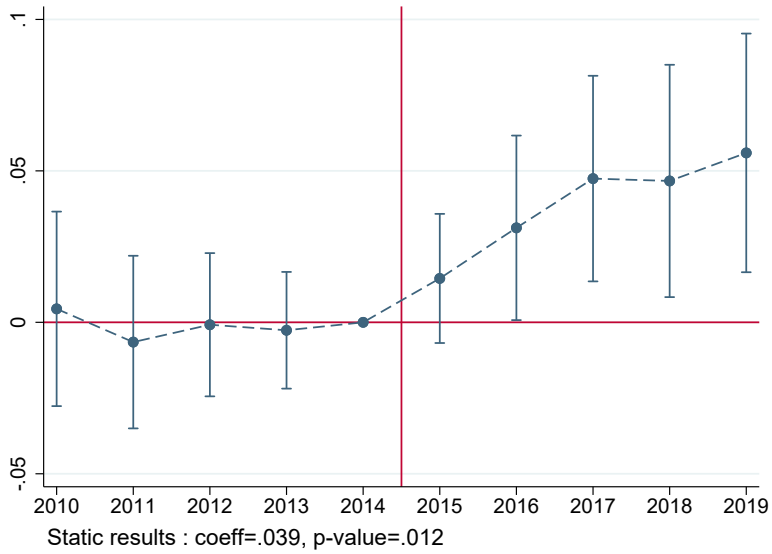


Figure 16: Effect on employee headcount of capital producers (log)

Notes: The figure plots event-study estimates from Equation (4), where the outcome is the logarithm of employee headcount. The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS; DADS.

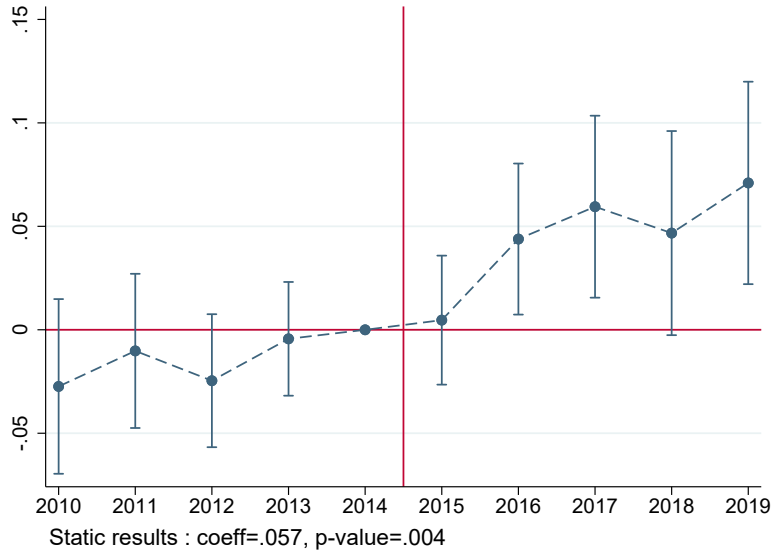


Figure 17: Effect on total assets of capital producers (log)

Notes: The figure plots event-study estimates from Equation (4), where the outcome is the logarithm of total assets (book value from the balance sheet). The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS.

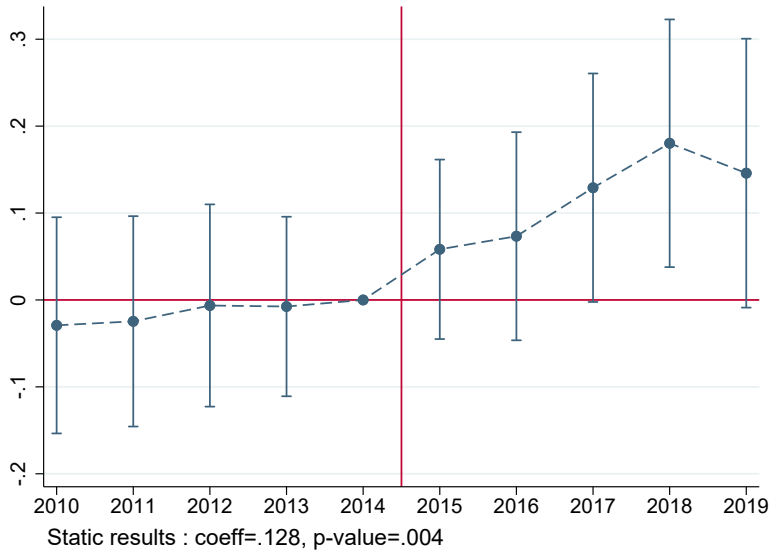


Figure 18: Effect on dividends distributed, normalized by pre-reform accounting income

Notes: The figure plots event-study estimates from Equation (4), where the outcome is dividends distributed in a given year normalized by the firm's pre-reform accounting income, winsorized at the 5th and 95th percentiles. Normalization scales the dividend response relative to a firm's baseline profitability, making it comparable across firms of different sizes while preserving zeros. The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS.

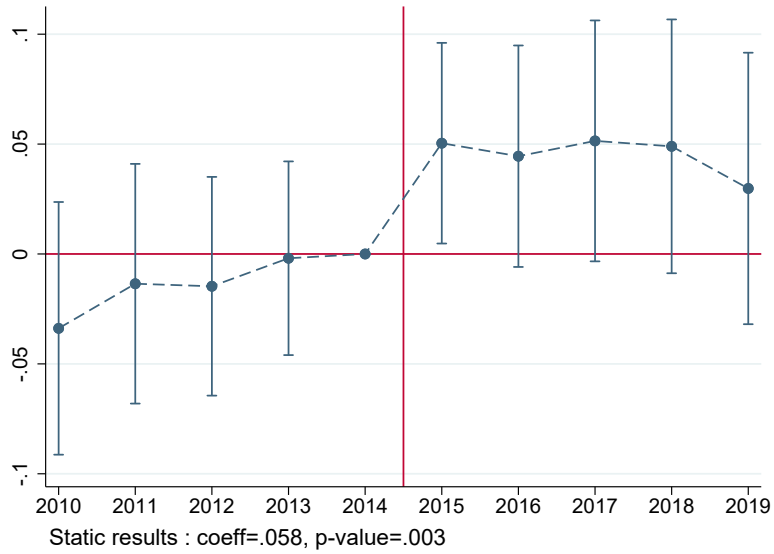


Figure 19: Effect on the probability of distributing positive dividends

Notes: The figure plots event-study estimates from Equation (4), where the outcome is a binary indicator equal to one if the firm distributes positive dividends in a given year. This extensive-margin outcome complements Figure 18, which captures both the extensive and intensive margins. The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS.

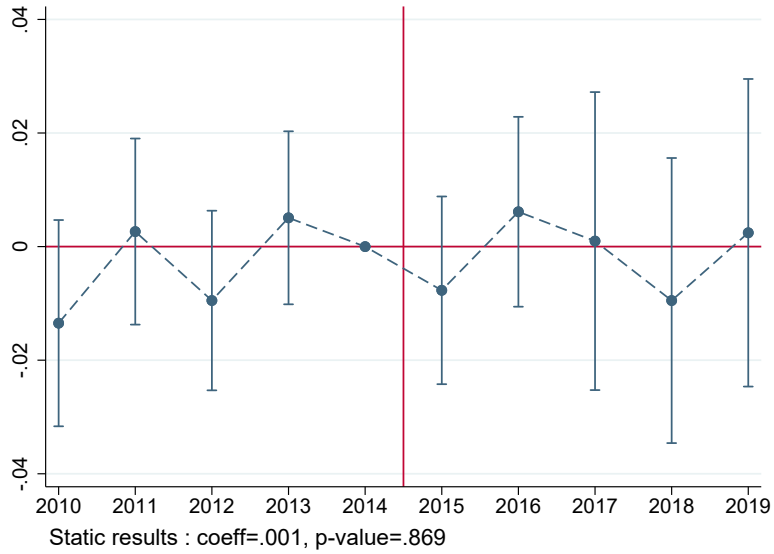
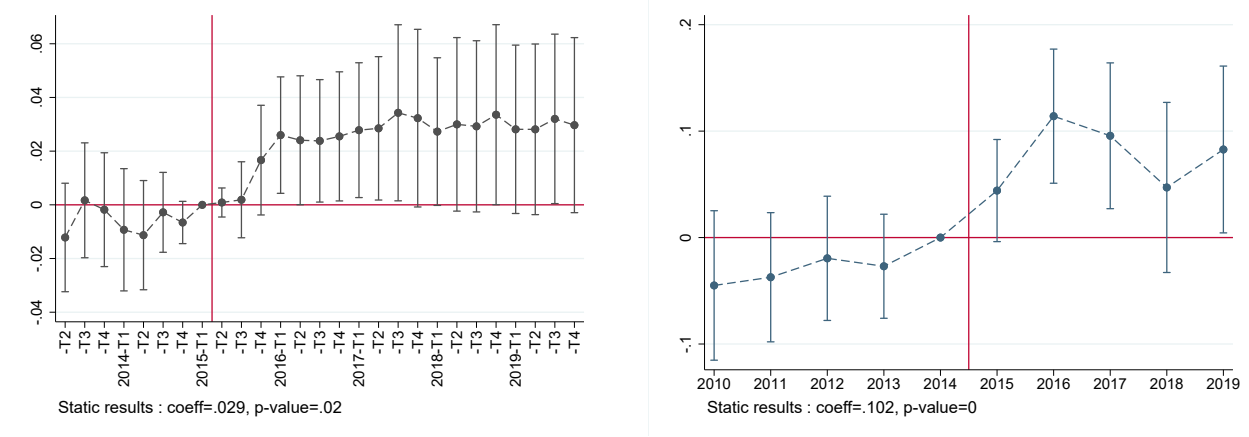


Figure 20: Effect on the average hourly wage of capital producers (log)

Notes: The figure plots event-study estimates from Equation (4), where the outcome is the logarithm of the average hourly wage. The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS; DADS.

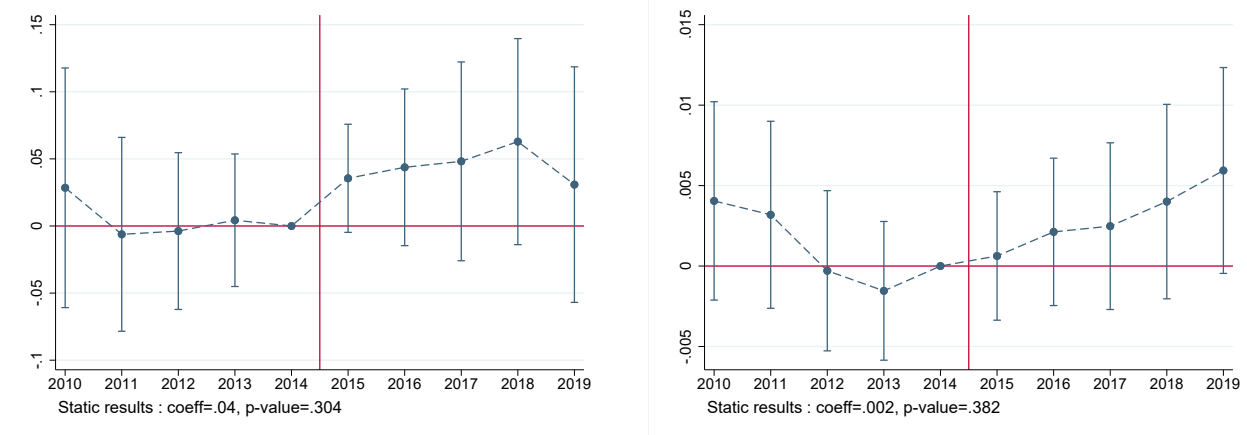


(a) Price of industrial goods

(b) Logarithm of domestic sales

Figure 21: Robustness to controlling for direct exposure as an investing firm

Notes: The figure replicates the baseline specifications of Figure 4 (left panel) and Figure 3 (right panel), augmented with controls for each firm's direct exposure to the policy as an investing firm. Direct exposure is measured by the firm-level ratio of eligible tangible assets to total tangible assets in 2010, discretized into five bins, with flexible bin-specific time trends included as additional controls (one fixed effect per pair of bin and time dummy). All other specification details are unchanged. Vertical bars represent 95% confidence intervals based on standard errors clustered at the firm level. *Sources:* OPISE; EAP; BIC-IS.



(a) Log intangible assets

(b) Share of R&D workers

Figure 22: Investigating quality effects among capital producers

Notes: The figure plots event-study estimates from equation (4) for two proxies for product quality upgrading. The left panel shows the logarithm of intangible assets (book value). The right panel shows the share of R&D workers in total employee headcount. Neither outcome responds significantly, providing limited evidence of quality upgrading as a driver of the observed price increase (see Section 5.2.5 for discussion). The treatment intensity, fixed effects, base year, and confidence intervals are as described in Figure 3. *Sources:* EAP; BIC-IS; DADS.

D User Cost of Capital: Calibration

We calibrate the reduction in the user cost of capital under the following assumptions: average tax life $n = 10$ years, discount rate $r = 7\%$, and corporate tax rate $\tau = 33.33\%$. The discount rate of 7% follows Zwick and Mahon (2017) and is also consistent with the average return on equity in France, which was 6.5% in 2016 according to Bank of France data. An average tax life of ten years is representative of the assets targeted by the policy, most of which have tax lives between 8 and 15 years. For simplicity, we assume linear depreciation before the reform. This assumption yields intuitive formulas, and the resulting estimate is very insensitive to alternative depreciation schedules.

Step 1: Present value of depreciation allowances. Under linear depreciation, the present value of depreciation deductions for 1 € of investment is:

$$\lambda(n, r) = \frac{1}{n} \sum_{s=1}^{n} \frac{1}{(1+r)^s}.$$

Before the reform: $\lambda_{\text{pre}} = \lambda(10, 7\%) \approx 0.702$.

Step 2: After-tax cost before the reform.

$$1 - \tau\, \lambda_{\text{pre}} = 1 - 0.333 \times 0.702 \approx 0.766.$$

Step 3: After-tax cost with extra depreciation (+40%). The extra depreciation allowance multiplies the present value of deductions by 1.4:

$$\lambda_{\text{post}} = 1.4 \times \lambda_{\text{pre}} = 1.4 \times 0.702 \approx 0.983.$$

$$1 - \tau\, \lambda_{\text{post}} = 1 - 0.333 \times 0.983 \approx 0.673.$$

Step 4: Percentage change in the user cost.

$$\frac{(1 - \tau\, \lambda_{\text{post}}) - (1 - \tau\, \lambda_{\text{pre}})}{1 - \tau\, \lambda_{\text{pre}}} = \frac{0.673 - 0.766}{0.766} \approx -12.2\%.$$

E Derivation of Surplus Variations

This appendix provides the detailed derivation of the changes in upstream and downstream producer surplus stated in Propositions 1 and 2. We also derive the upstream share of incidence. Our derivations adapt the framework of Adachi and Fabinger (2022) to our setting with an ad-valorem tax on the cost of capital and multi-factor production downstream.

E.1 Definitions and Preliminary Derivations

E.1.1 Downstream Firm

The downstream firm's program is:

$$\max_{Q,K,L} \; pQ - crK - wL \quad \text{subject to } F^D(K,L) \geq Q,$$

where we recall that $c \equiv \frac{1-\lambda t}{1-t}$ is the tax shifter on the cost of capital.

This program can be split into a cost-minimization step and a quantity choice. The cost function is:

$$C^D(Q; cr, w) = \min_{K,L} \left\{ crK + wL \mid F^D(K,L) \geq Q \right\},$$

and the marginal cost is $MC^D(Q; cr, w) = \frac{\partial C^D}{\partial Q}$.

Note that the downstream firm is assumed to be a price-taker in both input markets: it takes the pre-tax price of capital r and the wage rate w as given. This rules out any monopsony power in factor markets. Allowing for such power would require expressing r and w as functions of K and L, respectively, which we abstract from here.

The downstream firm surplus, as defined in the main text, is:

$$FS^D(Q) \equiv \frac{\pi^D}{1-t} = pQ - C^D(Q; cr, w).$$

E.1.2 Upstream Firm

The upstream firm maximizes:

$$\max_{\widetilde{K}} \; r(\widetilde{K})\,\widetilde{K} - C^U(\widetilde{K}),$$

where $r(\widetilde{K})$ is the inverse demand for capital. The upstream marginal cost is $MC^U(\widetilde{K}) = C^{U\prime}(\widetilde{K})$.

The upstream firm surplus is:

$$FS^U(\widetilde{K}) \equiv \frac{\pi^U}{1-t} = r(\widetilde{K})\,\widetilde{K} - C^U(\widetilde{K}).$$

E.2 Pricing and Market Conduct

E.2.1 Downstream: Lemma 1

The first-order condition for the downstream firm's quantity choice introduces the market conduct parameter θ^D as the weight the firm assigns to the indirect price effect of output:

$$p(Q) + \theta^D\, p'(Q)\, Q - MC^D = 0.$$

Rearranging:

$$\frac{p - MC^D}{p} = \frac{\theta^D}{\varepsilon^D}, \tag{16}$$

where $\varepsilon^D = -\frac{p}{p'(Q)\,Q}$ is the price elasticity of demand in the downstream market. Under perfect competition ($\theta^D = 0$), price equals marginal cost. Under monopoly ($\theta^D = 1$), we recover the standard Lerner index.

E.2.2 Upstream: Lemma 2

Similarly, for the upstream firm:

$$r(\widetilde{K}) + \theta^U\, r'(\widetilde{K})\,\widetilde{K} - MC^U = 0,$$

which rearranges to:

$$\frac{r - MC^U}{r} = \frac{\theta^U}{\varepsilon^U}, \tag{17}$$

where ε^U is the elasticity of the demand for capital goods with respect to the user cost cr.

E.3 Derivation of the Change in Downstream Producer Surplus

The change in downstream firm surplus following a change $d\lambda$ in the deductibility parameter is:

$$dFS^D = dp\,Q + p\,dQ - dC^D.$$

Change in costs. The change in costs writes as:

$$dC^D = dQ\,\frac{\partial C^D}{\partial Q} + d(cr)\,\frac{\partial C^D}{\partial (cr)} + dw\,\frac{\partial C^D}{\partial w}.$$

The partial derivative with respect to quantity is the marginal cost MC^D by definition. By Shephard's lemma, $\frac{\partial C^D}{\partial (cr)} = K$ and $\frac{\partial C^D}{\partial w} = L$, so:

$$dC^D = dQ\,MC^D + d(cr)\,K + dw\,L.$$

Shephard's lemma plays a crucial role here, because it implicitly takes care of substitution effects between capital and labor. When the user cost of capital changes, the firm can substitute between inputs. But by Shephard's lemma, these substitution effects must be cost-neutral: the cost of the additional units of one input exactly offsets the savings from using fewer units of the other. Formally, the sum of substitution effects in costs is zero:

$$cr\,\frac{\partial K}{\partial (cr)} + w\,\frac{\partial L}{\partial (cr)} = 0.$$

The most intuitive way to see this is by contradiction. Note that we are reasoning in terms of partial derivatives, holding quantity fixed: in the expansion of dC^D above, the effect of a change in output is already captured by the $dQ\,MC^D$ term, so the partial derivatives with respect to factor prices are evaluated at constant Q. Since the initial capital-labor pair is optimal, there cannot exist a departure that (i) maintains the quantity produced and (ii) is not cost-neutral. If such a departure were to strictly reduce costs, it would be an improvement over the supposedly optimal pair. If it were to strictly increase costs, the exact opposite changes would improve upon it. So starting from the optimum, any change in capital and labor that keeps production fixed must also keep costs unchanged. This is why only the direct, mechanical impact of factor-price changes, evaluated at the initial input quantities, enters the expression for dC^D.

Change in quantity. We write $dQ = \frac{dQ}{dp}\,dp = -\varepsilon^D \frac{dp\,Q}{p}$.

Combining. Substituting:

$$dFS^D = dp\,Q - \varepsilon^D \frac{dp\,Q}{p}\,p + \varepsilon^D \frac{dp\,Q}{p}\,MC^D - d(cr)\,K - dw\,L.$$

Using Lemma 1 ($MC^D/p = 1 - \theta^D/\varepsilon^D$):

$$\boxed{dFS^D = pQ\left[(1-\theta^D)\,d\ln p - \frac{crK}{pQ}\,d\ln(cr) - \frac{wL}{pQ}\,d\ln w\right].} \tag{18}$$

E.4 Derivation of the Change in Upstream Producer Surplus

The change in upstream firm surplus following a change $d\lambda$ is:

$$dFS^U = dr\,\widetilde{K} + r\,d\widetilde{K} - d\widetilde{K}\,MC^U.$$

Change in quantity. We write $d\widetilde{K} = \frac{d\widetilde{K}}{d(cr)}\,d(cr) = -\varepsilon^U\,\frac{d(cr)\,\widetilde{K}}{cr}$.

Combining. Substituting:

$$dFS^U = r\widetilde{K}\,d\ln r + (r - MC^U)\,d\widetilde{K} = r\widetilde{K}\,d\ln r - (r - MC^U)\,\varepsilon^U\widetilde{K}\,\frac{d(cr)}{cr}.$$

Using Lemma 2 ($\frac{r-MC^U}{r} = \frac{\theta^U}{\varepsilon^U}$), this simplifies to:

$$dFS^U = r\widetilde{K}\left[d\ln r - \theta^U\,d\ln(cr)\right].$$

Since $d\ln(cr) = d\ln c + d\ln r$:

$$\boxed{dFS^U = r\widetilde{K}\left[(1-\theta^U)\,d\ln r - \theta^U\,d\ln c\right].} \tag{19}$$

E.5 Upstream Share of Firm Surplus Changes

The upstream share of the change in total firm surplus is:

$$\frac{dFS^U}{dFS^U + dFS^D}.$$

Substituting:

$$\frac{dFS^U}{dFS^U + dFS^D} = \frac{rK\left[(1-\theta^U)\,d\ln r - \theta^U\,d\ln c\right]}{rK\left[(1-\theta^U)\,d\ln r - \theta^U\,d\ln c\right] + pQ(1-\theta^D)\,d\ln p - crK\,d\ln(cr) - wL\,d\ln w}. \tag{20}$$

Lower Bound under Downstream Monopoly. Setting $\theta^D = 1$ and $d\ln w = 0$:

$$\underline{I^U} = \frac{(1-\theta^U)\,d\ln r - \theta^U\,d\ln c}{(1-\theta^U)\,d\ln r - \theta^U\,d\ln c - c\,d\ln(cr)}. \tag{21}$$

This provides a conservative lower bound on the upstream share. Setting $\theta^D = 1$ removes any downstream price pass-through from the formula, and $d \ln w = 0$ ignores wage responses that would further reduce downstream surplus. Both assumptions therefore maximize dFS^D and minimize I^U.

F Estimation of the Upstream Perceived Elasticity

The upstream perceived elasticity of demand measures the responsiveness of the quantity of capital goods demanded to changes in their after-tax cost. By definition:

$$\varepsilon^U \equiv -\frac{d\ln \widetilde{K}}{d\ln(cr)}. \tag{22}$$

Since we observe domestic sales in value ($r\widetilde{K}$) rather than in quantity ($\widetilde{K}$), we decompose the quantity change as:

$$d\ln \widetilde{K} = d\ln(r\widetilde{K}) - d\ln r.$$

Similarly, the change in the after-tax cost of capital can be written as:

$$d\ln(cr) = d\ln c + d\ln r,$$

where $d\ln c$ is the mechanical change in the tax shifter $c = \frac{1-\lambda t}{1-t}$ induced by the policy, and $d\ln r$ is the endogenous price response. Substituting into (22):

$$\varepsilon^U = -\frac{d\ln(r\widetilde{K}) - d\ln r}{d\ln c + d\ln r}. \tag{23}$$

Plugging in estimates. From our reduced-form results in Section 5, the change in domestic sales is $d\ln(r\widetilde{K}) \approx 0.115$ and the upstream price response is $d\ln r \approx 0.029$. The calibrated change in the tax shifter from Appendix D is $d\ln c \approx -0.12$. Hence:

$$\varepsilon^U = -\frac{0.115 - 0.029}{-0.12 + 0.029} = -\frac{0.086}{-0.091} \approx 0.95.$$