Shocking Capital: Firm-level Responses to a Large Business Tax Reform in France

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Abstract

The present paper aims at assessing how firms adjust to changes in the marginal and average tax rate levied on their investment. We exploit administrative data newly made available to researchers and a large French reform in 2010 generating exogenous and heterogeneous shock on firms local taxation of their equipment capital stock. We build a measure of ex-ante exposure to the reform and confirm, in a simple difference-in-differences setting, that it predicts the evolution of firm-level tax burden. Our results suggest an increase in investment and sales in response to the decrease in the tax burden of capital taxation, suggesting that investment, even in troubled economic times, is sensitive to its user cost. The reform triggers also an increase in employment that is roughly proportional to capital stock and value-added, which is compatible with a low elasticity of substitution between equipment capital and labor in the short to medium-run. Finally, we find a moderate but positive impact on hourly wage suggesting a small labor share of the incidence of the reform (about 5%).

JEL classification: H25, H32, D22

Keywords: Business taxation, firm behavior, fiscal policy, tax reform

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1 Introduction

Until recently, France was the only advanced economy where a local tax was levied on the non-property tangible assets of firms (i.e. equipment and machinery or capital). In 2010, a major reform shifted the tax base from equipment to value-added and replaced the local city-specific rates with a single, nation-wide rate. While the reform had a highly heterogeneous effect on firms depending on initial capital intensity and location, it overall decreased the burden of local taxation. According to DGTrésor (2018) local business taxation amounted to 1.1 percentage point of GDP before the reform and drop to 0.8 percentage point after the reform.

Prior to 2010, firms were taxed based on the historical cost of all of their tangible capital assets, which includes both their real estate property and their equipment (machines). The reform implemented in 2010 consisted of two main measures. First, the reform took the book value of equipment out of the tax base. Second, a new tax was introduced that is levied on value-added and whose rate rather than being local is set nationally – and depends only on firms' overall size. This reform was not revenue neutral and the nationally set tax rate on value added resulted in an overall reduction of the tax burden of about euros 5 billion euros the year it was implemented.

In this paper, we use administrative data newly made available to researchers to assess the impact of this reform on firm behaviour, shedding light on the manner firms adjust to changes in the marginal and average tax rate levied on their investment. The appealing nature of the reform for our purpose is manifold: first the design of the local tax, prior to 2010, generates substantial spatial heterogeneity across firms; second, the magnitude of the effect is strongly driven by the local marginal rate which is, to some extent, exogenous to the firm's response; and third, the nature of the tax base - the book value of tangible assets before 2010 and the value added and the value of real-estate assets after 2010 - generate an additional variation as the tax cuts will be larger for firms whose balance sheet had more machinery and less real estate property.

We are able to exploit this heterogeneity in a dynamic difference-in-differences setting in order to estimate the impact of a reduction in tax on capital immobilisation on a set of firm-level outcome. We first build a measure of ex-ante exposure to the reform – following Auten and Carroll (1999) standard instrumentation of tax reforms – and confirm that it predicts the evolution of firm-level tax burden. We then apply a difference-in-differences estimation on this instrument.

Preliminary results suggest an increase in investment in response to the decrease in the tax burden of capital taxation, suggesting that investment, even in troubled economic times, is sensitive to its user cost. Profitability and sales are also positively affected. We confirm these results using a difference-in-discontinuities design. We will explore whether the tax reform had a a differential impact depending on initial leverage and on the state of the local economy. We finally will assess the overall incidence of the tax.

This reform (and the heterogeneity it generates) allows us to answer some important questions pertaining to how taxes affect firm dynamics and behaviour. It is a long-standing theoretical results that taxation of production factors is particularly distorsive. Diamond and Mirrlees (1971) optimal taxation model concluded to the necessity of non-taxation of intermediate goods. This result has been largely confirm since, even in already distorted environments (Acemoglu et al., 2008).

Nevertheless, the result empirical assessment of the impact of capital taxation on firm investment are not fully conclusive: for instance, Chirinko et al. (1999) find an actual negative impact of the usage cost of capital on its accumulation but Yagan (2015) find no impact of a US tax on capital (dividends) on firms' investments. Moreover, a large literature has analysed the responsiveness of investment bonuses – which decreases the user cost of capital – during recessions (House and Shapiro, 2008). Zwick and Mahon (2017) find that firms respond strongly when tax policy generates immediate cash flows, but not when cash flows only come in the future. Our paper contributes to this literature by analyse a reform that, when it was announced in France in 2009, set the marginal tax rate on *new investments* to zero but, because the tax is paid on the *lagged value of tangible assets*, only mechanically affected firm cash-flows in 2010 when the tax was effectively cancelled and firms stopped paying taxes the lagged value of their equipment.

Simula and Trannoy (2009) provide a theoretical analysis grounded in the q-theory of investment (Summers et al., 1981) by looking at the impact of different taxes on capital on the its usage cost. Actually, they show that French local business taxation prior to the reform should have a large impact on usage cost of capital and therefore on investments. However, Rathelot and Sillard (2008a) empirical assessment of French local business taxation found little if any impact on firms locations.[1] In the present paper, we do not yet analyse firm relocation but focus the behaviour of firms stable geographically. We actually find a substantial impact of taxation of firm tangible assets on their investments. We moreover exploit a much larger shock (a shift in the tax base and the level of taxation whereas previous research exploit variation in local rates).

Such behavioural impact of taxation may have large impact on firms productivity due to misallocation of production factors (see Restuccia and Rogerson 2008 and Hsieh and Klenow 2009).[2] Baqaee and Farhi (2017) build a general equilibrium model for measuring the macroeconomic impact of microeconomic distoritions – among whose taxes. They show theoretically a large potential impact of microecomic misallocations and the calibration of their model states that 50% of total factor productivity growth between 1997 and 2015 was not the consequence of "pure" technological progress but rather the consequence of improvement in production factor allocations.

The rest of the paper is organised as follows: Section 2 presents the institutional setting and the data, Section 3 builds a theoretical framework to guide our empirical investigation which is presented in Section 4. Section 5 present our results regarding the response of firm to the reform and Section 6 provides a preliminary conclusion.

2 Data and institutional context

2.1 The *Taxe Professionnelle*

Prior to 2010, every firm had to pay a tax based on the value of its business capital called the *Taxe Professionnelle* (TP). This local corporate tax was based on the value of tangible fixed assets (equipment and real-estate) with a marginal rate that is specific to the city where the assets are located. This marginal rate results from the addition of different components which reflects different geographical layers of the mainland French territory: around 36,000 *communes*

[1] Analysing the impact of larger tax cut – not only local business taxation but also social contribution and corporate income tax – in specific French area, Rathelot and Sillard (2008b) find significant business relocation, but still little impact on the overall number of businesses.

[2] Such distortion can be particularly strong in the case of real-estate or more generally land, see Duranton et al. (2015) or Bergeaud and Ray (2017).

(municipalities) are located in 94 *Département* (departments) which can be aggregated into 21 *Régions* (regions).[3] The rate can change every year and is a result of a complex mix of political, economic, financial, geographical and social local characteristics. The timing is as follow:

1. In May of year $T-1$, each firm must declare the value of its real-estate and equipment fixed assets owned during year $T-2$.

2. During year $T-1$, the local authorities vote for a tax rate that will be enforced during year T.

3. Firms must pay the TP during year T. In practice, the firm pays in two times, first in May of year T and then in December.

The amount of TP that a firm is charged is limited downward by 1.5% of the value added, and upward by 3.5% of the value added. The lower bound only exists for firms with sales exceeding 7.5m euros.

To formalise this, let us consider the following notations. We consider N firms, indexed by i which we observe every year t from $t_0 < 2010$. During year t, a firm i owns a set of $n(i,t)$ establishments that are located in a set of cities $C_{i,t}$ (this set can vary in time because establishments can be opened/closed). For the purpose of our model, the dimension of interest is the firm-city-year. For this reasons, all the establishment level information are collapsed at the city level. The amount of tax that firm i must pay through the TP is:

$$\mathcal{T}_{i,t} = \min\left[\max\left(0.015 z_{i,t-2} y_{i,t-2}, \tilde{\tau}_{i,t}(KB_{i,t-2} + KE_{i,t-2})\right), 0.035 y_{i,t-2}\right]$$

where $z_{i,t-2}$ is a binary variable equal to 1 if the firm has sales $S_{i,t-2}$ over 7.5m in year $t-2$, $y_{i,t}$ its value added, KB (resp. KE) the value of its real-estate (resp. equipment) capital. $\tilde{\tau}_{i,t}$ is the marginal tax rate faced by firm i. This tax rate is defined at the firm level following:

$$\tilde{\tau}_{i,t} \equiv \sum_{c \in C_{i,t-2}} \frac{\tau_{c,t}(KB_{c,i,t-2} + KE_{c,i,t-2})}{KB_{i,t-2} + KE_{i,t-2}}$$

where $\tau_{c,t}$ is the marginal tax rate of commune c at t. For the majority of single-establishment firms, $\tilde{\tau}_{i,t} = \tau_{c,t}$ where c is the commune where the firm is located. For multi-city firms, $\tilde{\tau}_{i,t}$ is

[3] Before 2010, mainland France had 2 regions, this number has been reduced to 13 in 2014.

a weighted average of local marginal tax rates. It corresponds to a marginal tax rate if the firm wanted to expand its assets in equal proportion in all cities. Finally, $KB_{c,i,t-2}$ (resp. $KE_{c,i,t-2}$) is the value of real-estate (resp. equipment) capital of firm i that is located in commune c.[4]

2.2 After 2010

In 2009, the French government declared that the TP will be abolished and replaced by a new tax whose base was supposedly less distorsive: the *Contribution Economique Territoriale* (CET). This new tax is the sum of two contributions: the CVAE which is a national rate on the firm's value added and the CFE whose rate is still city-specific but whose base now only includes real-estate fixed assets. Here again, the amound of this tax (CVAE+CFE) cannot exceed 3% of the firm's value added. Formally:

For $t \geq 2010$, $\mathcal{T}_{i,t}$ is defined as:

$$\mathcal{T}_{i,t} = \max\left\{\left(\underbrace{\eta_t(S_{i,t-2})y_{i,t-2}}_{\text{CVAE}} + \underbrace{\sum_{c\in C_{i,t-2}} \kappa_{c,t} KB_{c,i,t-2}}_{\text{CFE}}\right), 0.03y_{i,t-2}\right\}$$

Where η and κ are the CVAE and CFE tax rates that are defined at the national level and city level respectively. While η is spatially invariant, its value depends on the level of sales of the firm $S_{i,t}$ (in million of euros):

$$\eta_t(S) = \begin{cases} 0 & \text{if } S < 0.5 \\ 0.005\frac{S-0.5}{2.5} & \text{if } 0.5 \leq S < 3 \\ 0.005 + 0.009\frac{S-3}{7} & \text{if } 3 \leq S < 10 \\ 0.014 + 0.001\frac{S-10}{40} & \text{if } 10 \leq S < 50 \\ 0.015 & \text{if } S \geq 50 \end{cases}$$

For simplicity, from now on, we shall abstract from this dependency of η on sales at this stage.

[4]Note that we denote $\tilde{\tau}_{i,t}$ the marginal rate faced by the firm at t. Given the timing of the TP, it is the tax rate that is associated with the value of the firm's assets at $t-2$.

2.3 Effect of the reform

The transition from the TP to the CET in 2010 therefore induced a change in the cost of capital for firms, especially for non real-estate assets. But the magnitude of the effect of this reform is heterogeneous spatially and depends on the local tax rates τ and κ. Consider the fictional example of a firm with a value added of 50m, a turnover of 150m, a renting value of building of 3m, and a renting value of non-building capital of 5m. If this firm is located in a city where the local tax rates τ and κ are both equal to 20%, then the reform will generate a net gain of 0.25m. If a similar firm were located in a city in which these two rates were at 15%, its net gain from the reform would be 0.

We consider variable $\Delta\mathcal{T}_{i,t} = (\mathcal{T}_{i,t} - \mathcal{T}_{i,t-1})/y_{i,t-2}$ that is defined as the difference between the level of local business taxation in t and in $t-1$, standardised by the value added of the firm in $t-1$. Then, depending on the ratio of capital to value added, six cases can arise for $\Delta\mathcal{T}_{i,t}$ in 2010. They are summarised in Table 1.

Table 1 – Value of $\Delta\mathcal{T}_{i,2010} = (\mathcal{T}_{i,2010} - \mathcal{T}_{i,2009})/y_{i,2008}$ for different cases.

Before Reform | After Reform	$\eta + \kappa\frac{KB_{2008}}{y_{2008}} < 0.03$	$\eta + \kappa\frac{KB_{2008}}{y_{2008}} > 0.03$
$\frac{KB_{2007}+KE_{2007}}{y_{2007}}\tau < 0.015$	$\eta + \frac{\kappa KB_{2008}}{y_{2007}} - 0.015\frac{y_{2007}}{y_{2008}}$	$0.03 - 0.015\frac{y_{2007}}{y_{2008}}$
$\frac{KB_{2007}+KE_{2007}}{y_{2007}}\tau \in [0.015, 0.035]$	$\eta + \frac{\kappa KB_{2008} - \tau KE_{2007}}{y_{2008}} - \tau\frac{KB_{2007}}{y_{2008}}$	$0.03 - \tau\frac{KE_{2007}+KB_{2007}}{y_{2008}}$
$\frac{KB_{2007}+KE_{2007}}{y_{2007}}\tau > 0.035$	$\eta + \kappa\frac{KB_{2008}}{y_{2008}} - 0.035\frac{y_{2007}}{y_{2008}}$	$0.03 - 0.035\frac{y_{2007}}{y_{2008}}$

Notes: κ and η are taken in 2010 while τ is taken in 2009.

2.4 Data source

For each municipality, we draw information on relevant tax rate of TP τ, and the subsequent rates of CFE κ from the *déclarations de taxe professionelle* database, whose time coverage spans the years 2002 to 2015. Figure 1 gives the distribution of τ in 2008 and Figure 2 their spatial distribution. In practice, rich municipalities (e.g. Paris) tend to have lower rates of TP as they are able to draw revenue from housing-tax.

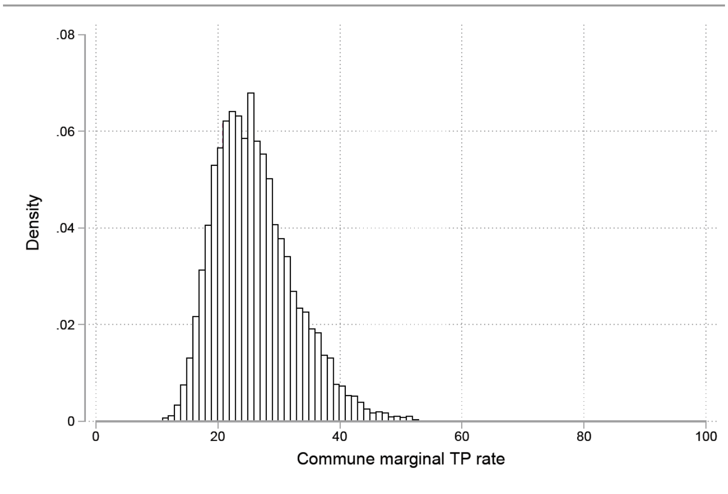


Figure 1 – Distribution of marginal tax rate in 2008.

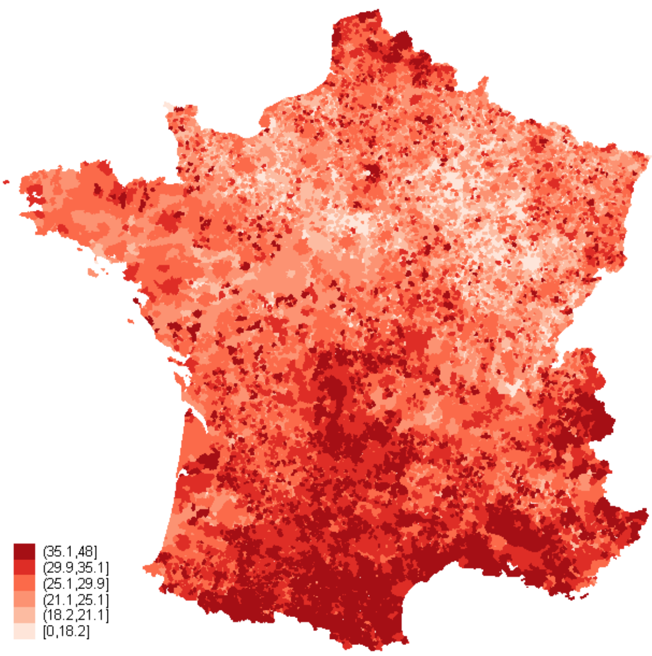


Figure 2 – Marginal tax rate in 2008, by municipality.

Our firm level data are taken from the BIC database. The BIC data reports standard balance sheet information (value added, sales, employment...) based on firm's legal tax report. We restrict attention to firms in the manufacturing and business services sectors. We augment this dataset sheet with detailed data at the establishment level. In particular, we have information about the renting value of building (KB) and equipment capital (KE), i.e. the tax base for the TP. This dataset made recently available to researchers has the unique feature of providing details about the geographical distribution of a firm's capital, as well as information on the current *value* of its assets. Because of the nature of the tax base of the TP, such information have been collected by the fiscal authorities on a yearly basis, at least since 2010. This tax base being very specific to France, we believe this is a level of details that is unique in the literature.

Before moving to the empirical exercise based on this dataset, Table 2 shows some basic descriptive statistics. We namely see that on average, the value of real-estate capital is lower than the value of equipment, and that they are approximately equal to 2% and 7-8% of value added.

In the next section, we sketch a theoretical framework that will guide us through the empirical analysis.

Table 2 – Descriptive statistics from our final sample.

Year	Firms	L	Y	manuf	KB/Y	KE/Y	$\mathcal{T}/S$
2004	379,598	25.9	6.29	0.13	0.023	0.080	0.0096
2005	441,429	24.1	6.43	0.12	0.023	0.075	0.0091
2006	453,889	24.0	6.61	0.12	0.022	0.073	0.0091
2007	568,588	23.6	6.47	0.12	0.022	0.071	0.0087
2008	480,728	23.0	6.55	0.12	0.022	0.072	0.0085
2009	476,734	22.6	6.24	0.13	0.023	0.078	0.0091
2010	497,748	21.7	6.29	0.12	0.023	0.079	0.0057
2011	568,927	20.6	6.11	0.11			0.0046
2012	586,516	20.0	6.13	0.11			0.0049
2013	597,111	19.5	5.99	0.11			0.0051
2014	605,826	19.3	5.96	0.10			0.0051
2015	617,715	19.0	5.97	0.10			0.0051

Notes: L denotes employment in full time equivalent, Y is value added in million of current euros, manuf is the share of manufacturing firms, KB and KE are the value of real-estate (resp. equipment) assets and $\mathcal{T}/S$ is the total amount paid by the firm in local tax divided by its turnover.

3 Conceptual framework

We consider a simple two-period model in order to consider qualitatively the theoretical impact of the TP tax reform on investment. For simplicity, we focus on the investment decision and ignore other factor of production, most notably land and labor. We further abstract away from the ceiling and floor of the tax as a function of value-added which were documented in the previous section, in order to focus on the case of firms whose TP tax base is effectively the lagged value of its tangible assets.

We consider a firm that is financing an investment project out of retained earnings. The investment is realized at the beginning of each period 1 and 2, then production takes place and at the end of the period the capital stock depreciates at rate δ. The relative price of the investment good is denoted by q. The law of motion of capital is therefore:

$$K_t = (1 - \delta)K_{t-t} + I_t \text{ for } t = 1, 2 \tag{1}$$

A corporate tax at τ_c is levied on profits defined as revenues net of depreciation where depreciation for tax purposes is assumed to match economic depreciation δ.

The local business capital tax (TP) is raised on the lagged value of capital at rate τ_2^P. In the two period model, it is paid in period 2 based on the tax value of capital in period one which we denote : K_1^T. K_1^T refers to a value in the numéraire good (and not in the capital good). It is defined as :

$$K_1^T = q(K_0 + I_1) \tag{2}$$

where K_0 is exogenous. Note that in line with the institutional setting, the tax base K_1^T is based on historical cost without taking depreciation into account. At the end of the second period, the firm shuts down and the remaining capital is sold for a salvage value of s.

The firm maximises the discounted value of cash-flows. Cash-flows in period 1 and 2 are defined as :

$$CF_1 = F(K_1) - qI_1 - \tau_c(F(K_1) - q\delta K_1) \tag{3}$$

$$CF_2 = F(K_2) + sK_2 - qI_2 - \tau_2^P K_1^T - \tau_c(sK_2 + F(K_2) - q\delta K_2 - \tau_2^P K_1^T) \tag{4}$$

We note here that the tax on capital (τ_2^P) does not affect directly the firm's cash-flow during the first period. Consistently with the institutional setting, there is lag between when the investment is realized and its entry in the tax base.

The objective function of the firm writes as:

$$\max_{I_1,K_1,I_2,K_2} \Pi = \sum_{t=1}^{2} \beta_{t-1} CF_t = CF_1 + \beta_1 CF_2 \tag{5}$$

subject to the law of motion of capital (1) and the definition of the tax base (2).

We consider first the case where the investment is not constrained by financial factors. That is we first assume that the level of retained earnings is sufficient to finance the optimal level of investment. We then impose *ad-hoc* financial constraints and see how the effect of the tax (and its abolition) affect investment in that setting.

3.1 No financial constraint

Denoting λ_t the Lagrange multiplier associated with the law of motion of capital period t and λ_2^T the multiplier associated with the definition of capital for tax purposes we obtain the following first order conditions:

$$I_1: \qquad q = \lambda_1 - \lambda_2^T q \tag{6}$$

$$I_2: \qquad \beta q = \lambda_2 \tag{7}$$

$$K_1: \qquad (F'(K_1) - \tau_c(F'(K_1) - q\delta)) = \lambda_1 - (1-\delta)\lambda_2 \tag{8}$$

$$K_2: \qquad \beta(F'(K_2) - \tau_c(F'(K_2) - q\delta) + s(1-\tau_c)) = \lambda_2 \tag{9}$$

$$K_1^T: \qquad -\beta\tau_2^P(1-\tau_c)q + \lambda_2^T\tau_2^P = 0 \tag{10}$$

Re-arranging the FOCs yield the following optimal capital decisions:

$$F'(K_1) = q\left(\frac{1-\delta\tau_c}{1-\tau_c} + \beta\tau_2^P\right) \tag{11}$$

$$F'(K_2) = q\frac{1-\delta\tau_c}{1-\tau_c} - s \tag{12}$$

On the left hand-side of the equation (11), we see the gross-return to investing one more unit of capital in period 1. This return is equated to its cost which is presented in the right HS. In the absence of taxation, the cost is simply equal to the relative price of the capital good q. A positive corporate tax rate ($\tau_c > 0$) in the absence of full expensing ($0 < \delta < 1$) of capital expenditures implies an increase in the user cost of capital (Hall and Jorgenson, 1969). The TP contributes to raise the price of capital substantially as it enters linearly in the expression for the user cost of capital. It is discounted due to the fact that the tax levied on capital at period 1 is actually paid in period 2.

Equation (12) line shows the optimal condition for capital stock at period 2. As the firm shuts down at the end of period 2, no TP will be levied on its period 2 capital stock and as a result, optimal investment in period 2 is independent of the TP rate τ_2^P. Therefore cancelling the TP, i.e. setting $\tau_2^P = 0$, will mechanically affect the cash-flow of the firm in period 2 only but will not modify its incentives to invest in that period. On the contrary, investment incentives are affected for period 1 only due to fact that the firm is forward-looking.

3.2 Financial constraints

We introduce financial constraints in a very reduced-form way. We assume that the firm is limited on the amount of cash it can invested. The limit is exogenously given and states that the sum of investment and TP tax payment must be below some level of cash each period.[5]

$$I_1 \leq C_0 \text{ and } I_2 + \tau_2^P \leq C_1$$

Denoting the μ_1 and μ_2, the multiplier we find the following:

[5] We do not include corporate tax payment in the constraint. The TP is more interesting as it affects the firm independently of profits in period 2 and therefore can affect cash-flows even when profitability is quite low.

$$I_1: \qquad q = \lambda_1 - \lambda_2^T q - q\mu_1 \tag{13}$$

$$I_2: \qquad \beta q = \lambda_2 - q\mu_2 \tag{14}$$

$$K_1: \qquad (F'(K_1) - \tau_c(F'(K_1) - q\delta)) = \lambda_1 - (1-\delta)\lambda_2 \tag{15}$$

$$K_2: \qquad \beta(F'(K_2) - \tau_c(F'(K_2) - q\delta) + s(1-\tau_c)) = \lambda_2 \tag{16}$$

$$K_1^T: \qquad -\beta\tau_2^P(1-\tau_c)q + \lambda_2^T + \mu_2\tau_2^P = 0 \tag{17}$$

$$F'(K_2) = \frac{q\mu_2}{\beta(1-\tau_c)} + \frac{q(1-\tau_c\delta)}{1-\tau_c} - s \tag{18}$$

The condition for period 2 investment is now slightly amended, with the additional term

$$\frac{q\mu_2}{\beta(1-\tau_c)}.$$

One can show that the term μ_2 is increasing in τ_2^P. Intuitively, an increase τ_2^P increase the bindingness of the financial constraint and rise the marginal value of relaxing that constraint (which is measured by μ_2). Accordingly, in the presence of financial constraints, the reform is likely to raise investment both periods. In period 1 because the marginal return to investment is affected and in period 2 because the financial constraint is relaxed.

That conceptual framework speaks directly to our empirical setting. The reform was announced in 2009, accordingly firms knew, provided they trust the government, that their new investment were not going to be taxed. However they still had to pay the TP that year based on the lagged value of their tax capital. Therefore, 2009 is akin to the first period of our model: the reform changes marginal incentives to invest but does not directly affect cash-flows. In 2010, firms finally saw their tax burden decrease, however their marginal incentives to invest remain unchanged as the effective marginal rate on new investment was already null in 2009. In that sense, 2010 and other years resembles the period 2 of the model: marginal incentives are already maximized and the TP should not enter the user cost of capital unless there are financial constraints creating some degree of cash-flow sensitivity of investment.

4 Empirical strategy

4.1 The model

Recall that we have denoted $\Delta\mathcal{T}_{i,t}$ the variation in the amount of local tax a firm i has to pay at the end of period t compared to the end of period $t-1$. In 2010, a large heterogeneity in $\Delta\mathcal{T}_{i,t}$ arises due to the TP reform. We want to measure the idiosyncratic response of firms to this shock on their cost of capital using a standard difference-in-difference (DinD) approach. The model we want to estimate is the following:

$$y_{i,t} = \alpha\Delta\mathcal{T}_{i,t} \times \mathcal{R}_t + \beta\Delta\mathcal{T}_{i,t} + \psi_{s(i,t),t} + \psi_i + \varepsilon_{i,t}. \tag{19}$$

Where $y_{i,t}$ is a measure of firm i's outcome (sales, value added, employment etc....), $s(i)$ is the sector of the firm, so that $\psi_{s(i),t}$ is a vector of sector-year fixed effect. $\mathcal{R}_t$ is a binary variable that is equal to 1 if $t \geq 2010$ and therefore indicates whether or not the treatment is active at t. In this model α represents the proportional effect of the tax reform on y, through its effect on $\Delta\mathcal{T}$.

In theory, we could directly estimate this model as we observe $\Delta\mathcal{T}_{i,t}$ from the firm's tax report. However, such estimation would suffer from obvious endogeneity problems as naturally, $Cov(\Delta\mathcal{T}_{i,t}, \varepsilon_{i,t}) \neq 0$, as a shock of output y_i that hits the firm will of course directly impact its tax base and therefore the value of $\Delta\mathcal{T}_i$. Note that given that the value of $\Delta\mathcal{T}_i$ is based on previous years' values of firm i characteristics, this problem would arise if ε_i is serially correlated.

To estimate equation (19), we therefore turns to an IV strategy and looks for an instrument z such that $\mathbb{E}[z_i\varepsilon_i] = 0$.

4.2 Construction of the shock

In order to build a measure at the firm level that is correlated with the magnitude of the treatment (i.e. with the reduction in the tax burden affecting all firms following the reform), we first consider for simplification that all firms are in the case where $\frac{KB_{2007}+KE_{2007}}{y_{2007}}\tau_{2008} \in [0.015, 0.035]$, that is, their ratio of asset values to value added before the reform is within the interval where the tax base is the renting value of their capital stock (i.e., the second line of Table 1). In

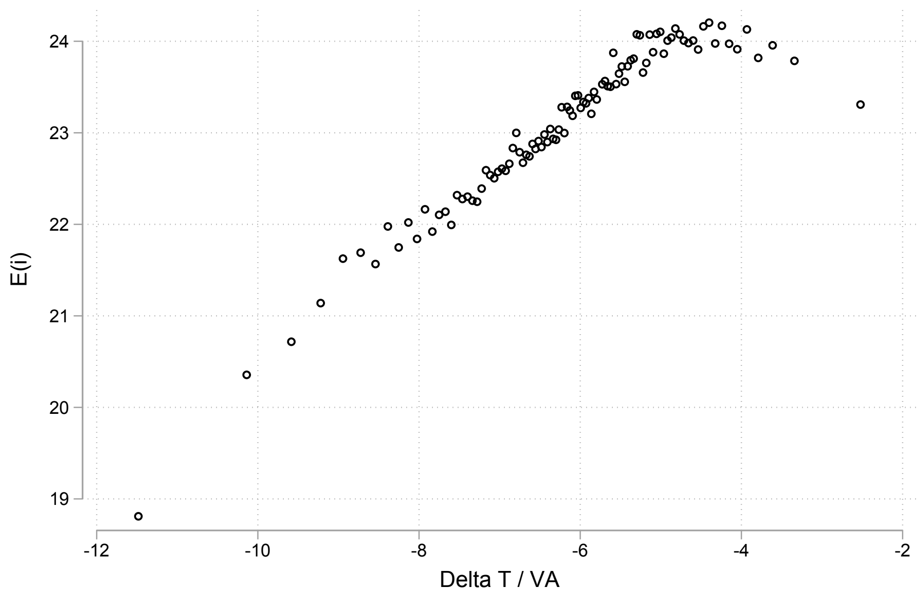


Figure 3 – Correlation between $\mathcal{E}(i)$ and the ratio of $\Delta\mathcal{T}$ over value added.

that case, the effect of the reform can be well proxied by the pre-reform marginal tax rate τ, multiplied by $KB/(KB + KE)$, the share of building in total capital vlaue. This is true as long as we assume that κKB is relatively close to τKE (compared to the value of τKB).

To operationalize this idea, we construct the following quantity $\mathcal{E}(f)$ for every firm f:

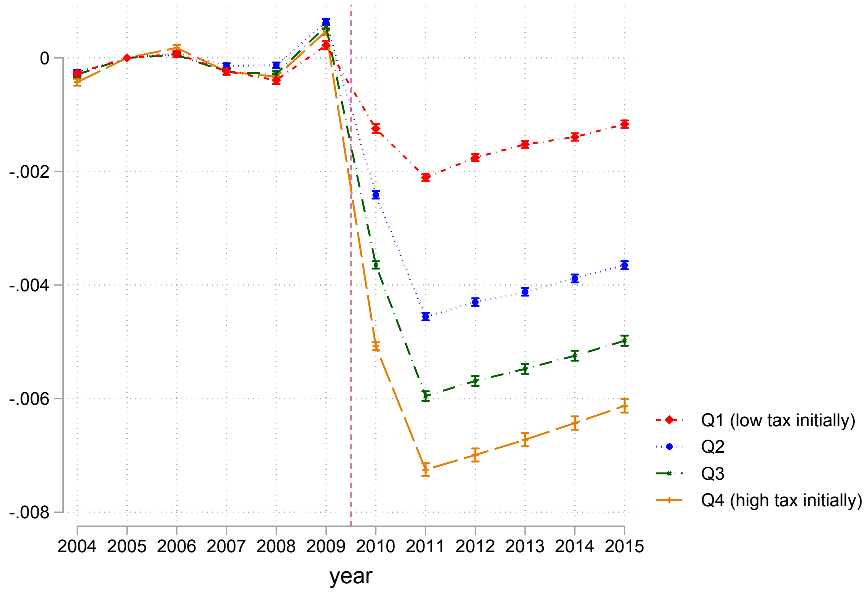
$$\mathcal{E}(i) = \frac{KB_{i,t_0}}{K_{i,t_0}}\tilde{\tau}_{i,t_0}, \text{ where } \tilde{\tau}_{i,t_0} = \sum_{c\in C(i,t_0)} \frac{K_{i,c,t_0}}{K_{i,t0}}\tau_{c,t_0}$$

where $C(i, t_0)$ denotes the set of municipalities where firm i holds an establishment during year t_0, which we take to be equal to 2008, and K is the total value of firm i's assets. $\mathcal{E}$ is therefore the average tax rate that the firm faced in t_0, weighted by the share of building in its total asset values. The average value of $\mathcal{E}$ is equal to 22%, which is also the value of its median, while its 25^{th} (resp. 75^{th}) percentile is 16% (resp. 28%). Figure 3 shows the correlation between $\mathcal{E}(i)$ and $\Delta\mathcal{T}/Y$.

Based on this measure, we first proceed to a discretization of the treatment and construct 4 groups of firms of equal size. These groups are homogeneous in terms of sector and size composition of firms by construction and we denote them Q_1, Q_2, Q_3 and Q_4 in the following.

We first consider the value of $\mathcal{T}_{i,t}$, the total expenditure in local taxation at the firm level for each year between 2004 and 2015, on average for each of the 4 groups. To do so, we standardise

Figure 4 – Evolution of tax rate for each group. Reference year is 2009.



the value of the retention rate, defined as minus the logarithm of $1 + \frac{\mathcal{T}}{y}$ so as to be equal to 0 in 2005 and aggregate by group. Results are shown in Figure 4. Figure 4 clearly shows[6] that prior to the reform, firms in the 4 groups have parallel trends in terms of their retention rate, and that after 2010, a clear divergence occurs: the tax burden decrease relatively more for firms in Q_4 than for firms in Q_3, which in turns are more affected than firms in Q_2 etc...

Since all groups have a similar composition of firms, we are essentially immune to the concern that Figure 4 captures an heterogeneous effect of the crisis across our different groups. Specifically, one can imagine that firms in Q_1 are located in more rural areas, perhaps more exposed to macroeconomic shocks that affected the French economy in 2009. In that case, Figure 4 will only reflect the fact that the crisis has heterogeneous effects on firms and that the level of heterogeneity is correlated with the value of $\mathcal{E}(i)$. Table 3 shows some basic descriptive statistics for firms in each groups in 2008.

[6] We have kept the firms that are present every year in the sample from 2004 to 2015 and winsorized the data at the bottom/top 1% of the retention rate for this graph.

Table 3 – Descriptive statistics by group of intensity of exposure.

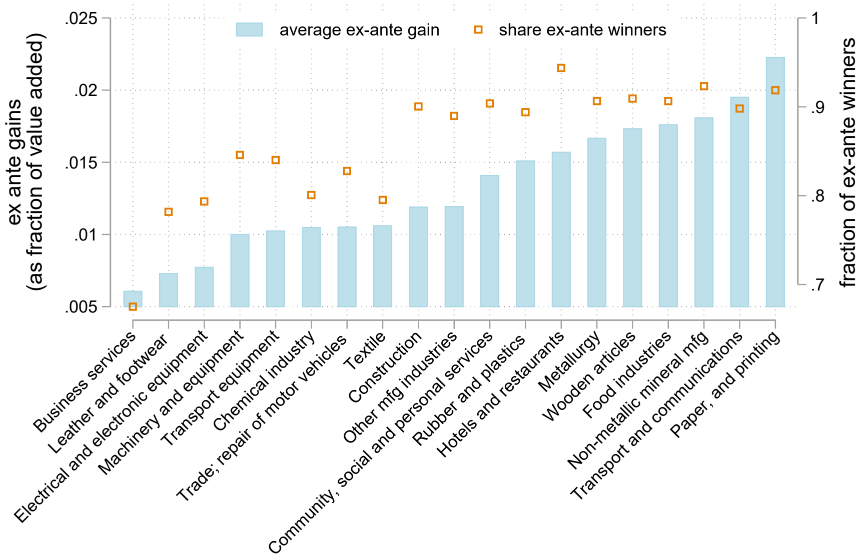
Group	Y	KE/Y	KB / Y	$\mathcal{T}/S$	KB/K
Q1	3,032	0.023	0.119	0.023	0.20
Q2	3,529	0.023	0.114	0.025	0.20
Q3	3,600	0.023	0.108	0.025	0.21
Q4	2,779	0.023	0.105	0.028	0.21

Notes: Q1, Q2, Q3 and Q4 are groups of firm of equal size that are constructed based on the value of $\mathcal{E}$. Groups have been computed by calculated within sector and size bin quartiles. S is sales in thousand of current euros, KB and KE are the ratio of the value of real-estate (resp. equipment) assets and $\mathcal{T}/S$ is the total amount paid by the firm in local tax divided by its turnover. the values presented are the averages of each quartile.

4.3 Descriptive statistics on the instrument and the mechanical effect of the reform

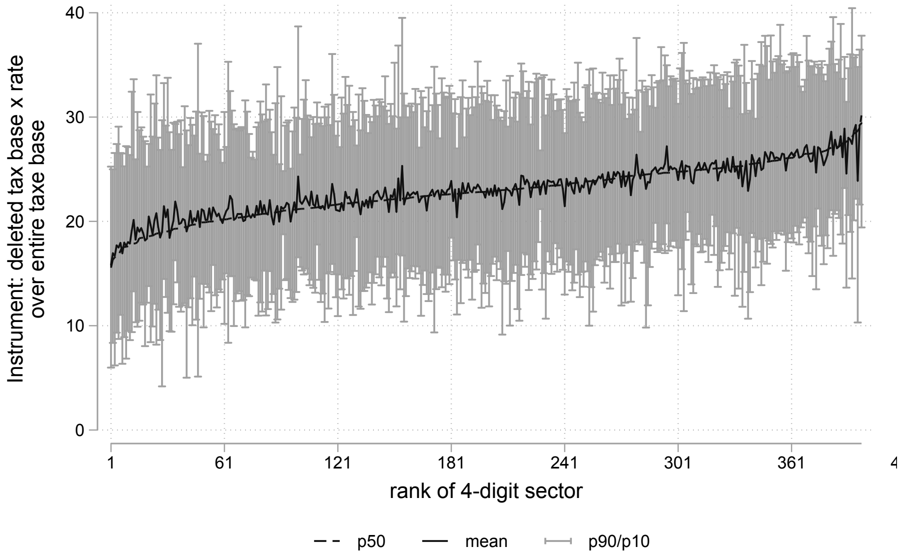
To get a sense of the distribution across sector of the gain of the reforms, we compute for each firm based on its 2008 characteristics the 2010 legislation. We then compute the gap between the actual 2008 tax burden and the simulated tax and divide it by the firm value added in 2008. This yields a measure of ex ante fiscal gains as a fraction of the value-added. The distribution of the average gain per broad industry (1-digit) is displayed in Figure 5.

Figure 5 – Descriptive statstics by group.



Focusing on the instrument described above, we show its distribution across and within 4 digit sector in Table 6. Interestingly, we see that while there is some variation across sectors, most industries display a high degree of within-industry dispersion in the exposure of firms to the reform.

Figure 6 – Distribution of the instrument across and within 4-digit industries.



4.4 First-Stage results

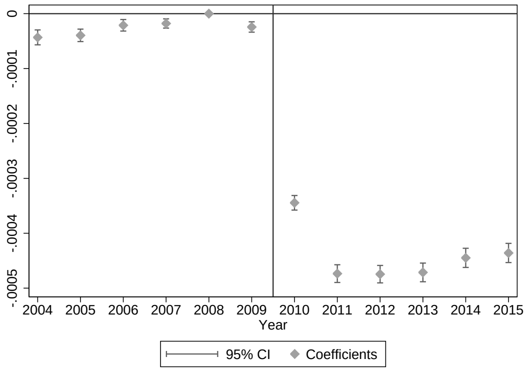
We now turn to a more continuous estimation of the effect of $\mathcal{E}(i)$ on the retention rate. Based on the results shown in Figure 4, it seems that there is no pre-trends in the value of $\mathcal{T}$ across different firms. To check that this is the case, and because $\mathcal{E}(i)$ is not varying in time, we run the following regression:

$$\log\left(1 + \frac{\mathcal{T}_{i,t}}{y_{i,t}}\right) = \sum_{l=2004}^{2015} \alpha_l \mathcal{E}_i + \psi_{s(i),t} + \psi_i + \varepsilon_{i,t}$$

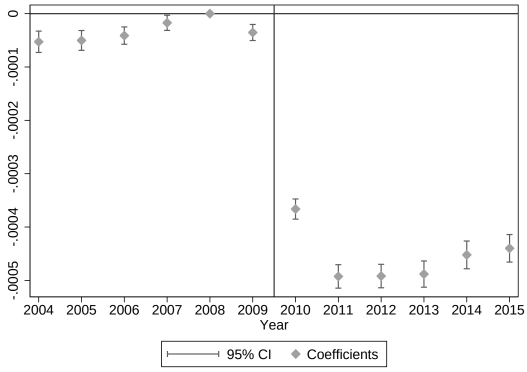
and $\alpha_{2008} \equiv 0$

In this setting, we control for firm-specific characteristics by including a fixed-effect ψ_i and by sector-specific trends by including a sector-year fixed effect. We are therefore essentially interested in the variation of within-firm variations in $\log\left(1 - \frac{\mathcal{T}_{i,t}}{y_{i,t}}\right)$ compared to the sector average.

Coefficients α are plotted along with a 5% confident interval, constructed using heteroskedastic standard errors, clustered at the firm level. Figure 7(a) show the coefficients when the sample



(a) All firms



(b) Single-establishment fims

Figure 7 – Coefficients α_k and 95% confidence interval of the first-stage equation.

include all firms, and Figure 7(b) restrict to mono-establishment firms.[7] One advantage of restricting to single-location firms is that it allows to control for local specific trends in addition to our set of fixed effect. In both case, we see that after 2010, the retention rate decreases with $\mathcal{E}(i)$ compared to pre-reform trends.

5 Firms response

5.1 Static model

Reduced-form.

Using our instrument $\mathcal{E}(i)$ presented in the previous section, we want to estimate the effect of the reform on various firm level outcome. We will consider sales, capital, total wage bill and employment. We start by estimating equation (19), but replacing $\Delta\mathcal{T}_{i,t}$ by $\mathcal{E}(i)$, our instrument:

$$y_{i,t} = \alpha\Delta\mathcal{E}_i \times \mathcal{R}_t + \psi_{s(i,t),t} + \varepsilon_{i,t} \tag{20}$$

Because this measure is not time varying, we cannot identify β and only report the value of β in Table 4.

Table 4 shows that sales and capital positively respond to a shock in local taxation that

[7]Recall that we have aggregated every establishment of a firm at the city level. So single-establishment firms is in fact a single-city firm.

Table 4 – Static DiD: reduced-form.

Outcomes	**(1)** 2-digit	**(2)** 4 digit	**(3)** 2 digit × size	**(4)** 4 digit × size
Sales	0.148***	0.141***	0.096***	0.091***
	(0.016)	(0.016)	(0.016)	(0.016)
Value Added	0.187***	0.183***	0.117***	0.116***
	(0.016)	(0.016)	(0.016)	(0.016)
Capital	0.123***	0.111***	0.101***	0.091***
	(0.021)	(0.021)	(0.022)	(0.022)
Wagebill	0.169***	0.165***	0.120***	0.113***
	(0.015)	(0.015)	(0.016)	(0.016)
Total hours	0.150***	0.146***	0.102***	0.100***
	(0.015)	(0.015)	(0.015)	(0.015)
Wage per hour	0.019***	0.019***	0.018***	0.019***
	(0.005)	(0.005)	(0.006)	(0.006)
Observations	1,260,544	1,260,544	1,260,390	1,260,390
Firm Fixed Effect	√	√	√	√
Sector × Year	2-digit	4 digit	2 digit × size	4 digit × size

Notes: Robust standard errors clustered at the firm level are reported under parenthesis. ***, ** and * indicate p-value below 0.01, 0.05 and 0.1 respectively.

reduces the tax burden. The fact that the stock of capital increases when its cost decreases is not surprising and could suggest that the TP generated distortions in the allocation of resources. The positive response of sales could suggests in turns a capital deepening effect that follows the increase in capital. Table 4 also shows a positive response on wage, while no response on the workforce. Although this absence of effect could be attributed to mismeasurement, it could also results from a substitution between labor and capital. This view is supported by the positive effect on the wage bill, which could indicate a skill upgrading in the firm's workforce resulting from the complementarity between high skill workers and capital.

TSLS results.

We now estimate the elasticity of several firm-level outcomes to reform-induced changes in the average tax burden. The TSLS system of equations is described below where the fist equation refers to the instrumented second stage and the second to the first stage. :

Table 5 – Static DiD: IV estimation

Outcomes	**(1)** 2-digit	**(2)** 4 digit	**(3)** 2 digit × size	**(4)** 4 digit × size
Sales	-0.057***	-0.053***	0.041***	-0.039***
	(0.006)	(0.006)	(0.007)	(0.007)
Value Added	-0.070***	-0.067***	-0.048***	-0.048***
	(0.006)	(0.006)	(0.007)	(0.007)
Capital	-0.045***	-0.040***	-0.041***	-0.037***
	(0.008)	(0.008)	(0.009)	(0.009)
Wagebill	-0.063***	-0.060***	-0.049***	-0.048***
	(0.006)	(0.006)	(0.007)	(0.007)
Total hours	-0.057***	-0.053***	-0.042***	-0.041***
	(0.006)	(0.006)	(0.006)	(0.006)
Wage per hour	-0.007***	-0.007***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)
First Stage: dependent variable: log(T)				
Z	-0.309***	-0.321***	-0.282***	-0.288***
	(0.005)	(0.004)	(0.005)	(0.005)
Observations	1,260,544	1,260,544	1,260,390	1,260,390
KP Wald F-stat.	5130	6043	4166	4720

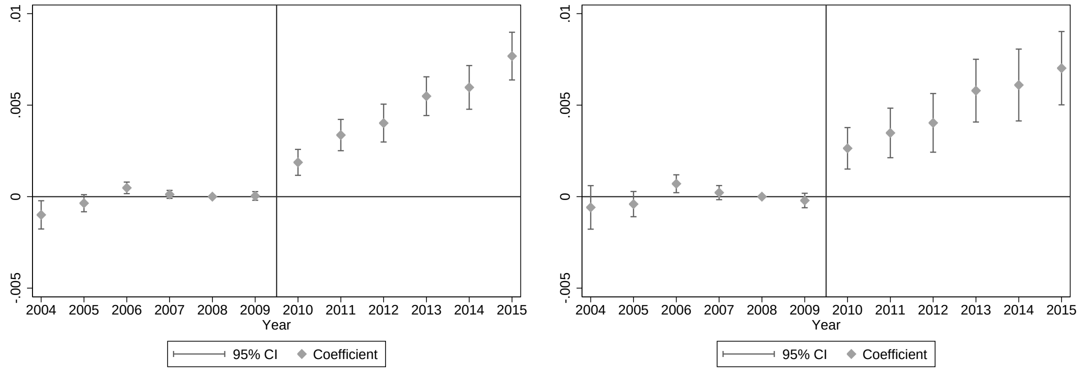
$$y_{i,t} = \alpha_2 \widehat{\Delta\mathcal{T}}_{i,t} + \psi_{2,s(i,t),t} + \psi_{2,i} + \varepsilon_{2,i,t} \tag{21}$$

$$\Delta\mathcal{T}_{i,t} = \alpha_1 Z_i \times \mathcal{R}_t \psi_{1,s(i,t),t} + \psi_{1,i} + \varepsilon_{1,i,t} \tag{22}$$

Results are displayed in Table 5.

Given an average ratio of T/VA = 2.5% and worker compensation over VA = 0.7, the results in Column 4 implies that an exogenous decline of €1 in tax burden causes +€2.8 increase in net-of-tax value-added in the long-run (5 years horizon). Out of these €2.8, €1 is driven by the mechanical effect of lowering the tax burden and €1.8 by business expansion.

Out these additional €2.8, +€1.76 is spent on wagebill and +€1.60 goes to increasing hours and +€0.16 goes to increasing hourly wages. Based on simple computations presented in appendix, this suggests a positive but small incidence on labor where by the labor share of



(a) All firms

(b) Single-establishment fims

Figure 8 – Coefficients α_k and 95% confidence interval of the dynamics response of the logarithm of sales.

the incidence share is about 5% (see Appendix A).

5.2 Dynamic framework

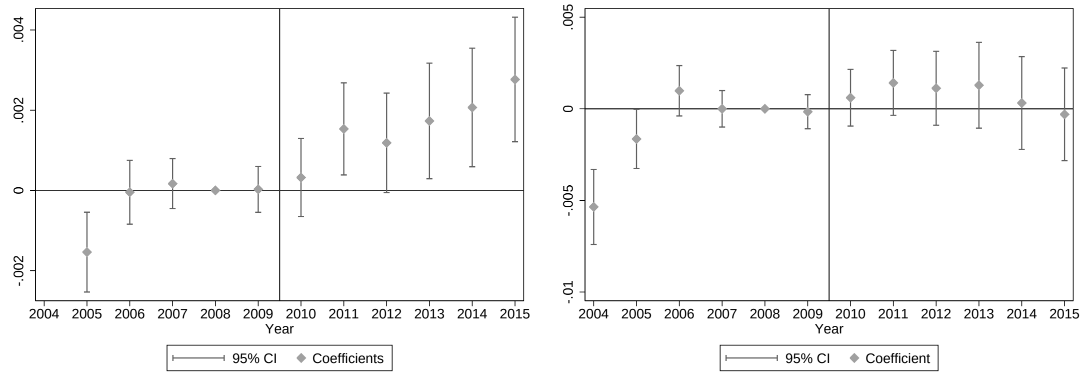
We now test the results presented in Table 4 in a more dynamic framework as we did in the first-stage results. We estimate equation (23) below, using different outcome variables y.

$$y_{i,t} = \sum_{l=2004}^{2015} \alpha_l \mathcal{E}_i + \psi_{s(i),t} + \psi_i + \varepsilon_{i,t} \text{ and } \alpha_{2009} \equiv 0 \tag{23}$$

We first look at the dynamics response of sales, by considering $y_{i,t} = log(S_{i,t})$. Results are shown in Figures 8(a) and 8(b), respectively for all firms and single-establishment firms.

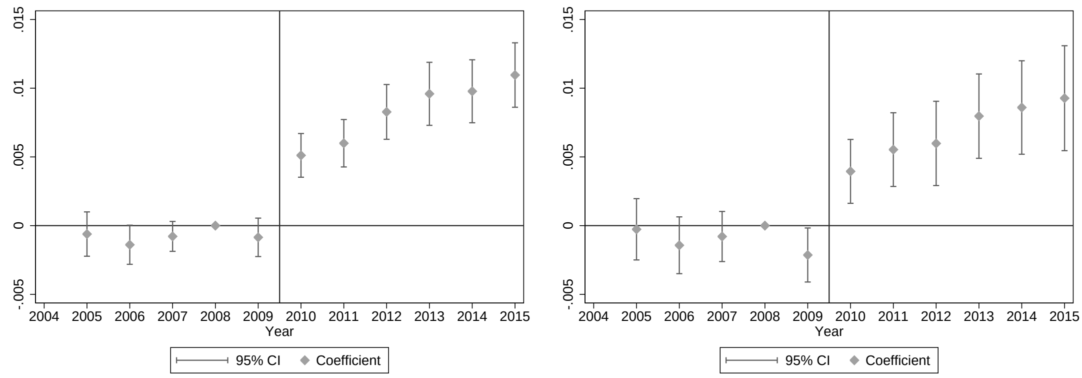
First of all, the pre-reform response of sales shows no specific trends, once firm and sector-year fixed effects are included. The point estimates are quite non-discernible to 0, although they could be significantly different from 0 given their low magnitude. This confirms the validity of the estimation strategy: although substantially differently treated by the reform – see first stage estimates above – different firms did not response to a future shock in their level of taxation.

Then the point estimates increase significantly away from 0 post reform, highlighting the impact of the reform on the sales of French firms. The increase of the sales continue to increase several years after the reform, and its magnitude suggests a 0.5% increase in sales for a 1% shock. This demonstrates that French local taxation of tangible assets had a negative impact on



(a) All firms (b) Single-establishment fims

Figure 9 – Coefficients α_k and 95% confidence interval of the dynamics response of the logarithm of total wage bill



(a) All firms (b) Single-establishment fims

Figure 10 – Coefficients α_k and 95% confidence interval of the dynamics response of the logarithm of total capital over value added.

firms capital stock.

Turning now to other outcome variables, we report the dynamics response of the logarithm of the total wage bill in Figures 9(a) and 9(b), here again for all firms and then only single-establishment firms. We also report the response of the ratio of capital over value added in Figures 10(a) and 10(b).

6 Conclusion

In this paper, we exploit administrative data newly made available to researchers to assess the impact of a large French reform of business capital taxation. The reform generated substantial heterogeneity across firms depending on the pre-reform level of the local tax rates. We exploit this heterogeneity in a dynamic difference-in-differences setting to estimate the impact of a reduction in tax on capital immobilisation on a set of firm-level outcome.

Our results suggest an increase in investment in response to the decrease in the tax burden of capital taxation, suggesting that investment, even in troubled economic times, is sensitive to its user cost. Profitability and sales are also positively affected. We confirm these results using a difference-in-discontinuities design. We will explore whether the tax reform had a a differential impact depending on initial leverage and on the state of the local economy. We finally will assess the overall incidence of the tax.

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A Incidence

- Workers have QL preference with indirect utility $V(w)$.
- Firms have the same profit function as before:

$$\Pi = pY - wL - rK(1+\tau_K) - Y\tau_Y$$

- Overall changes in welfare following a marginal change in the instrument dZ:

  $dW = LdV + d\Pi$

- Envelop theorem implies:

$$dV = L\frac{dw}{dZ}dZ \text{ and } d\Pi = -\frac{dw}{dZ}dZL - rK\frac{d\tau_K}{dZ}dZ$$

  We assume that $\frac{d\tau_Y}{dZ} = 0$.

  Overall change in welfare writes as: $dW = -rK\frac{d\tau_K}{dZ}dZ$

- Labor share:

$$\begin{aligned} I_L \equiv \frac{dV}{dV+d\Pi} &= \frac{dw/w}{dZ} \times \frac{wL}{rK} / \left(\frac{d\tau_K}{dZ}\right) \\ &= \widehat{\beta}^w_{RF}\frac{\alpha_L}{1-\alpha_L} / \left(\frac{d\tau_K}{dZ}\right) = 4.43\% / \left(\frac{d\tau_K}{dZ}\right) = 4.43\% \end{aligned}$$

  Assuming our instrument maps one-to-one with changes in marginal rate and calibrating the labor share $\alpha_L = 0.7$ and choosing $\widehat{\beta}^w_{RF} = 1.9\%$.

B Data appendix

In this appendix, we detail the construction of some of the variables used in the study.

Most of the information at the firm-level is taken from the official form is CERFA 2050-9. This form is the French equivalent to the IRS Form 1120 (Corporate Income Tax Return).

- Sales:

- Value added:
- Total wage bill:
- Capital:

We use the files from the “Taxe professionelle” declaration. These files allows us to measure the value of the tax base at the plant level as well as its repartition between property and non-property tangible assets. We aggregate that data at the firm-city level in order to construct our instrument.

C Empirical results

Table 6 – Regression results in the static framework for different models and dependent variables.

Dep. Var	**(1)** Sales	**(2)** Wage	**(3)** K	**(4)** Emp.
Model 1				
Coefficient	0.004***	0.002*	0.005***	0.000
Std. Err.	(0.000)	(0.001)	(0.001)	(0.000)
Avg dep var	13.5	11.4	1.7	1.9
Model 2				
Coefficient	0.005***	0.002*	0.005***	0.000
Std. Err.	(0.001)	(0.001)	(0.001)	(0.000)
Avg dep var	13.5	11.4	1.7	1.9
Model 3				
Coefficient	0.004***	0.002***	0.006 ***	0.001***
Std. Err.	(0.000)	(0.001)	(0.001)	(0.000)
Avg dep var	13.8	11.7	1.7	2.2

Notes: OLS estimation of coefficient α in equation (20) and associated standard errors in parentheses. Each coefficient corresponds to a different regression. Model 1 considers all single-establishment firms, model 2 considers the same sample but add a départment-year fixed effect and model 3 uses all firms. The dependent variable varies by column. Column 1 uses the logarithm of sales, column 2 uses the logarithm of total wage bill, column 3 uses the ratio of capital over value added and column 4 uses the logarithm of full-time equivalent employment. Standard errors are clustered at the firm level. ***, ** and * indicate significance at the 1, 5 and 10% level.