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Local Taxation and Tax Base Mobility: Evidence from a business tax reform in France

Tidiane Ly, Sonia Paty

Abstract:

This paper investigates the impact of tax base mobility on local taxation. We first develop a theoretical model in order to examine the connection between local business property taxation and tax base mobility within a metropolitan area. We find that decreasing capital intensity in the tax base increases the business property tax rates unambiguously. We then test this result using a French reform, which changes the composition of the main local business tax base in 2010. Estimations using Difference-in-Differences show that the reduction in the mobility of the tax base indeed results in higher business property tax rates. Housing tax rates were not affected by the reform.

Keywords:
Local taxation, Tax base mobility, Tax competition, Difference-in-Differences

JEL codes:
H71, H72, R50, R51

Working Paper

Local Taxation and Tax Base Mobility:

Evidence from the French business tax reform

Tidiane Ly* Sonia Paty†

December, 2018

Abstract

This paper investigates the impact of tax base mobility on local taxation. First, we develop a theoretical model in order to examine the connection between local business property taxation and tax base mobility within a metropolitan area. We find that, in the presence of a budget compensation, decreasing capital intensity in business property tax base, composed of capital and land, increases the business property tax rates and decreases the tax rates on residents. We test this result using a French reform which changed the composition of the main local business tax base in 2010. Difference-in-difference estimations show that in 2010, the reduction in tax base mobility indeed resulted in a 14% rise in business property tax rates and a reduction in housing tax rates of 1.3%, compared to pre-reform average levels.

Keywords: Local taxation;Tax base mobility;Tax competition;Difference-in-differences
JEL: H71; H72; R50; R51

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1. Introduction

On February 9, 2009, the French President declared: "the *Taxe professionnelle* will be removed in 2010 because I want France to retain its businesses". Less than a year later, 80% of the tax base of the French local business property tax, the so-called '*Taxe professionnelle*', had been removed. Prior to the reform, business property tax relied both on capital investments (equipment and machinery) and real property (building and land) used by firms. The reform removed the capital part from the tax base. Similar reforms resulting in capital being limited in or removed from the local combined property tax base have been implemented in some states in the United States of America (Ohio in 2005 and Michigan in 2014).[1] This quasi-natural experiment represents a unique opportunity to investigate how a change in the degree of mobility of their tax base affects the tax rates set by municipalities. The objective of the paper is to exploit the 2010 French local tax reform, to study the impact of the degree of mobility of the local business tax base on local tax rates, and, specifically on the business property tax and the housing tax rates. To our knowledge, this paper proposes the first empirical investigation of the effect of capital tax base mobility on local tax rates.

The link between local taxes and tax base mobility was mooted initially in tax competition literature in the form of the efficiency problem caused by business capital mobility across local jurisdictions on the provision of local public goods. The basic problem is summarized in Oates (1972) as: "The result of tax competition may well be a tendency toward less than efficient levels of output of local public services." Oates points to the cause of this inefficiency as being "an attempt to keep tax rates low to attract business investment [by] local officials." Thus, capital mobility pushes each single competing local government to charge inefficiently low capital taxes, since it fears that capital leaves its jurisdiction for a more attractive one. This non-cooperative behavior leads to a "prisoner's dilemma" problem (Boadway and Wildasin, 1984) where all capital tax rates are too low and local public goods are under-provided. This major result has been confirmed by many subsequent contributions. Zodrow and Mieszkowski (1986) and Wilson (1986) provide the basic framework showing that capital mobility drives local jurisdictions to charge inefficiently low capital tax and supply inefficiently low levels of local public goods. Wildasin (1989) demonstrates that this tax competition problem is due to a positive fiscal externality on other jurisdictions which is ignored by a single jurisdiction when choosing its tax level: it ignores that by setting higher capital tax, other jurisdictions benefit from more capital. A number of studies based on the

[1] See Stafford and DeBoer (2014) for a detailed discussion of these reforms in the US.

aforementioned papers develop other features of tax competition for mobile capital.[2]

To study the relationship between taxes and capital mobility at the local level, two concerns emerge from the early contributions cited above. First, since most of these studies focus on the efficient provision of public goods rather than the actual tax level, equilibrium tax rules are usually not determined and the relationship between tax rate levels and capital mobility is not explicit.[3] Second, the framework developed in these early contributions which consider households to be immobile, is better suited to the study of large jurisdictions (such as states or countries) than to municipalities. It is indeed difficult to argue household immobility at the local level.[4] It raises issues also for the study of local tax settings. Indeed, in a basic tax competition model, allowing jurisdictions to choose the level not only of a capital tax but also of a residential tax leads to the following inevitable outcome: all jurisdictions will not tax capital and will impose the entire tax burden on households.[5] Therefore, it is difficult to explain capital taxation if we want to consider both capital and housing taxation in the same setting.

Another strand of the tax competition literature which started with Wilson (1995), Richter and Wellisch (1996) and Brueckner (2000) considers both residents' and capital (or more generally firm) mobility. In the framework developed by Wilson (1995), for instance, the equilibrium tax rates on capital and on residents are both positive.[6] It also appears that household mobility forces local governments to internalize their residents' preferences so that public goods are always provided efficiently (if residential taxes are available), which confirms the well-known result in Tiebout (1956). Since public good provision is often peripheral in these studies, tax rate levels assume an important role. Taxation rules generally are characterized for multiple institutional setting hypotheses, and both capital and residents responses to policy changes are explicit in these rules (see e.g. Wellisch and Hulshorst, 2000). However, in these models household mobility is still not in line with with municipal characteristics, since residents are assumed to

[2] See e.g. Wilson (1999), Wilson and Wildasin (2004) and Wellisch (2006) for comprehensive reviews of this literature.

[3] Zodrow and Mieszkowski (1986) expresses the marginal rate of substitution of the local public good as an inverse function of capital elasticity with respect to the capital tax rate. Several empirical studies use functional forms to derive the reduced form of the capital tax rate. However the resulting tax rate equation does not show a clear link between the tax rate and the capital tax base.

[4] Most OECD countries experience a substantial population mobility across regions and cities. (OCDE, 2013) shows that 18 million people change residence annually, in 28 observed OECD countries. This correspond to 2% of the total population.

[5] There is a resident tax in Zodrow and Mieszkowski (1986), but it is set exogenously.

[6] The tax on residents is used to internalize the congestion costs generated by residents but is not sufficient to satisfy the budget constraint so the capital tax also is used.

be mobile across jurisdictions but necessarily work in their jurisdiction of residence. This feature is more appropriate to large jurisdictions such as regions or states as noted in Braid (1996) which developed a sub-metropolitan tax competition model in which capital and workers are mobile, but residents are immobile. Ly (2018) combines the features of the above frameworks into a sub-metropolitan tax competition model in which capital, residents and workers are all mobile.[7]

To test the impact of tax base mobility on tax rates in metropolitan areas, we first develop a theoretical model which builds on the model in Ly (2018) which was designed to analyze tax competition among sub-metropolitan governments. Local jurisdictions understood as municipalities, compete for mobile capital and for mobile residents using a single business property tax on both capital and business land and a tax on residents to finance a local public good.[8] Ly (2018) shows that the equilibrium business property tax rate depends negatively on the share of capital in the business property tax base and that the rate of the tax on residents does not depends directly on this capital share. In this paper, we further investigate these relations. Specifically, we analyze the impact of removing capital from the business property tax base which therefore becomes a tax on business land only. We show that this institutional change affects the local tax rates via two different effects. First, the budgetary effect entails that shrinking the business property tax base spurs municipalities to increase their tax rates on residents and firms. Second, the capital-mobility effect implies that since the new business property tax base (business land) becomes less mobile, municipalities can charge a higher business tax rate and reduce their tax on residents.

The budgetary effect and the capital-mobility effect on tax rates of a removal of capital from the business property tax base can *a priori* not be disentangled. However, we show also that if the central government guarantees municipalities a compensation to cover the revenue losses resulting from removal of the capital tax base, the budgetary effect is controlled for. Compensation for lost revenue allows us to identify the capital-mobility effect which is our focus in this paper.[9]

To test the existence of the capital-mobility effect on the local tax rates, we exploit

[7] Note that the urban tax competition model developed in Gaigné et al. (2016) also combines resident, firm and worker mobility.

[8] For simplicity, we do not model labor mobility explicitly, contrary to Ly (2018). However, our sub-metropolitan tax competition framework would allow to introduce costless commuting across municipalities without affecting any of our results.

[9] Formally, we derive reduced forms for the resident and business property tax rate changes as a function of the eliminated capital share in the business property tax base. This capital share can be regarded as a proxy for the degree of capital mobility of the business property tax base in the context of the French local tax reform of 2010.

a 2010 French reform, which changed the composition of the main local business tax base. The reform removed capital investment from the local business property tax base (the so-called '*Taxe professionnelle*'), which represented around 80% of this tax base. More precisely, while the French local municipality business property tax base consisted of capital investments (machinery and equipment) and firms' real property (buildings) used by firms, municipalities ended up with a business real property tax only. This change to the composition of the tax base caused a dramatic change to the degree of mobility of the business property tax base ; it turned from taxation relying mostly on capital into taxation relying exclusively on business real property. At the same time, a state grant was allocated to each municipality equal to the amount of their pre-reform capital tax revenues.[10]

By analyzing the impact of this reform, we address the following question: how and to what extent the local business tax rate is affected by a change in the tax base composition? To address this, we build a dataset of local taxation and socio-demographic, political and economic characteristics for more than 11,800 French municipalities from 2006 to 2012.We use the share of capital in the business property tax base in 2009 (the last pre-reform year) to proxy tax base mobility. Using a difference-in-difference (DD) approach, we consider this continuous variable — the share of capital in the tax base — as our treatment variable. This capital intensity is a proxy for the pre-reform business property tax base mobility.

Our DD estimates show that a drastic cut in the mobile part of the tax base (capital) relative to the far less mobile part of the tax base (buildings) led French municipalities to increase their business property tax rates and decrease their housing tax rates. Since a perfect state compensation was allocated to French municipalities, in line with our theoretical results, our empirical investigation suggests that the increase in the business tax rate was motivated by a less mobile tax base and not by a budgetary effect. Our analysis also suggests that this increase in the business property taxation due to the decline in the tax base mobility allowed French municipalities to alleviate the tax burden on households by cutting their housing tax.

This paper contributes to the empirical tax competition literature which tends to focus on the estimation of tax reaction functions, where a municipality tax rate depends on the tax rates in nearby municipalities (Brueckner and Saavedra, 2001; Brueckner and Kim, 2003; Revelli, 2005; Allers and Elhorst, 2005; Charlot and Paty, 2007; Hauptmeier et al., 2012; Lyytikäinen, 2012). However, with the exception of Carlsen et al. (2005),[11]

[10] This compensation, which was assured for all the years following the reform, was constant over time.

[11] The mobility of the tax base is based on the geographic profit variability of industrial sectors in

the empirical literature on the extent that the mobility of local tax base leads to a downward pressure on local tax rates is very limited.[12] Using a quasi-natural experiment, the present paper provides some initial empirical evidence of a negative relationship between local business taxation and the degree of tax base mobility, which corroborates one of the main theoretical statements of the original tax competition literature.

The remainder of the paper is organized as follows. Section 2 presents the theoretical framework underlying our empirical analysis. Section 3 describes the institutional structure of French municipalities and the 2010 tax reform. Section 4 discusses the identification strategy. Section 5 describes the data. Section 6 reports the regression results. Section 7 concludes.

2. Theoretical background

2.1. Framework

We now develop a theoretical model to examine the connection between local business taxation and tax base mobility.[13] The economy consists of a metropolitan area composed of n small identical municipalities indexed by $i = 1, \ldots, n$.[14] The metropolitan area is endowed with fixed capital and land endowments, respectively denoted $\mathcal{K}$ and $\mathcal{L}$,[15] and inhabited by an exogenous number of $\mathcal{P}$ residents. The representative

Norway.

[12] Notice a strand of the empirical literature on international taxation (e.g. Quinn, 1997; Bretschger and Hettich, 2002; Slemrod, 2004) addresses a related question: how openness, integration, globalization affects tax policy? Three main differences with our study can be noticed. First, these crooscountry studies better apply to a theoretical framework with immobile households as in Zodrow and Mieszkowski (1986) (background in e.g. Bretschger and Hettich, 2002). Second, based on the assumption that openness and capital mobility are positively correlated, they often consider aggregated measure of trade as interest variables (no specific care on capital). Third, when focusing on the capital market, they compare the different statutory restrictions imposed by countries on capital flows (which is rarely possible for municipalities).

[13] The model is in line with tax competition models with both households and firms mobility (e.g. Wilson, 1995; Richter and Wellisch, 1996; Brueckner, 2000). In order to better fit with features of the municipal level the present framework relies more on Ly (2018). Indeed, the present framework allows households to consume land and can be extended to allow household to commute to work, so that they can reside and work in separate municipalities. Introducing costless commuting would not alter any of the results derive hereafter.

[14] Relaxing the assumption of identical municipalities would not affect the results derived hereafter, but it simplifies the exposition. See our working paper for a version without symmetrical municipalities.

[15] Since housing/building supply is assumed to be inelastic, land can be regarded as a set of premises which can be used by households as housing or firms as business premises.

municipality i is inhabited by R_i perfectly mobile residents. Each resident derives utility from private consumption x_i, a congestible local public good G_i and one unit of land (housing) paying the land rent ρ_i. A resident is characterized by the utility function $U(x_i, G_i, R_i) = x_i + \alpha \log(G_i/R_i)$, where utility is decreasing in the municipality's population R_i due to congestion. Each resident of the economy possesses the same exogenous capital endowment $\mathcal{K}/\mathcal{P}$ which she invests in the municipality offering the highest return. Since capital is perfectly mobile across municipalities, in equilibrium the same return to capital r prevails across municipalities. From the perspective of a small municipality, r is exogenous. For simplicity, we assume that labor considerations are absent from the present framework.[16]The exogenous land endowment ℓ_i of municipality i is equally distributed among all households of the metropolitan area, so that the individual land income is $\sum_{i=1}^{n} \rho_i \ell_i / \mathcal{P}$. The local government i collects a head tax τ_i^R on its residents. Since the individual land consumption is inelastic, τ_i^R can be interpreted as a housing tax. The budget constraint of a representative resident of municipality i can be written as

$$x_i + \rho_i = \frac{r\mathcal{K} + \sum_{i=1}^{n} \rho_i \ell_i}{\mathcal{P}} - \tau_i^R. \tag{2.1}$$

Household perfect mobility implies that utility is equal in all municipalities in equilibrium:

$$\alpha \log\left(\frac{G_i}{R_i}\right) - \rho_i - \tau_i^R = \alpha \log\left(\frac{G_j}{R_j}\right) - \rho_j - \tau_j^R \equiv u, \qquad \forall j \neq i, \tag{2.2}$$

where (2.1) has been used to substitute x_i into the utility function. Due to atomicity, municipality i cannot affect variables in other jurisdictions so that u is exogenous.[17]

The production technology in municipality i is described by the well-behaved homogeneous (of degree 1) production function $F^i(K_i, L_i)$, and firms choose capital K_i and land L_i so as to maximize profits $F^i(K_i, L_i) - [r + (1-\theta)\tau_i^P]K_i - (\rho_i + \tau_i^P)L_i$, where τ_i^P is the business property tax rate, and θ is the share of the capital tax base which is exempted from tax. The exemption rate θ, which is exogenously fixed by the central government and applies identically to all municipalities, can only take two values: 0 (no exemption) and 1 (full exemption). Factor prices and taxes are taken as given by firms so that profit maximization implies:

[16] All the results derived in this section would be strictly identical if labor perfect mobility were introduced. See Ly (2018) for a framework with this additional feature.

[17] Notice that due to the quasi-linearity of the utility function, u is the metropolitan utility level net of land and capital individual income. Then, household mobility does not imply that the gross utility level is fixed from the perspective of jurisdiction i. By affecting ρ_i it can indeed affect the return to local landowners. See Ly (2018) for further details.

$$\frac{\partial F^i}{\partial K_i}(K_i, L_i) = r + \tau_i^P(1-\theta), \qquad (2.3a) \qquad\qquad \frac{\partial F^i}{\partial L_i}(K_i, L_i) = \rho_i + \tau_i^P, \qquad (2.3b)$$

The land market clearing condition entails:

$$\ell_i = R_i + L_i. \tag{2.4}$$

The cost function of the provision of local public goods is $C(G_i) = G_i + f_i$, where the fixed costs f_i comprise, for instance, running and maintenance costs, and interests of past debt. The benevolent local authorities must satisfy the following budget constraint:

$$\tau_i^R R_i + \tau_i^P[(1-\theta)K_i + L_i] + \theta\Lambda_i = G_i + f_i. \tag{2.5}$$

where Λ_i is an exogenous grant provided by the central government if it removes the ability to tax capital — ie. $\theta = 1$.

2.2. Local taxation choices

We now examine the taxation choices of the representative government i — index i is dropped hereafter to alleviate notations. We are especially interested in the effects of a reform consisting in the removal of capital from the business property tax base on local taxation choices. Formally, this requires to describe the optimal local taxation decisions in two configurations: $\theta = 0$ (pre-reform) and $\theta = 1$ (post-reform).

The benevolent local government maximizes the utility of its own residents, choosing the level of τ^P, τ^R and G while satisfying the local budget constraint (2.5) and accounting for private behavior characterized by (2.1)-(2.4). Specifically, the local government does not directly controls capital and household location but accounts for these location decisions when designing its policy. As shown in Appendix A, the optimal behavior

rules of the local authorities are:[18]

$$\tau^{R0} = \alpha + \left(1 + \frac{K^0}{L^0}\right)\tau^{P0}, \quad (\text{TR}^0) \qquad \tau^{P0} = \frac{R^0}{K^0 + L^0}\left(\alpha - \tau^{R0} + \frac{f}{R^0}\right) \quad (\text{BC}^0)$$

$$\tau^{R1} = \alpha + \tau^{P1}, \quad (\text{TR}^1) \qquad \tau^{P1} = \frac{R^1}{L^1}\left(\alpha - \tau^{R1} + \frac{f - \Lambda}{R^1}\right), \quad (\text{BC}^1)$$

where the superscripts 0 and 1 respectively stand for the equilibrium value of the variables when $\theta = 0$ and $\theta = 1$. Symmetry implies that, in equilibrium, $R^0 = R^1 = \mathcal{P}/n$, $L^0 = L^1 = \ell - \mathcal{P}/n$ and $K^0 = K^1 = \mathcal{K}/n$.

Let us first consider the pre-reform case where $\theta = 0$. The optimal taxation rule (TR^0) shows that local authorities choose the level of the tax on residents so as to internalize the mobility costs of households and capital. To see this, suppose that a new resident enters the municipality. She brings τ^R tax revenues — left-hand side of (TR^0) — but she also entails three marginal costs for the municipality — right-hand side of (TR^0): a congestion cost, $R|\partial U/\partial R| = \alpha$, since she decreases the utility of all other residents; a fiscal cost τ^P due to the crowd-out of one unit of business land; and an additional fiscal cost $\tau^P \times |\partial K/\partial R| = \tau^P \times K/L$ due to capital mobility.

This last marginal fiscal cost is central to our analysis. It stems from the fact that the new resident, by crowding-out one unit of business land, also generates an outflow of K/L units of capital from the municipality. If the municipal capital stock were fixed — that is, if capital were immobile — there would be no capital outflow and this last marginal fiscal cost would be zero.[19] Moreover, it appears that if the municipality is more capital-intensive (higher K/L), capital mobility has a stronger impact on its taxation choices since it would suffer from larger capital outflows when loosing its firms. Condition (BC^0) simply states that τ^P allows to satisfy the budget constraint (2.5). In sum, our theoretical model shows that a municipality's capital intensity can be regarded as a "proxy" for capital mobility in the taxation decision. This proxy will be used in

[18] Only the taxation rules are exposed here. However, the public good provision rules — which are peripheral to the present analysis — are also derived in Appendix A (see condition (A.14)). In both cases ($\theta = 0$ and $\theta = 1$), the local public good is provided according to the Samuelson rule: the sum of the marginal willingness to pay for the public good of all residents, $R(\partial U/\partial G) = \alpha R/G$, equals its marginal cost $C'(G) = 1$. This means that the public good is provided efficiently which is typical to models with small municipalities linked by perfectly mobile residents paying a local head tax (Wellisch and Hulshorst, 2000).

[19] In this case, (TR^0) boils down to (TR^1).

our empirical strategy described in section 4.

Let us now turn to the post-reform case where $\theta = 1$. Similarly to (BC^0), (BC^1) states that τ^P allows to satisfy the budget constraint. The main change with respect to the pre-reform situation, appears in (TR^1). Compared to (TR^0), observe that the marginal fiscal cost due to capital mobility disappears. Since capital is not taxed anymore, a new resident becomes less costly relative to new firms. This spurs local authorities to set a lower (resp. higher) resident tax (reps. business property tax) relative to the business property tax (resp. resident tax). Solving $\{(\text{TR}^0); (\text{BC}^0)\}$ for $\{\tau^{R0}; \tau^{K0}\}$, and $\{(\text{TR}^1); (\text{BC}^1)\}$ for $\{\tau^{R1}; \tau^{K1}\}$ allows to derive the reduced form of the tax on residents and the business property tax before and after the institutional change:

$$\tau^{R0} = \alpha + \frac{f}{\ell}, \tag{2.7a}$$

$$\tau^{R1} = \alpha + \frac{f - \Lambda}{\ell}, \tag{2.7b}$$

$$\tau^{P0} = (1 - \kappa^0)\frac{f}{\ell}, \tag{2.8a}$$

$$\tau^{P1} = \frac{f - \Lambda}{\ell}. \tag{2.8b}$$

where $\kappa^0 \equiv K^0/(K^0 + L^0)$ denotes the pre-reform capital intensity in the business property tax base.

2.3. Capital removal without compensation

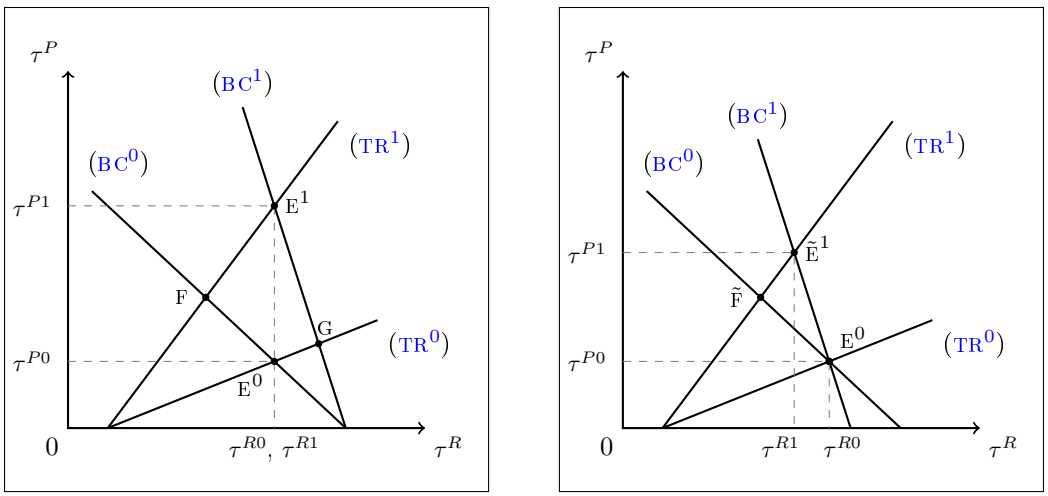
The reduced forms (2.7) and (2.8) allow to highlight the key role of the pre-reform capital intensity κ^0 on the evolution of the tax rates accompanying the reform. To understand it, suppose for the moment that the central government removes capital from the business property tax base without compensating municipalities in return so that $\Lambda = 0$. Then, we have:

$$\frac{\partial(\tau^{R1} - \tau^{R0})}{\partial \kappa^0} = 0 \tag{2.9a}$$

$$\frac{\partial(\tau^{P1} - \tau^{P0})}{\partial \kappa^0} = \frac{f}{\ell} \quad > 0. \tag{2.9b}$$

While (2.9a) shows that capital intensity does not affect the evolution of the tax on residents following the reform, according to (2.9b), capital intensity plays a key role in the evolution of the business property tax. More precisely, as shown by (2.8a), capital intensity exerts a downward pressure on the pre-reform tax rate, so that, the presence of capital-intensive firms spurs the municipality to increase its business property tax following the reform. The higher the pre-reform capital intensity, the higher

the spike in the business property tax rate. Two rationales underly this result. First (*capital-mobility effect*), if local firms are more capital-intensive, mobile capital exerts a stronger downward pressure on the pre-reform business property tax rate due to a higher marginal fiscal cost caused by capital mobility. Second (*budgetary effect*), the tax revenue loss due to the removal of the capital tax base is more onerous in a municipality hosting more capital. Then, local authorities are also spurred to increase their business property tax rate to compensate this loss.



(a) Without revenue compensation **(b)** With revenue compensation

Figure 1. Effect of a removal of the capital tax base K on τ^R and τ^P. The graphs represents the equations (TR^0), (TR^1), (BC^0) and (BC^1) and the resulting equilibria both in the absence of compensation ($\Lambda = 0$) on panel (a) and in the presence of compensation ($\Lambda = \tau^{P0}K^0$) on panel (b). The graphs corresponds to the following parameter values: $n = 10$, $\mathcal{P} = 35$, $\mathcal{L} = 50$, $\mathcal{K} = 35$, $\alpha = .05$ and $f = 1.05$.

Further understanding of this key result may be gained from a graphical representation of equations (TR^0), (TR^1), (BC^0) and (BC^1), as depicted on Figure 1a. The taxation-rule curve (TR^0) represents the pre-reform positive relation connecting τ^R to τ^P: an increase in τ^P implies a rise in the marginal fiscal cost of new residents which is covered by a rise of τ^R. The budget-constraint curve (BC^0) represents the pre-reform negative budgetary relation linking τ^P to τ^R: increasing τ^R allows local authorities to alleviate the tax burden on firms by cutting τ^P. Thus, point E^0 which intersects (TR^0) and (BC^0), represents the pre-reform equilibrium in tax rates.

The reform consisting in a removal of capital from the business property tax base, induces two different effects. The first effect is a budgetary effect resulting in an increase of both tax rates to compensate the loss in tax revenues entailed by the tax base cut.

This effect is illustrated by the rightward move of the budget-constraint curve from (BC^0) to (BC^1) which shifts the equilibrium from E^0 to G.[20] The second effect due to capital mobility is characterized by a decrease in τ^R and an increase in τ^P. It is illustrated by the upward move of the taxation-rule curve from (TR^0) to (TR^1) and a shift of the equilibrium from E^0 to F. Indeed, after the reform the local government does not incur the marginal fiscal cost due to capital mobility anymore. Thus, the marginal cost of hosting residents instead of firms becomes lower after the reform. Therefore, local authorities transfer part of the burden of financing public services on firms.

The new equilibrium E^1 results from the combination of the two preceding effects. Since both the budgetary effect and the capital-mobility effect imply a rise in the business property tax, this tax increases non-ambiguously: $\tau^{P0} < \tau^{P1}$. Figure 1a also illustrates the result of equation (2.9b): a higher capital-intensity makes (TR^0) less steep which widens the gap $\tau^{P1} - \tau^{P0}$. However, the tax on residents is pushed up by the budgetary effect but pulled down by the capital-mobility effect. As visible on Figure 1a, the present stylized framework predicts that both effects exactly compensate so that $\tau^{R0} = \tau^{R1}$ and the gap $\tau^{R1} - \tau^{R0} = 0$ obviously does not depend on κ^0 — which confirms (2.9a). In practice, such a perfect balancing of the budgetary and capital-mobility effects is rather unlikely,[21] but, this result makes clear that in the absence of compensation (ie. $\Lambda = 0$), the reform would have an ambiguous impact on τ^R — since capital-mobility effect and budgetary effect are in opposite directions. We can

[20] An increase in the fixed costs f would also imply a rightward shift of (BC^0).

[21] In the present framework, perfect compensation of the two effects is due to the homogeneity of the production technology. It implies that when decreasing slightly τ^R, the amount of capital by units of crowded-out business land $(\partial K/\partial \tau^R)/(\partial L/\partial \tau^R)$ is equal to K/L. That is, the capital-intensity of firms remains constant.

summarize the main findings of this subsection in the following result.[22]

Result 1. *Absent any compensation from the central government, suppose that capital is removed from the local business property tax base. Then, the capital-mobility effect and the budgetary effect combine so that:*

(i) the business property tax increases, ie. $\tau^{P1} > \tau^{P0}$*, and the tax on residents remain unchanged, ie.* $\tau^{R1} = \tau^{R0}$*,*

(ii) the business property tax increase is all the more significant that the pre-reform capital intensity κ^0 *is higher.*

2.4. Capital removal with compensation

The above result shows that the change in local tax rates accompanying the reform combines both a capital-mobility effect and a budgetary effect. This can make the identification of the first effect uneasy. To disentangle between the two, we now suppose that the central government removes capital from the business property tax base but compensates municipalities in return so that the post-reform compensation is $\Lambda = \tau^{P0}K^0$.[23] Then, the budgetary loss induced by the removal of the capital tax base is offset by the central government grant. As shown in Appendix A, (2.7) and (2.8) now imply:

$$\tau^{R1} - \tau^{R0} = -(1-\sigma)\frac{f}{\ell}\kappa^0 < 0 \quad (2.10a) \qquad \tau^{P1} - \tau^{P0} = \sigma\frac{f}{\ell}\kappa^0 > 0, \quad (2.10b)$$

[22] Result 1 echoes Proposition 2 and Proposition 3 in Ly (2018). Three main contributions distinguish our result. First, our model allows to compare the level of the tax rates before and after the institutional change based on their reduced form while the framework in Ly (2018) does not allow to derive reduced forms so that the author only studies general deviations from a first-best equilibrium. Our second important contribution in Result 1 is that our analysis allows to establish that both a capital-mobility effect and a budgetary effect interacts so as to explain the change in the tax rates. Specifically, while Ly (2018) only attributes the downward pressure of capital intensity on the business property tax rate τ^P to a capital-mobility effect, we show that, in the absence of revenue compensation, the pre-reform level τ^P would be lower than its post-reform level even if no capital-mobility effect arises. This point is of particular importance from an empirical viewpoint, since it raises an identification issue regarding the capital-mobility effect. As shown in subsection 2.4, this problem can be solved by a well-designed compensation. This is the third theoretical contribution of our paper.

[23] As will be seen in section 3, this the French government has indeed provided such a compensation.

where $\sigma = \mathcal{P}/\mathcal{L} \in [0,1]$ is the metropolitan household land-use rate. And then:

$$\frac{\partial(\tau^{R1} - \tau^{R0})}{\partial \kappa^0} = -(1-\sigma)\frac{f}{\ell} \quad < 0, \quad (2.11a) \qquad \frac{\partial(\tau^{P1} - \tau^{P0})}{\partial \kappa^0} = \sigma\frac{f}{\ell} \quad > 0, \qquad (2.11b)$$

Equations (2.10) and (2.11) offer several important insights about the tax rate changes resulting from the removal of the capital tax base in the presence of a perfect budgetary compensation.

First, as expected from the analysis of the no-compensation case, while the business property tax still increases (equation (2.10a)), the tax on resident now decreases (equation (2.10b)). This confirms the fact that the removal of the capital tax base — which exerts a downward pressure on the pre-reform business property tax rate τ^{P0} due to capital mobility — allows the municipality to rise the business tax rate while alleviating the taxation of households.

Second, it appears from (2.10a) that the increase in the business property tax rate is weaker than in the no-compensation case (since $\sigma < 1$) presented in the previous subsection. This is also intuitive since, in the absence of budgetary effect, the rise in τ^P is now only driven by the capital-mobility effect.

Third, equations (2.11a) and (2.10b) show that the increase (resp. decrease) in τ^P (resp. τ^R) is widened by the pre-reform capital intensity. In other words, as in the no-compensation case, if the municipality hosts more capital-intensive firms it is more affected by the reform.

Again, a graphical representation allows to complete the understanding of these results. Figure 1b depicts the effect of the removal of the capital tax base in the presence of a perfect budgetary compensation. In this case, the budget-constraint curve only rotates around the point E^0. Compared to Figure 1a, the points E^0 and G now coincide, which simply illustrates that the pure budgetary effect is controlled for by the revenue compensation.[24] Then, in this case, the upward shift of (TR^0) allows to identify a pure capital-mobility effect.[25] We can summarize the main findings of this

[24] It is easily shown that replacing Λ with $\tau^{P0}K^0$ in (BC^1) and solving for τ^R and τ^P using (TR^0), we obtain τ^{R0} and τ^{P0}.

[25] Notice that the rotation of the budget constraint shifts the post-reform equilibrium from $\tilde{\text{F}}$ to $\tilde{\text{E}}^1$, which might be viewed as an *indirect budgetary effect*. However, the *pure budgetary effect* is controlled for by the revenue compensation since in the absence of any capital-mobility effect, the tax rates would remain unchanged (ie. $\tau^{R0} = \tau^{R1}$ and $\tau^{P0} = \tau^{P1}$).

subsection in the following result.

Result 2. *In the presence of a compensation $\Lambda = \tau^{P0}K^0$ from the central government, suppose that capital is removed from the local business property tax base. Then, the capital-mobility effect implies that:*

(i) the business property tax increases, ie. $\tau^{P1} > \tau^{P0}$, and the tax on residents decreases, ie. $\tau^{R1} < \tau^{R0}$,

(ii) the business property tax increase and the tax on residents decrease are all the more significant that the pre-reform capital intensity κ^0 is higher.

Result 2 (especially part (ii)) is the core theoretical prediction of the paper. It states that a reform consisting in a removal of capital from the local business property tax base offset by a revenue compensation provided to municipalities, allows to assess the effect of capital mobility — whose proxy is the pre-reform capital intensity κ^0 — on the tax rate levels. The remainder of the paper exploits the 2010 French business property tax reform, which essentially consisted in the institutional change considered in this subsection, to examine the impact of capital mobility on the business property tax and on the residential (housing) tax.

3. Institutional setting

3.1. Institutional setting before the 2010 reform

Up to 2010, the tax instruments available to French municipalities mainly consisted mainly of two direct local taxes whose rate was set by a vote among a municipal council which changes every six years based on direct voting.[26]

The first of these taxes is the business property tax or "*taxe professionnelle*" (TP) which was imposed on local firms and relied on the personal property (capital investments such as machinery and equipment) and the real property (land and buildings) they use, regardless of whether they own it or not.[27] The personal property tax base (ie. capital) is evaluated according to the rate of depreciation of capital used by the firms. The real property tax base (ie. business land) is assessed according to the evaluation made nationally in 1961 for undeveloped property (agricultural land, mines, quarries,

[26] The last (resp. first) municipal election before (resp. after) the reform of 2010 held in March 2008 (resp. 2014).

[27] Personal property is property that is movable, as opposed to real property which is immovable. See Fisher (2015) for more details about personal and real property.

pits, etc) and in 1970 for developed property (commercial, industrial and professional buildings, etc.). National government revises these assessed rents annually through the application to all developed and undeveloped properties of a unique revaluation rate which is based on the national commodity inflation rate.

The second important tax is the local housing tax paid by all local residents. It relies on the house or apartment in which the households live, regardless of whether they own it. The housing tax base is also assessed based on a national determination of 1970 and the same annual revaluation rate is applied as in the case of the business property tax base.

The two main local taxes described above, namely the business property tax and the housing tax, are the two key taxes on which we focus in this paper. However, municipalities have also access to other tax other more marginal tax instruments. They include a direct tax on developed property (houses, apartments, buildings, etc.) which is payable by the landowner and a direct tax levied on the owners of undeveloped land (mainly vacant land).[28] Additionally, the municipal council can levy several other minor lump-sum taxes such as taxes on domestic wastes, power transmission lines or outside advertising.[29]

While the focus in this paper is on the municipal level, an analysis of the 2010 reform requires consideration of the salient features of the tax instruments prior to that date, available to the three layers of local government above the municipality level, ie. region, county and inter-municipal cooperations (called EPCIs).[30] First, the highest government level consists of *regions*. Similar to municipal councils, regional councils vote on the regional business property tax rate, the developed property tax rate and the undeveloped property tax rate.[31] However, there is no regional housing tax. Second, each region contains several *counties*. County councils vote a county-level tax rate of the four direct taxes just as the municipal councils. Third, directly above municipalities

[28] Until 2010, the tax instrument set of municipalities also comprises a local tax on firms based on the value added of local firms, called "*taxe professionnelle bis*" (TP bis). Contrary to the aforementioned taxes, the choice of its rate is not left to the municipal council but is nationally fixed at a level of 1.5%. However, this tax had a very limited importance since only firms with sales revenue over 7.6 millions euros are concerned.

[29] See Bouvier (2018) for further details.

[30] Table A.1 in Appendix B summarize the distribution of the tax instruments between all government layers.

[31] The revenue received by the region from these taxes corresponds to the regional tax rates times the regional tax base which is the sum of the municipality tax base in the region. This pattern applies to each level of government which sets them in a context of vertical tax competition.

are EPCIs.[32] Contrary to regions and counties, the boundaries of EPCIs may slightly vary over time. Municipalities have full discretion over whether to form an EPCI or not.

3.2. The French business property tax reform

The French local business property tax reform occurred during an economic crisis. Its main objective was to stimulate investment in France by alleviating the tax burden on firms. It was implemented according to a temporal process represented in Figure 2. The reform was announced by the President of the French Republic on February 5, 2009.[33]

The president's unexpected announcement gave few details about how the reform would be implemented. He announced only that the business property tax (TP) would be removed in 2010, and that further details, especially regarding revenue compensation to local governments, should be discussed with the associations of locally elected representatives.These discussions led to a first version of the law — written mostly during summer 2009 (Guené, 2012) — which was submitted by the government to the parliament on September 30, 2009. After four months of debating in the parliament which resulted in several amendments, the final version of the reform was voted on December 30, 2009 and enacted on January 1, 2010.

Figure 2 shows that the reform was implemented rapidly (in less than a year) which reduced the possibilities for municipalities to make changes in anticipation of its implementation. It was difficult for municipalities to make anticipation changes to their 2009 tax rates since the period for the annual voting on local tax rates - January 1st to April 15th - had passed before the first version of the law was published.[34]

3.3. Two-step enactment of the reform in 2010 and 2011

The timeline in Figure 2 shows also that the actual enactment of the reform was achieved in two steps which are summarized in Table 1: the first was in January 2010 and the second in January 2011. The first step of the reform in January 2010 decreed that the municipal level would vote the tax rate of the new business property tax on business

[32] In 2009, there was 36,682 municipalities, 15,202 EPCIs,101 counties and 27 regions in France — including overseas territories.

[33] This announcement has been made by the President during a television interview called "*Face à la crise*" (Facing the crisis).

[34] Especially, the period from the President's announcement to the first version of the law has been perceived as strongly uncertain from a legal perspective by municipalities (Guené, 2012); very few anticipation about the concrete implementation of the reform could be made.

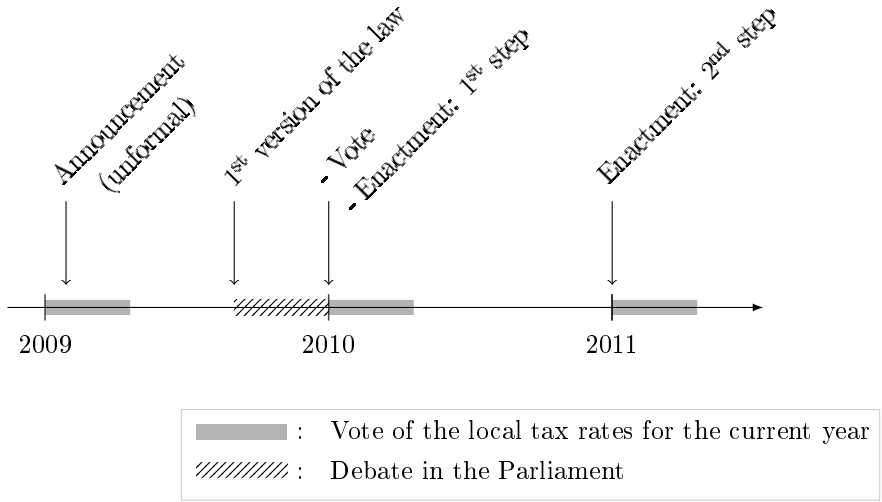


Figure 2. Timing of the Reform. The annual voting period of local tax rates spans each year between January 1st and April 15th. The precise timing of the reform implementation was: informal announcement on February 5, 2009; 1st version of the law on September 30, 2009; vote of the final version of the law on December 30, 2009; enactment of the 1st step of the law on January 1, 2010; and enactment of the 2nd step of the law on January 1, 2011.

land (CFE) instead of the former on capital and business land (TP). The municipal level would receive both the revenue from the CFE and a compensation paid by central government equivalent to the revenue from the capital base of the TP in 2009.[35] Thus, in 2010, municipalities could vote for the new business property tax rate, confident that they would experience no revenue losses compared to 2009.

Additionally, firms were required from 2010 to pay two new local taxes whose revenue were not perceived by municipalities but transferred to national government in 2010. First, a new business value added tax called CVAE has been created. Its rate is fixed at 1.5% of the added value created by local firms and is paid by all firms whose sales revenue are higher than 500,000€. Second, a flat-rate tax IFER was imposed on network businesses (transport, energy and telecommunications). The level of this tax paid by each firm was related to its sector and size. Municipalities had no decision making power over the level of this tax.[36]

[35] This compensation scheme is allowed by a national grant called *Compensation relais* (Bridging compensation).

[36] These additional changes brought by the reform from 2011 were introduced to provide new resources to municipalities to compensate for the reductions to the business property tax base. They

Table 1. Main features of the reform at the municipal level.

	≤ 2009	2010	≥ 2011
		A. Main local taxes	
Business property tax	$\tau^P \cdot (K+L)$	$\tau^P \cdot L$	$\tau^P \cdot L$
Houing tax	$\tau^R \cdot R$	$\tau^R \cdot R$	$\widetilde{\tau}^R \cdot R$
		B. New business tax revenue	
Business taxes			CVAE + IFER + TASCOM
		C. Compensation	
Revenue from capital in 2009		$\tau^P_{2009} \cdot K_{2009}$	$\tau^P_{2009} \cdot K_{2009}$
minus			*minus*
New revenue			$\text{CVAE}_{2010} + \text{IFER}_{2010} + \text{TASCOM}_{2010}$

NOTE.—K, L and R respectively stand for the tax base relying on capital, business land use, and residents' housing. τ^P and τ^R are the associated tax rates voted by the municipality. $\widetilde{\tau}^R$ is the post-reform tax on residents' housing pushed up by the transfer of the pre-reform transfer to municipalities of the county tax on residents' housing. CVAE is the new business value added tax, IFER is the flat-rate tax on network businesses, and the TASCOM is the tax on commercial building.

In January 2011, the second step of the reform consisted of several additional changes to the tax instruments at the municipal level. First, the municipal level received the CVAE and the IFER. Second, the municipal level received the share of direct tax revenues allocated previously to the higher local government levels. The municipalities benefited from the county level housing tax rate and the county and regional tax rates on undeveloped property.[37, 38] Third, following the reform, the municipalities received transfers of state level fiscal revenues: tax on commercial buildings known as TASCOM and management costs related to housing tax and property tax.

reduced the central government's costs related to the grant compensation mechanism.

[37] See Table A.1 in Appendix B for a summary of the way the reform affected the tax instrument set of counties and regions.

[38] In practice, these tax rate transfers were implicitly induced by a twofold change. First, the county housing tax and the county and regional tax on undeveloped property were removed. Second, the compensation mechanism (described below) was reduced from the amount of the county and regional tax revenues which were regarded as having been transferred to the municipalities. The effect of these two mechanisms combined can be expected to induce the municipalities to raise their tax rates to a level equal to the suppressed tax rates of higher government levels.

From 2011, a new compensation mechanism was implemented via two state grants DCRTP and FNGIR to maintain the level of the municipalities' resources. The level of compensation is computed, for each municipality, as the difference between the revenue collected from the capital base of the TP in 2009 and the sum of the revenues from the new taxes referred to above which the municipality would have obtained in 2010. This difference could be positive in which case the municipality would receive a subsidy from the national government, or negative in which case the municipality pays a compensation to the national government. This compensation mechanism was designed based on the fiscal revenue level in 2010 which implies that it does not change over time. Finally, note that if the new revenues do not vary significantly compared to their 2010 level, the compensation after 2011 is equivalent to the compensation revenue lost induced by the only removal of the capital tax base, similarly to the compensation of 2010 (see Table 1).

4. Empirical strategy

Our theoretical model developed in section 2 suggests that the French business property tax reform described in the previous section represents a quasi-natural experiment to investigate the connection between the local business property tax base mobility and the level of the local tax rates on firms. The removal of the most mobile part of the business property tax base (i.e. capital) considerably reduces the degree of mobility of the business property tax base which, from 2010, relies only on business real property. From part (ii) of Result 2, we can expect first that the municipalities deprived of a larger share of capital will increase their business property tax rate compared to municipalities with a less capital-intensive tax base before the reform. Indeed, in municipalities hosting more capital-intensive firms, this change in nature to the tax base further releases the downward pressure exerted by capital mobility on the business property tax rate.[39] This greater business tax relief in more capital-intensive municipalities is expected — this is our second main theoretical prediction — to drive them to decrease the tax rate on their residents (the housing tax) compared to less capital-intensive municipalities.[40]

To test for these results, a continuous treatment difference-in-differences (DD) regression appears as the natural empirical setting.[41] It allows to estimate the effect

[39] Theoretical prediction stated in (2.11b).

[40] Theoretical prediction stated in (2.11a).

[41] See e.g. Card (1992) for an early application of DD regression with continuous treatment. Card (1992) studies the impact of a reform consisting in a federal minimum wage increase in the US; the continuous treatment variable is the share of young people likely to be affected by a minimum wage

of the capital tax base removal on the tax rates by contrasting the change in tax rate levels in municipalities with higher pre-reform removed capital intensity $\kappa_{2009} = K_{2009}/(K_{2009} + L_{2009})$ — ie. the treatment intensity — versus those with lower κ_{2009}. This capital intensity is a proxy for the pre-reform business property tax base mobility, in line with our theoretical analysis. Formally, the baseline DD model that we fit is of the form:

$$\tau_{it} = \beta_R Ratio_i + \beta_P Post_t + \beta_{RP} Ratio_i \times Post_t + \beta'_{\mathrm{x}} X_{it} + \gamma_{gt} + \lambda_i t + \varepsilon_{it}, \qquad (4.1)$$

where τ_{it} is either the business property tax rate τ^P_{it} or the housing tax rate τ^R_{it} voted by municipality i in year $t = 2006, \ldots, 2012$, $Ratio_i$ is the removed capital share of the business property tax base in 2009 (κ_{i2009}), $Post_t$ is a dummy which is equal to 1 the post-reform years $t = 2010, 2011, 2012$ and 0 otherwise, γ_{gt} is a set of EPCI and county year-specific effects, $\lambda_i t$ is a time-trend for municipality i allowing municipalities to follow different trends, $\mathbf{x}_{it}$ is a vector of socio-demographic and economic control variables described in section 5 below, and ε_{it} is the error term. The γ_{gt} effects control for time-varying unobservable shocks experienced by municipality i occurring at upper jurisdictional levels.[42] We cluster the standard error at the level of EPCIs of 2009.

An extended version of the baseline DD model of equation (4.1) including year-specific treatment effects within the post-reform period allows us to investigate the dynamics. It is estimated by replacing the post-treatment period dummy with year dummies for each of the post-reform years. The extended model is summarized in equation (4.2):

$$\tau_{it} = \beta_R Ratio_i + \beta'_P POST_t + \beta'_{RP} Ratio_i POST_t + \beta'_{\mathrm{x}} X_{it} + \gamma_{gt} + \lambda_i t + \varepsilon_{it} \qquad (4.2)$$

where $\beta'_P = (\beta^{10}_P \quad \beta^{11}_P \quad \beta^{12}_P)$, $\beta'_{RP} = (\beta^{10}_{RP} \quad \beta^{11}_{RP} \quad \beta^{12}_{RP})$, $POST'_t = (Post^{10}_t \quad Post^{11}_t \quad Post^{12}_t)$, and $Post^{10}_t$, $Post^{11}_t$ and $Post^{12}_t$ are year dummies respectively for 2010, 2011 and 2012.

In equation (4.1) and (4.2) the key coefficients β_{RP} and β^j_{RP} estimate the effect of the deletion of the pre-reform capital share from the business property tax base on local tax rates by contrasting changes in the tax rate level of more capital-intensive

increase in each state, and the outcome variable is the teen wage. DD with continuous treatment has been used in many subsequent studies; it is a widespread approach in cases where a continuous treatment measure is available.

[42] It is not necessary to add regional year-specific effects since they are already captured by the county effects; each county is fully contained within a single region. This is not necessarily the case of EPCIs which can overlap several counties or regions. This is especially true for the group of municipalities which do not belong to any EPCI.

municipalities relative to less capital-intensive municipalities. It is estimated holding constant socio-demographic municipal characteristics, cross-EPCI and cross-county differences, municipal specific time trend and nationwide changes in tax rates between the pre-reform and post-reform periods.

Any effect of the reform that accrue nationwide are soaked up by the time effects $Post_t$ in (4.1) and $POST_t$ in (4.2). Since these time effects absorb any macroeconomic factor affecting the the level of French municipalities tax rates, we do not interpret them as an effect of the pre-reform capital share removal. The coefficient on the $Ratio_i$ main effect is also of limited relevance since it cannot be considered as an effect of the degree of mobility of the pre-reform capital share on the pre-reform tax rate levels. It not only picks up unobserved factors that determined the municipal capital intensity[43] but it also combines indiscriminately budgetary and capital-mobility effects.

The removal of capital from the business property tax base in 2010 was followed in 2011 by several institutional changes (section 3) at the municipal level and at upper government levels. This raises the possibility of confounding municipal tax rate trends. The time effects $Post_t$ and $POST_t$ will absorb these changes to the extent that they affect the overall tax rate levels of all municipalities. They will not control for differential adjustments in the tax rates voted by municipalities. This concern is addressed by including in the regression EPCI and county year-specific effect γ_{gt} to control for institutional changes in upper government levels and municipal time trends $\lambda_i t$ to control for differential adjustments at the municipal level.

For the DD approach to provide good estimitaes of the effect of the pre-reform capital share elimination on the tax rates (β_{RP} and β^j_{RP}), it must be the case that the reform shall not have been fully anticipated by municipal authorities. This appears plausible in light of the fast implementation of the reform and of the fact that the very first draft of the reform law was tabled six month after the annual voting period of the local tax rates was closed (see Figure 2). In subsection 6.2 we present event-study graphs which go in this direction and suggest that the effect of the capital share removal was not present before the reform.

[43] As discussed in section 6, the main reason why the coefficient *Ratio* has no causal interpretation is that tax rate and tax base influence one another. By integrating the *Ratio* term in the regressions, the DD-strategy allows to control for this pre-reform relation between the capital share in the business property tax base and the tax rate level.

5. Data and summary statistics

To examine the connection between local tax rates and the composition of the municipal business property tax base, we use REI which is a yearly database[44] obtained from the French Ministry of Public Finance and which includes a range of local public finance variables.We use data on French mainland (excluding overseas) municipalities from 2006 to 2012 so that we consider the four year pre-reform period (2006-2009) and three post-reform years (2010-2011). In 2009, a total 27,416 municipalities reported information on their tax rates and their business property tax base and its composition.[45] Our dataset is based on a sample of municipalities, which had control over their tax rates in 2009. While the tax rates in 13,558 municipalities subject to municipal voting, 13,858 had adopted a single business tax (SBT) regime which delegated voting on the business property tax rate to their EPCI. We excluded the municipalities which delegated voting power and also the 1,441 which were under SBT regime for at least one year during the time span considered; this left 12,417 municipalities and after dropping municipalities with missing socio-demographic data the final sample is 11,896. Thus, our seven-year panel data includes 83,272 observations.

For each of the direct local taxes, the database provides the tax rates voted for by each jurisdictional level (municipalities, EPCIs, counties and regions) and the associated tax base net of exemptions. While the data provide the overall net tax base of the business property tax for all years, this is not true for its two components. That is, the net tax bases for capital and for business land are not available separately before 2010. However, the database provides their gross value. We use these gross tax bases to build the treatment variable: the capital share in the business property tax base in 2009.

Note that the overall gross and net business property tax bases are, not surprisingly, highly and positively correlated (Pearson's coefficient over 99.98%) in each year of the period considered.[46] This suggests that the gross business property tax base is an appropriate proxy for its net counterpart.

Our regressions include a number of controls for municipal, socio-demographic, political and economic characteristics, obtained from the National Institute of Statistics and Economic Studies (INSEE) and the French Ministry of Interior.[47] The municipal variables include size and density of the municipal population. We also include a

[44] REI stands for *Recensement des éléments d'imposition*.

[45] The 8,886 remaining municipalities, which did not report the relevant fiscal information in the REI are essentially very small (231 inhabitants on average) rural (97%) municipalities.

[46] See Table A.4 in Appendix C.

[47] See Table A.2 in Appendix C for descriptive statistics of the control variables.

dummy indicating whether the municipality is located in a metropolitan area or not. The definition of a metropolitan area relies on INSEE's definition of an urban area as composed of a center — a set of municipalities in a continuously built-up area with more than 2000 inhabitants and 1500 jobs — and a periphery — municipalities where at least 40% of the residents work in the center. The socio-demographic variables include the municipal median income, share of young people (population aged under 15 as a percentage of the total population), schooling rate (share of population aged under 17 enrolled in school) and population share per socio-professional category: farmers, craftsmen, managers, temporary workers, employees, blue collar workers, retirees and unemployed — this last group is excluded so that the sum does not equal 1. As a political variable, we include the share of left-wing voters in the second round of the 2007 presidential election which posed a left-wing candidate against a right-wing one.

Finally, the economic variables include the share of commuters (number of individuals working outside the municipality as a percentage of the total number of workers in the municipality) and the total number firms per capita. We account also for firms' size by including the shares of firms with no employee, less than ten employees and more than 10 employees (which is the excluded category). Sectoral composition is also accounted for by including the share of firms in the four sectors: industry and building, finance and real estate, trade and retail, and other services (which is the excluded category).[48] The last economic variable is a dummy for whether a municipality gains or loses from the reform. It is equal to 1 if the municipality receives a positive national grant from 2011 and 0 otherwise. It controls for the fact that municipalities hosting highly capitalistic firms with low added value may have been affected differently by the reform compared to municipalities which include firms with less capital but generate higher added value; the former incur substantial capital tax revenue loss but receive a higher business value added tax from 2011 while the reverse applies to the latter type of municipalities.[49]

Table 2 presents descriptive statistics for the outcome variables (tax rate on business property and tax rate on housing) and the treatment variable (capital share in

[48] In our regressions, we control for four business sectors for the sake of parsimony. However, we also tested our results with a less aggregated hypothesis by integrating the shares of firms by category (around 32 categories) of exemption from the business property tax. They were measured as the ratio of the number of firms exempted from the business property tax relative to the total number of firms exempted. This alternative specification does not substantially alter the results.

[49] From Table 2, one can see that around 18.5% municipalities receive a positive compensation since 2011 after the entire new institutional setting has been implemented. On the contrary, the remaining municipalities return the surplus they gain from the new setting compared to the pre-reform one.

Table 2. Descriptive statistics.

	2006	2007	2008	2009	2010	2011	2012
Municipal treatment and outcome variables							
Capital share	.7993	.8015	.8041	.8018			
	(.1991)	(.2004)	(.2032)	(.2118)			
Business property tax rate	.0952	.0952	.0956	.096	.1794	.1802	.1812
	(.0526)	(.0527)	(.0528)	(.0532)	(.0615)	(.0613)	(.0615)
Housing tax rate	.0808	.081	.0816	.0824	.0829	.1516	.1522
	(.0361)	(.0361)	(.0363)	(.0365)	(.0389)	(.0487)	(.049)
Other informative variables							
County's housing tax rate	.077	.0784	.0794	.083	.0838		
	(.0156)	(.0163)	(.0168)	(.0178)	(.0177)		
Positive compensation after 2011						.1859	.1859
						(.3891)	(.3891)
Observations	11896	11896	11896	11896	11896	11896	11896

NOTE.—Each cell contains the variable mean and standard error in parentheses. The last "positive compensation" variable is a dummy which is equal to one if the municipality receives a positive compensation from the central government following the reform and zero otherwise.

the business property tax base). It indicates a capital share in the business property tax base around 80% in 2009, so that its removal by the reform should have had a significant impact. Since its removal is perfectly compensated by the central government grant from 2010, its quantitative budgetary impact should not affect the municipality. However, it represented an important qualitative change to the nature of the business property tax base. This is the motivation for our empirical study of the impact of the change from a highly mobile tax base composed essentially of capital to a far less mobile tax base composed uniquely of business real property on the voted local tax rates on business property and housing.

The evolution of the municipal tax rates is presented in Table 2. It shows that during the whole pre-reform period (2006-2009) both the business property tax rate (around 9.5%) and the housing tax rate (around 8%) increased regularly and very moderately. This stable evolution is due in part to various institutional constraints on the evolution of the local tax rates which however, were temporarily abandoned in 2010 and 2011 to allow municipalities sufficient leeway to respond to the reform. Moreover, the evolution of the tax rates presented in Table 2 shows no evidence of anticipation of the reform. This, combined with the stability of the pre-reform tax rates are encouraging signs that the common trend assumption holds.

We observe that the reform significantly affected the municipal tax rate levels since the two tax rates almost doubled between 2009 and 2011. The business property tax rate rose from 9.6% to 18% and the housing tax rate increased from 8.2% to 15.2%. Interestingly, these tax rate spikes show evidence of some delay: while the significant increase in the business property tax rate occurred almost entirely in 2010, the housing tax rate remained fairly stable in 2010 and jumped by 7 points in 2011. This time lag must be considered in the context of the two-step enactment of the reform (subsection 3.3).

Year 2010 is the year that the basic fundamental reform was implemented: capital was deleted from the business property tax base and the municipalities received corresponding compensation revenue. Since the compensation controls for the budgetary effect, we expect, from our theoretical model, a rise in the business property tax rate caused by the change in the composition of its tax base (less mobile now). The spike in the business property tax rate observed in the data is consistent with this prediction. The absence of a similar pattern in the evolution of the housing tax rate which remained stable in 2010 seems to confirm that the pure budgetary effect was controlled for by the compensation. However, we observe no significant reversal in the increasing trend of the housing tax rate. The preliminary descriptive statistics provide no evidence of a clear rebalancing of the tax burden from residents to firms. To test this theoretical prediction more thoroughly, we need to compare the change in the housing tax rate among municipalities with different business property tax base composition (see section 6).

In 2011, the housing tax rate increased sharply. Its stability between 2009 and 2010 indicates that this hike had little to do with the compensated removal of the capital tax base. The most plausible explanation for it lies in the new institutional changes that occurred in 2011. As described in section 3, the housing tax rate voted for by the counties in 2010 (around 8%) has been transferred to the municipalities from 2011. Table 2 shows that almost all of this county tax was internalized by the post-reform municipal housing tax rates (which jumped by some 7 points). Note also that the rise in the municipal housing tax rate is about 1 point lower than might have been expected as a result of the transfer of the county tax rate. This might be a positive sign in relation to the rebalancing of taxation from firms to residents but further investigation is needed to understand the underlying mechanisms.

6. Results

6.1. *Effect of the capital share removal*

Panel A of Table 3 reports the baseline estimates of equation (4.1) for the effect of the removal of the capital share from the business property tax base, compensated by national grants, on voted tax rates for business (columns 1 to 3) and housing (columns 4 to 6). All the estimations below use the full set of 11,896 municipalities from 2006 to 2012. Panel A presents the results of the regression including the two-period indicator variable *Post* which gathers the post-reform period year 2010-2012. Columns 1 and 4 report a parsimonious specification including only the *Ratio* main effect, the *Ratio* $\times$ *Post* interaction, the *Post* indicator, and a set of municipality specific time trends which allow the tax rates to follow different overall appreciation across municipalities. Columns 2 and 5 include the control variables described in section 5, and thus absorbs cross-municipality sociodemographic economic and political differences. Columns 3 and 6 refine the precision of the estimation by including year-specific EPCI and county effects, which negate the effects on the municipal tax rates of changes affecting higher local government levels (EPCIs, counties and regions).

In the business property tax rate regression, in the most demanding specification in column 3 of panel A the coefficient of *Post* shows that the business property tax rate (in municipalities with no capital tax base in the pre-treatment period) appreciated significantly (by about 7.6 points) between the pre and post-reform periods, which is consistent with the observation in section 5.[50] It appears also that prior to the removal of the capital tax base, municipalities with a higher capital share of the business property tax base had lower average business property tax rates.Specifically, the point estimate of -0.02 on the *Ratio* measure indicates that a municipality at the mean capital share level of 80.2% in 2009 (see Table 2) voted on a tax rate that was approximately 1.6 points lower than the tax rate voted for a municipality without capital, ie. around 16.7 % of its tax rate of 9.6%. We do not consider this tax differential as causal mostly because tax rate and tax base affect one other: while higher tax bases may allow lower tax rates, a rise in the tax rate can discourage tax payers and shrink the related tax base. Moreover this coefficient does not allow to disentangle budgetary and capital-mobility

[50] It might be tempting to interprete this rise as an effect of a decrease in the degree of mobility of the business property tax base, but the coefficient on *Post* picks up all macroeconomic factors arising between the two periods. Moreover, the presence of the *Ratio* $\times$ *Post* coefficient in the regression also limits the scope of interpretation *Post* since its coefficient only captures the tax rate appreciation in municipalities without capital before the reform.

Table 3. Regression results: before/after estimates.

	Dependent variable: Business property tax			Dependent variable: Housing tax		
	(1)	(2)	(3)	(4)	(5)	(6)
	A. Continuous treatment					
Ratio × *Post*	.00817**	.00704**	.00686**	-.00412***	-.00549***	-.00553***
	(.00257)	(.00256)	(.00250)	(.00011)	(.00012)	(.00012)
Post	.07683***	.07617***	.07625***	.04695***	.05238***	.04726***
	(.00226)	(.00227)	(.00223)	(.00094)	(.00109)	(.00103)
Ratio	-.00891***	-.01917***	-.02000***	-.02392***	-.02912***	-.02912***
	(.00096)	(.00283)	(.00282)	(.00024)	(.00046)	(.00047)
R^2	.989	.989	.996	.964	.968	.971
Observations	83272	83272	83272	83272	83272	83272
	B. Discrete treatment					
High × *Post*	.00414*	.00420*	.00399*	-.00206**	-.00210**	-.00211**
	(.00199)	(.00197)	(.00190)	(.00066)	(.00075)	(.00074)
Post	.08306***	.08161***	.08169***	.04762***	.04460***	.04434***
	(.00072)	(.00078)	(.00076)	(.00025)	(.00034)	(.00033)
High	-.00629	-.01086*	-.01179*	-.01375***	-.01355**	-.01350**
	(.00429)	(.00493)	(.00478)	(.00341)	(.00420)	(.00418)
R^2	.989	.989	.991	.959	.962	.964
Observations	83272	83272	83272	83272	83272	83272
Controls	No	Yes	Yes	No	Yes	Yes
EPCI & County by year effects	No	No	Yes	No	No	Yes

Note.—The sample includes all 11,896 municipalities from 2006 to 2012. *Ratio* is the 2009 share of the removed capital tax base in the business property tax base consisting of capital and land. *High* is an indicator equal to 1 if the municipality had a capital share in 2009 above the sample median (around 86.76%), and zero otherwise. *Post* is an indicator of the post-reform years 2010-2012. Individual time trends are included in all the regressions. The controls are all the socio-demographic, political and economic variables described in the data section. Robust standard errors clustered by 2009 EPCI are reported in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

effects. Conversely, the coefficient of 0.007 on the *Ratio* × *Post* interaction implies that 34% of this tax rate differential was erased in the years after the capital share

was eliminated. Under our identifying assumption of no anticipation of the reform, the coefficient of the $Ratio \times Post$ indicator can be considered as a causal estimate of the effect on the business property tax rate of the pre-reform capital share removal. That is, a municipality that lost a larger pre-reform capital share responded by imposing a higher business property tax increase. Columns 1 to 3 show that this effect is robust and stable across all specifications, although is reduced by the introduction of controls.

This result is in line with the prediction of our theoretical model that removing the capital share from the business property tax base spurs municipalities with higher share to increase their business property tax rate relative to those with lower capital share.[51] Moreover, controlling for all other relevant factors, this relative rise in the business property tax rate may result from two effects working potentially in combination. The budgetary effect implies that to maintain (at least in part) their tax revenues, municipalities with more capital before the reform, which suffered a greater loss, respond by a bigger rise in their tax rates. The capital-mobility effect means that municipalities hosting more-capital intensive firms before the reform have been relieved from a stronger pressure exerted by capital mobility. This allows them to raise their business property tax rate which now only rely on business land, since it is much less mobile than capital. However, the compensation mechanism implemented from 2010 (section 3) ensures that central government reimburses each municipality for the amount of the tax revenue lost due to the removal of its capital tax base. Therefore, the budgetary effect being controlled for by this grant scheme, our most demanding estimate ($Ratio \times Post$ in column 3) suggests that the average capital-mobility effect of the capital share removal on the business property tax rate is 0.55 points.[52] That is, a municipality with an average pre-reform capital share of 80.02% increased its business property tax rate (which was 9.6% in 2009) by 5.7% due to the capital-mobility effect.

Turning now to the two-period estimates of the housing tax regression reported in columns 4 to 6 in panel A of Table 3, our most demanding specification in column 6 shows that consistent with the data description of section 5, municipalities with no capital tax base before the reform raised their housing tax rates by 4.7 points between the pre and post-reform periods. Additionally, the point estimate of -0.029 on the $Ratio$ measure indicates that the pre-reform housing tax rate was lower in more capital-intensive municipalities which likely reflects the higher tax revenue potential of these municipalities. The coefficient of -0.006 of the key interaction term $Ratio \times Post$

[51] See conditions (2.9b) and (2.11b).

[52] As standard, the average treatment effect 0.55 points is obtained by multiplying the estimate of 0.686% on $Ratio \times Post$ by the average pre-reform capital share of 80.02% (ie. the average treatment level).

reveals that the housing tax gap between municipalities with higher and lower capital intensity widened by 19% after elimination of the capital tax base. Then, since the budgetary effect of this tax base elimination is controlled for by the central grant, we can infer that the average capital-mobility effect entailed by the reform is a 0.44 points cut in the housing tax rate which represents 5.4% of the 8.2% mean housing tax rate of 2009.

This housing tax rate cut by municipalities hosting more capital intensive firms relative to those hosting less capital intensive firms is consistent with the theoretical predictions in section 2.[53] Indeed, as expected, more capital-intensive municipalities where removal of capital base taxation resulted in less downward pressure from capital mobility on their business property tax rates, were driven to impose a higher business tax rate. This allowed them to further alleviate the tax burden on their residents. Interestingly, our negative estimates on $Ratio \times Post$ suggest that we can reject the hypothesis of a budgetary effect on housing tax rates outweighing or exactly compensating the capital-mobility effect, which would have showed a positive or non-significant coefficient on $Ratio \times Post$. This can be regarded as further evidence that the central grant is perceived by municipalities as proper revenue compensation, and that a capital-mobility effect is present.

Our continuous treatment measure of the removed pre-reform capital intensity *Ratio* exploits the entire range of capital intensity in 2009, and allows comparison among municipalities with very close *Ratio* levels. It might be informative to consider a more aggregated treatment measure to check whether our results hold in a larger perspective. Panel B of Table 3 reports the estimates of equation (4.1) where the *Ratio* variable is replaced by an indicator variable $High$ which takes the value 1 if the municipality's capital intensity in 2009 was above the median (around 86.76%), and is equal to zero otherwise.[54] Not surprisingly, this more aggregated treatment measure reduces the precision of the estimation. However, the main results derived in the continuous case appear to be qualitatively robust to this alternative measure. Specifically, considering our most demanding specification in columns 3 and 6, we see that the group of municipalities hosting more capital-intensive firms set an average pre-reform business property tax rate 1.2 points below that set by municipalities with less capital-intensive firms. This gap closes by 0.4 point following the removal of the capital tax base. Additionally, these more capital-intensive municipalities charge an average pre-reform housing tax rate that is 1.4 points lower than that set by less capital-intensive municipalities, and

[53] See condition (2.11a).

[54] See Table A.3 in Appendix C for descriptive statistics on these two categories of municipalities.

the gap widens by 0.2 point following the reform.

6.2. Time path of the capital-mobility effect

To complete this picture of the effect of the removal of capital from the business property tax base, we take advantage of the panel dimension of our dataset to investigate the dynamic impact of the reform. Panel A of Table 4 reports the estimates of equation (4.2) which allow for year-specific treatment effects. We report only the interaction terms capturing the treatment effects, ie. the interaction of the heterogeneity terms between municipalities of different capital intensity and over time. Regardless of the specification, the most striking new insight obtained is that the effect of the reform is concentrated on the first treatment year, since only the $Ratio \times Post^{10}$ the treatment effect is significant. In subsequent years, the point estimate decreases sharply — business property tax regressions, columns 1 to 3 — or the precision of the estimation is considerably reduced — housing tax regressions, columns 4 to 6. This suggests that the differential tax behavior between municipalities with different capital intensity prior to the reform occurs mainly in the first year of the reform. As described in section 3, in 2010, only the core of the reform was implemented since the capital tax base was eliminated and replaced by a grant equal to the revenue collected from capital by the municipality in 2009. All other institutional changes were implemented only from 2011. Thus, year 2010 perfectly fits with the theoretical framework developed in section 2 and local government responses in this first treatment year can even more convincingly be interpreted as a consequence of the capital-mobility effect.

Let us examine this in greater depth. First, in the case of the business property tax regression, , the point estimate in column 3 of 0.017 on the $Ratio \times Post^{10}$ interaction term, implies a differential appreciation of 1.4 points for a municipality at the mean level of the pre-reform capital intensity of 80.2% relative to a municipality with a zero pre-reform capital tax base. Our most demanding estimate implies that municipalities, which have been removed a higher capital share relatively increased their business tax rate. This differential appreciation represents a 14% rise compared to the 9.6% average business property tax rate in 2009. This capital-mobility effect of the capital tax base on the business property tax rate for the year 2010 is much more important than the 5.7% in subsection 6.1 with the merged post-treatment period. The coefficients on the interaction terms for years 2011 and 2012, although non-significant may explain this difference. Since the capital-mobility effect on business property tax rates appears to be very low or non-existent from 2011, merging the post-treatment period hides part of the strong effect observed in 2010. This strong positive effect confirms the theoretical predictions of subsection 2.4 and is further evidence of the capital-mobility effect.

Table 4. Regression results: year-specific estimates.

	Dependent variable: Business property tax			Dependent variable: Housing tax		
	(1)	(2)	(3)	(4)	(5)	(6)
	A. Continuous treatment					
$Ratio \times Post^{10}$	.01802***	.01682***	.01714***	-.00105***	-.00120***	-.00125**
	(.00300)	(.00296)	(.00291)	(.00026)	(.00036)	(.00039)
$Ratio \times Post^{11}$	.00483	.00485	.00430	-.00151	-.00069	-.00136
	(.00286)	(.00287)	(.00283)	(.00151)	(.00157)	(.00155)
$Ratio \times Post^{12}$	.00186	.00161	.00094	-.00179	-.00096	-.00155
	(.00272)	(.00278)	(.00273)	(.00151)	(.00160)	(.00157)
R^2	.989	.989	.996	.991	.991	.996
Observations	83272	83272	83272	83272	83272	83272
	B. Discrete treatment					
$High \times Post^{10}$	.00126*	.00132*	.00134*	-.00142***	-.00056**	-.00061**
	(.00056)	(.00058)	(.00067)	(.00039)	(.00019)	(.00021)
$High \times Post^{11}$	-.00091	-.00048	-.00062	-.00227*	-.00087	-.00105
	(.00062)	(.00065)	(.00071)	(.00099)	(.00045)	(.00057)
$High \times Post^{12}$	-.00135*	-.00089	-.00033	-.00269**	-.00095*	-.00106
	(.00066)	(.00071)	(.00074)	(.00102)	(.00048)	(.00060)
R^2	.989	.989	.996	.991	.991	.994
Observations	83272	83272	83272	83272	83272	83272
Controls	No	Yes	Yes	No	Yes	Yes
EPCI & County by year effects	No	No	Yes	No	No	Yes

Note.—The sample is all 11,896 municipalities from 2006 to 2012. *Ratio* is the 2009 share of the eliminated capital tax base in the business property tax base consisting in capital and land. *High* is an indicator equal to 1 if a municipality has a 2009 capital share above the sample median, and zero otherwise. $Post^j$ is a year dummy which equals 1 for year 20j, and zero otherwise. Individual time trends are included in all the regressions. The controls are all the socio-demographic, political and economic variables described in the data section. Robust standard errors clustered by 2009 EPCI are reported in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

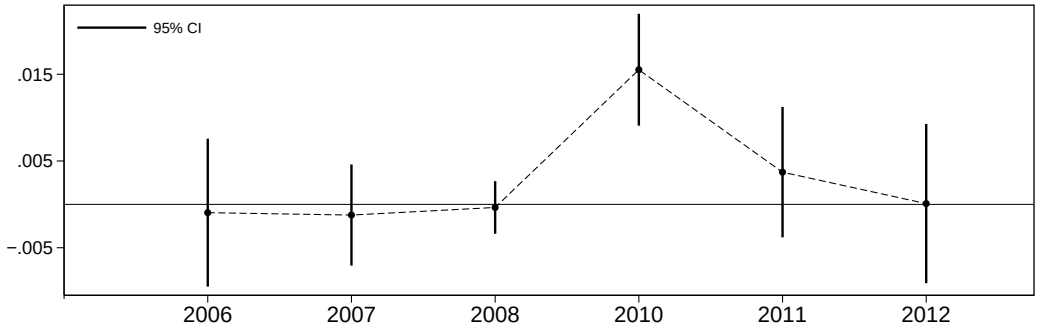
Similarly, the point estimate of -0.0013 on $Ratio \times Post^{10}$ in column 6, confirms the theoretical prediction that more capital-intensive municipalities will decrease their

housing tax rate relative to others, since they benefit from more scope to increasing their business property tax rates. More precisely, it follows from this point estimate that the average capital-mobility effect of the reform induced a 1.3% decrease in the housing tax rate. This decline is 4 points lower than the one estimated in the before/after regression in the previous subsection. Again, the (non-significant) point estimates on the interaction terms for the years 2011 and 2012 may provide an explanation. Contrary to the business property tax case, the capital-mobility effect of the reform on the housing tax rate although non-significant after 2010 seems more persistent. This might explain the larger effect in the estimations merging the post-treatment years. This negative effect the year of the reform is in line also with the theoretical predictions.

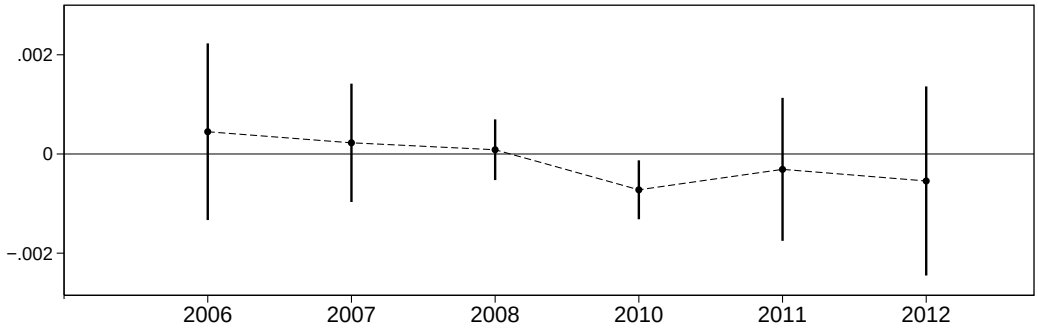
As in the before/after regression, we check the robustness of the above results replacing the continuous treatment measure *Ratio* with the binary variable *High* indicating municipalities with a capital share above the median in 2009. The results are reported in panel B of Table 4. Again, the main results for the continuous-treatment case appear to be confirmed by the discrete specification. As can be seen from the most conservative specifications in columns 3 and 6, the effect of the reform is observed only in the first treatment year. Also, the coefficients have the expected signs: more capital-intensive municipalities increased their business property tax rate by 0.13 and decreased their housing tax rate by 0.06 points relative to less capital-intensive ones.

Exploiting the panel dimension of our dataset even further, we can use an event study to investigate potential anticipation of the reform by municipalities. This requires to slightly transform equation (4.2) replacing the $POST$ vector by $\widetilde{POST}'=(Post^{06}\ Post^{07}\ Post^{08}\ Post^{10}\ Post^{11}\ Post^{12})$, where $Post^j$ is a dummy for the year $20j$. Including pre-reform year indicators in the $POST$ vector slightly changes the interpretation of the coefficients on the interaction terms $Ratio \times Post^j$. Whereas, with the $POST$ vector, each post-reform year 2010-2012 is compared to all the pre-reform years 2006-2009, with the $\widetilde{POST}$ vector, the single reference year is 2009. This allows us to estimate the effect of the treatment not only for the post-reform years 2010-2012 as above, but also for the pre-reform years 2006-2008 in order to investigate potential anticipation of the reform. Figure 3 plots the key coefficient estimates associated to the interaction terms $Ratio \times Post^j$ from the modified equation (4.2) for our most demanding specification with controls and EPCI and county by year effects.[55] It corresponds to year estimates of the tax rate differential between municipalities with

[55] Table A.5 in Appendix D reports the point estimates and the 95% confidence interval both for the continuous specification (*Ratio* treatment variable) and for the discrete specification (*High* treatment variable).



(a) Business property tax regression



(b) Housing tax regression

Figure 3. Event study for the effect of the capital-share elimination on tax rates, 2006-2012. The figure plots, for the sample of all 11,896 municipalities, the coefficients on $Ratio \times Post^j$, where $Post^j$ is a time dummy for the year $20j$, $j = 06, 08, 10, 11, 12$. *Ratio* is the 2009 share of the eliminated capital tax base in the business property tax base consisting of capital and land. The regression also includes all the socio-demographic, political and economic variables described in the data section, individual time trends, and EPCI and county by year effects. Robust standard errors are clustered by 2009 EPCI.

high and low capital intensity measured relative to the omitted reference year of 2009.

Figure 3a indicates that more capital-intensive municipalities relative to less capital-intensive municipalities increased non-significantly their business property tax rate by roughly 0.01 points (resp. 0.1 and 0.04) between 2006 (resp. 2007 and 2008) and 2009. This strongly non-significant increase suggests that we can dismiss spurious anticipation of the reform, as expected from the timing of its implementation. However, the more capital-intensive municipalities significantly increased their relative business property tax rate in 2010 by 1.5 points. This is close to the 1.7 points relative increase reported in column 3 of Table 4. This relative rise quickly falls to become a non-significant relative increase of 0.004 point in 2011 and around 0 point in 2012 compared to 2009.

The evolution of the housing tax rate in more capital-intensive municipalities relative to less capital-intensive ones is fairly symmetric. It decreases non-significantly by less than 0.045 points between 2006 (resp. 2007 and 2008) and 2009. It knows a slightly significant decrease of 0.07 points in 2010 (a bit lower than the 0.12 points in Table 4). At the end of the sample period in 2011 and 2012 the relative housing tax rate decreases are non-significant. The most important evidence from the Figure 3 is that the event-study estimates reject significant effects of the reform prior to its implementation. Thus, the reform can be regarded as unanticipated by municipalities, which reinforces our DD identifying assumption.

6.3. Variation across municipality types

By aggregating the full sample of municipalities, the results presented above potentially hide heterogeneous effects of removal of the capital tax base on municipal tax rates. Table 5 explores this possible heterogeneity in treatment effect across three municipal characteristics: (non-)metropolitan, ideology and high/low new business tax revenue. It reports the baseline estimates of equation (4.1) for the most demanding specification comprising controls and EPCI and county by year effects, for six municipality sub-samples. Columns 1 and 2 present the estimates for metropolitan and non-metropolitan municipalities. Columns 3 and 4 report the respective results for municipalities where the majority voted for a left-wing candidate and a right-wing candidate in the 2007 presidential election. Columns 5 and 6 distinguish between municipalities collecting higher (above the 2011 median) and lower (below the 2011 median) new business tax revenues per capita after 2011. For each of these sub-samples, we report the treatment effect estimates on the interaction $Ratio \times Post$ when the dependent variable is business property tax and when it is the housing tax. We also report the sub-sample means for these two tax rates and the capital share in the business property tax base in 2009. For easier comparison of the treatment effect among sub-samples, we report each sub-sample average treatment effect (ATE) relative to the mean related tax rate of 2009.[56]

A first look at the estimated treatment effects in Table 5 shows that the coefficients (although not all significant) have the expected signs. That is, in each sub-sample, municipalities which had larger capital share of their pre-reform business property tax base removed, responded by increasing their business property tax rate and decreasing their housing tax rate relative to less capital-intensive municipalities. However, we observe substantial differences among sub-groups which call for further discussion. Columns

[56] As usual, the ATE is computed by multiplying the point estimates on $Post \times Ratio$ by the sub-sample average capital share in 2009.

1 and 2 indicate that the treatment effect on the business property tax rate is much lower for municipalities located in a metropolitan area compared to non-metropolitan municipalities: it represents only 2.3% of the tax rate of 2009 for the former and 16.7% for the latter. This suggests that capital mobility exerts a weaker downward pressure on business tax rates in metropolitan areas. This result supports one of the main results in the agglomeration economies literature which suggests that the existence of agglomeration rents in metropolitan areas tends to mitigate the tax competition result that capital mobility spurs local governments to lower their business tax rate.[57] The treatment effect of capital share removal is also lower (and non-significant)in the housing tax rate regression for municipalities in metropolitan areas compared to others: respectively −2% and −4.3% of the 2009 tax rate for the first and second sub-samples. This suggests that comparison of higher and lower capital-intensive municipalities reveals a weaker rebalancing of the tax burden from businesses to residents following the decrease in capital mobility in metropolitan areas.

Columns 3 and 4 in Table 5 show that municipalities with higher capital shares increased their business property tax rate relatively less if they included a majority of left-wing voters. Indeed, the (non-significant) estimate of 0.004 on $Ratio \times Post$ for left-wing jurisdictions is lower than the strongly significant estimate of 0.01 for right-wing ones. This difference is reflected also in the ATE relative to the tax rate voted in 2009 (2.9% for left wing municipalities against 8.8% for right wing ones). This finding suggests that ideology matters for the response of voted business tax rate to capital mobility. Left-leaning municipalities appear to be less sensitive to the downward pressure exerted by mobile capital. The treatment effect on housing is also interesting since in contrast to what we observed for the business property tax rate, left-wing municipalities with a more capital-intensive tax base prior to reform appear to reduce their tax rate to the same extent as their right-wing counterparts. Indeed, the ATE represents −4.08% of their 2009 tax rate and −4.06% of right-wing municipalities. This result can be interpreted as a sign that left-wing municipalities are *ceteris paribus* more prone (compared to right-wing ones) to alleviate the tax burden on households.[58]

[57] See the seminal theoretical paper by Baldwin and Krugman (2004). Contributions providing empirical evidence are, e.g., Charlot and Paty (2010), Luthi and Schmidheiny (2013) and Fréret and Maguain (2017).

[58] Although these preliminary findings call for deeper analysis, they are informative in regard of the contrasting results obtained in the political economy studies dealing with the link between ideology and local taxation. Indeed, while e.g. Pettersson-Lidbom (2008) finds empirical evidence of the impact of ideology on local tax level in the case of Swedish municipalities, Ferreira and Gyourko (2009) point out the "striking lack of partisan impact at the local level" in a study of American municipalities.

Table 5. Business property tax and housing tax regressions with two-period treatment.

	Metropolitan		Ideology		New Revenue	
	Yes	No	Left	Right	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
	A. Business property tax regression					
Ratio × *Post*	0.00271*	0.02110***	0.00411	0.00990***	0.00082*	0.00849**
	(0.00115)	(0.00490)	(0.00216)	(0.00278)	(0.00035)	(0.00278)
Mean tax rate 2009	.0951	.0986	.1138	.0905	.1036	.0883
ATE relative to tax rate 2009	.0231	.1674	.0285	.0881	.0065	.0743
	B. Housing tax regression					
Ratio × *Post*	-0.00209	-0.00418*	-0.00444*	-0.00409***	-0.00398	-0.00419***
	(0.00118)	(0.00181)	(0.00174)	(0.00116)	(0.00234)	(0.00114)
Mean tax rate 2009	.0844	.076	.086	.0812	.0904	.0743
ATE relative to tax rate tax rate 2009	-.02	-.0431	-.0408	-.0406	-.0365	-.0436
Capital share 2009	.808	.7824	.7906	.8052	.83	.7736
Municipalities	9001	2895	2786	9110	5948	5948

Note.—Each pair of sub-samples comprises all 11,896 municipalities from 2006 to 2012. *Ratio* is the 2009 share of the eliminated capital tax base in the business property tax base consisting in capital and land. *Post* is an indicator for post-reform years 2010-2012. The regressions also include all the socio-demographic, political and economic variables described in the data section, individual time trends, and EPCI and county by year effects. Sub-samples high and low new revenue are municipalities collecting per capita new business tax revenue — CVAE + IFER + TASCOM — above and below the sample median. Robust standard errors clustered by 2009 EPCI are reported in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

Finally, columns 5 and 6 in Table 5 distinguish municipalities collecting per capita new business tax revenues in 2011 above the sample median and those whose new business tax revenues are below the median.[59] Since municipalities have no decision power on the vote for these new business taxes which rely on the value-added generated by local firms (CVAE) and their size and sector (IFER and TASCOM), they receive high or low new business tax revenues depending on their economic structure. Comparison of the

[59] The new business tax revenues are the sum of the CVAE, the IFER and the TASCOM (see section 3 for definitions). We divide these revenues by the municipal population for the sake of comparability.

last two columns in Table 5 reveals that more capital-intensive municipalities (relative to less capital intensive ones) collecting high tax revenues from the new business taxes after the reform are able to raise their business property tax rates much less than their counterparts that collected lower new tax revenues. Indeed, the respective ATE relative to the 2009 tax rate of 0.65% and 7.43% indicates that municipalities with important new tax revenues responded substantially less to the reduced downward pressure induced by elimination of the mobile capital tax base. This result makes economic sense. While capital now does not figure in the business property tax base, these municipalities cannot charge overly high taxes on business land since this might cause firms to move and have important negative effects on the revenues from the new business taxes.[60] Finally, we see that removing the capital share gave these municipalities with higher new business tax revenues less latitude to cut their housing tax rate: their ATE relative to the 2009 tax rate is of −3.65% compared to −4.36% for the other municipalities. This can be viewed as a sign that their lower ability of increasing business property tax rates in response to the reform allow lower leeway to reduce the tax burden on residents.

7. Conclusion

This paper examined the relationship between tax base mobility and local taxation through theoretical and empirical analyses. The theoretical model derived local tax setting equations, which showed that decreasing the capital intensity of the business property tax base increases the business property tax rates and decreases the tax on residents. We tested this result using a French reform implemented in 2010 which changed the composition of the main local business tax base to reliance on a much less mobile tax base and implemented compensation for the tax base loss. The results of the empirical analysis are consistent with the theoretical predictions, and suggest that reducing the mobility of the tax base results in higher business property tax rates. Also, housing tax rates are negatively affected by the reform.

In terms of public policy implications, we show that the composition of the local tax base has a clear impact on the related tax decisions. Although exact compensation was paid to the municipalities after the reform, local governments seized the opportunity to increase their tax rates on a less mobile tax base. However, since we do not know whether local business tax rates were initially lower or higher than the optimal level, we cannot draw conclusions as to the efficiency of the reform.

[60] Recall that the new business taxes (CVAE, IFER and TASCOM) are note voted for by the municipalities. They only depend on the type and size of firms they host.

Our analysis points to the need for more theoretical and empirical investigations of tax base reforms. A similar reform of the French national tax system is currently being discussed in France. Indeed, in the Draft Budget Bill for 2018, government proposed removing the most mobile part (based on capital) of the solidarity tax base on wealth ISF (initially based on capital and real property). We can expect this reform to produce a higher tax rate on the immobile tax base of the new ISF (real property), called tax on real property wealth (IFI). Unlike the business property tax reform studied in this paper, this increase would be due to both a capital-mobility effect and a budgetary effect since the draft budget bill does not stipulate complete budget compensation.

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Appendix A Derivation of the local public policy rules

The purpose of this appendix section is, first, to derive the optimal ta conditions (TR^0), (BC^0), (TR^0) and (TR^1) (Public policy rules),[61] which requires to characterize the first-order conditions of the local government (First-order conditions), as well as the location responses of resident and capital to local policy changes (Location responses) .The second objective of this appendix section is to derive the tax rate change conditions (2.10a) and (2.10b) in the presence of a perfect revenue compensation (Tax rate evolution in the presence of a revenue compensation). We focus on the representative jurisdiction i in all this appendix. We drop index i for notational convenience.

A.1 First-order conditions

The benevolent local government maximizes the utility of its residents $U \equiv U(x, G, R) = x + \alpha \log(G/R)$ which, by substituting x using (2.1), can be written as:

$$U = \frac{r\mathcal{K} + \rho\ell + (n-1)\bar{\rho}\ell}{\mathcal{P}} + \alpha \log\left(\frac{G}{R}\right) - \rho - \tau^R,$$

where $\bar{\rho} \equiv \rho_j$ with $j \neq i$ denotes the other municipalities' land rent. Using respectively (2.2) and (2.4) to substitute τ^R and ℓ, we obtain:

$$U = \frac{r\mathcal{K} + \rho R + \rho L + (n-1)\bar{\rho}\bar{\ell}}{\mathcal{P}} + u. \tag{A.1}$$

Since F is homogeneous of degree 1, Euler's theorem requires that $F = KF_K + LF_L$, where subscripts stand for derivatives. Inserting (2.3) into this condition implies the zero-profit condition $F^i(K_i, L_i) - [r + (1-\theta)\tau_i^P]K_i - (\rho_i + \tau_i^P)L_i = 0$. Replacing ρR and ρL into (A.1) using respectively (2.2) and the zero-profit condition yields:

$$U = \frac{\left[\alpha \log\left(\frac{G}{R}\right) - \tau^R - u\right] R + F - \left[\bar{r} + \tau^P(1-\theta)\right] K - \tau^P L + r\mathcal{K} + (n-1)\bar{\rho}\bar{\ell}}{\mathcal{P}} + u$$

From the household budget constraint (2.1), it follows that the local government objective can be written as:

$$U = \frac{F(K, \ell - R) - \bar{r}K + \left[\alpha \log\left(\frac{G}{R}\right) - u\right] R - G - f + \theta\Lambda + r\mathcal{K} + (n-1)\bar{\rho}\bar{\ell}}{\mathcal{P}} + u \tag{A.2}$$

where L has been substituted in the production function using (2.1).

[61] To this aim, we follow standard computational steps. See e.g. Wellisch (2006).

In the sequel, we assume without loss of generality that the local government freely chooses τ^R and G while adjusting τ^P to clear its budget constraint (2.5).[62] Since household and capital locations are not under the direct control of the local government, a rational government must take account of location responses to its policy. The responses of residents ($\partial R/\partial \tau^R$ and $\partial R/\partial G$) and capital ($\partial K/\partial \tau^R$ and $\partial K/\partial G$) to changes in the local government's policy instruments can be derived from the migration equilibrium condition (2.2) and the necessary conditions for the optimal demand for capital (2.3a) from local firms. Inserting (2.4) and (2.3b) into (2.2) and (2.3a) and substituting τ^P using the budget constraint (2.5) the following two-equation system results:

$$F_K(K, \ell - R) - \frac{G + f - \theta\Lambda - \tau^R R}{(1-\theta)K + \ell - R}(1-\theta) - r = 0 \tag{A.3}$$

$$\alpha \log\left(\frac{G}{R}\right) - F_L(K, \ell - R) - \tau^R + \frac{G + f - \theta\Lambda - \tau^R R}{(1-\theta)K + \ell - R} - u = 0 \tag{A.4}$$

The location system allows to derive R and K as implicit functions of τ^R and G.

Let us now determine the first-order conditions of the local government. Differentiating (A.2) with respect to $t \in \{\tau^R, G\}$, we have $\partial U/\partial t = 0$ is equivalent to:

$$[F_K - r]\frac{\partial K}{\partial t} + \left[\alpha \log\left(\frac{G}{R}\right) - u - F_L - \alpha\right]\frac{\partial R}{\partial t} + \left(\alpha\frac{R}{G} - 1\right)\frac{\partial G}{\partial t} = 0.$$

Replacing u, F_K and F_L using (2.2), (2.3a) and (2.3b) and collecting terms, the following first-order conditions result:

$$(\tau^R - \tau^P - \alpha)\frac{\partial R}{\partial \tau^R} + \tau^P(1-\theta)\frac{\partial K}{\partial \tau^R} = 0 \tag{A.5}$$

$$(\tau^R - \tau^P - \alpha)\frac{\partial R}{\partial G} + \tau^P(1-\theta)\frac{\partial K}{\partial G} + \alpha\frac{R}{G} - 1 = 0 \tag{A.6}$$

A.2 Location responses

We now determine the location responses of residents and capital. To this aim, we differentiate (A.3) and (A.4) with respect to $t \in \{\tau^R; \tau^P\}$, which yields in matrix form:

$$A\begin{pmatrix} \frac{\partial R}{\partial t} \\ \frac{\partial K}{\partial t} \end{pmatrix} = B$$

where

[62] This assumption allows to solve the model without introducing a Lagrange multiplier for the budget constraint of the local government. Note that whatever the instrument chosen to clear the budget (τ^R, τ^P of G), the results are strictly identical.

$$A \equiv \begin{pmatrix} \frac{(1-\theta)(\tau^R-\tau^P)}{(1-\theta)K+\ell-R} - F_{KL} & F_{KK} + \frac{\tau^P(1-\theta)^2}{(1-\theta)K+\ell-R} \\ -\frac{\alpha}{R} + F_{LL} - \frac{\tau^R-\tau^P}{(1-\theta)K+\ell-R} & -\frac{\tau^P(1-\theta)}{(1-\theta)K+\ell-R} - F_{LK} \end{pmatrix} \tag{A.7}$$

and

$$B \equiv \begin{pmatrix} \frac{(1-\theta)}{(1-\theta)K+\ell-R}\left[\frac{\partial G}{\partial t} - R\frac{\partial \tau^R}{\partial t}\right] \\ \left[1 + \frac{R}{(1-\theta)K+\ell-R}\right]\frac{\partial \tau^R}{\partial t} - \left[\frac{1}{(1-\theta)K+\ell-R} + \frac{\alpha}{G}\right]\frac{\partial G}{\partial t} \end{pmatrix} \tag{A.8}$$

Then, from Cramer's rule:

$$\frac{\partial R}{\partial t} = |A|^{-1} \begin{vmatrix} \frac{(1-\theta)}{(1-\theta)K+\ell-R}\left[\frac{\partial G}{\partial t} - R\frac{\partial \tau^R}{\partial t}\right] & F_{KK} + \frac{\tau^P(1-\theta)^2}{(1-\theta)K+\ell-R} \\ \left[1 + \frac{R}{(1-\theta)K+\ell-R}\right]\frac{\partial \tau^R}{\partial t} - \left[\frac{1}{(1-\theta)K+\ell-R} + \frac{\alpha}{G}\right]\frac{\partial G}{\partial t} & -\frac{\tau^P(1-\theta)}{(1-\theta)K+\ell-R} - F_{LK} \end{vmatrix}, \tag{A.9}$$

$$\frac{\partial K}{\partial t} = |A|^{-1} \begin{vmatrix} \frac{(1-\theta)(\tau^R-\tau^P)}{(1-\theta)K+\ell-R} - F_{KL} & \frac{(1-\theta)}{(1-\theta)K+\ell-R}\left[\frac{\partial G}{\partial t} - R\frac{\partial \tau^R}{\partial t}\right] \\ -\frac{\alpha}{R} + F_{LL} - \frac{\tau^R-\tau^P}{(1-\theta)K+\ell-R} & \left[1 + \frac{R}{(1-\theta)K+\ell-R}\right]\frac{\partial \tau^R}{\partial t} - \left[\frac{1}{(1-\theta)K+\ell-R} + \frac{\alpha}{G}\right]\frac{\partial G}{\partial t} \end{vmatrix} \tag{A.10}$$

where $|A|$ is the determinant of A, and for all $t \in \{\tau^R; G\}$, $\partial t/\partial t'$ is 1 if $t = t'$ and 0 otherwise.

A.3 Public policy rules

We can now determine the public policy rules by inserting the location responses (A.9) and (A.10) into the first-order conditions (A.5) and (A.6). Let us start with the taxation rules (TR^0) and (TR^1). Replacing t by τ^R in the location responses and inserting them into (A.5), we obtain:[63]

$$\begin{vmatrix} -\frac{(1-\theta)R}{(1-\theta)K+\ell-R} & F_{KK}\left[(\tau^R-\tau^P-\alpha) + \frac{F_{KL}}{F_{KK}}\tau^P(1-\theta)\right] - \alpha\frac{\tau^P(1-\theta)^2}{(1-\theta)K+\ell-R} \\ 1 + \frac{R}{(1-\theta)K+\ell-R} & -F_{LK}\left[(\tau^R-\tau^P-\alpha) + \frac{F_{LL}}{F_{LK}}\tau^P(1-\theta)\right] + \left[1 + \frac{R}{(1-\theta)K+\ell-R}\right]\frac{\alpha}{R}\tau^P(1-\theta) \end{vmatrix} = 0.$$

Applying the column operation $C2 \leftarrow C2 - \frac{\alpha}{R}\tau^P(1-\theta) \times C1$ and noticing $\frac{F_{KL}}{F_{KK}} = \frac{F_{LL}}{F_{LK}} = -\frac{K}{L}$ the derivative of F are homogeneous of degree 0, we obtain:

$$\begin{vmatrix} -\frac{(1-\theta)R}{(1-\theta)K+\ell-R} & F_{KK} \\ \frac{(1-\theta)K+\ell}{(1-\theta)K+\ell-R} & -F_{LK} \end{vmatrix} \left[\tau^R - \tau^P - \alpha - \frac{K}{L}\tau^P(1-\theta)\right] = 0.$$

[63] Recall that from usual determinant computation rules, we have:

$$\alpha \begin{vmatrix} a & c \\ b & d \end{vmatrix} + \beta\alpha \begin{vmatrix} e & a \\ f & b \end{vmatrix} = \alpha \begin{vmatrix} a & \alpha c - \beta e \\ b & \alpha b - \beta f \end{vmatrix}.$$

The determinant is negative due to the standard assumption $F_{KK} < 0$ (which implies $F_{KL} > 0$ by homogeneity F) so that:

$$\tau^R - \tau^P - \alpha - \frac{K}{L}\tau^P(1-\theta) = 0 \tag{A.11}$$

which is precisely the taxation rule (TR^0), for $\theta = 0$ and (TR^1), for $\theta = 1$.

We now derive the local public good provision rule.[64] Replacing t by G in the location responses and inserting them into (A.6), and following the same computation step as above, it follows that:

$$\begin{vmatrix} \frac{1-\theta}{(1-\theta)K+\ell-R} & F_{KK}\left[(\tau^R - \tau^P - \alpha) - \frac{K}{L}\tau^P(1-\theta)\right] - \alpha\frac{\tau^P(1-\theta)^2}{(1-\theta)K+\ell-R} \\ -\frac{1}{(1-\theta)K+\ell-R} - \frac{\alpha}{G} & -F_{LK}\left[(\tau^R - \tau^P - \alpha) - \frac{K}{L}\tau^P(1-\theta)\right] + \left[1 + \frac{R}{(1-\theta)K+\ell-R}\right]\frac{\alpha}{R}\tau^P(1-\theta) \end{vmatrix}$$
$$+ \left(\alpha\frac{R}{G} - 1\right)|A| = 0$$

Using (A.11) to simplify and applying the column operation $C2 \leftarrow C2 + \frac{G}{R}\tau^P(1-\theta) \times C1$, we obtain:

$$\begin{vmatrix} \frac{1-\theta}{(1-\theta)K+\ell-R} & -\frac{\tau^P(1-\theta)^2}{(1-\theta)K+\ell-R}\left(\alpha - \frac{G}{R}\right) \\ -\frac{1}{(1-\theta)K+\ell-R} - \frac{\alpha}{G} & \frac{\tau^P(1-\theta)}{(1-\theta)K+\ell-R}\left(\alpha - \frac{G}{R}\right) \end{vmatrix} + \left(\alpha\frac{R}{G} - 1\right)|A| = 0$$

which gives:

$$\left(\alpha\frac{R}{G} - 1\right)\left[|A| - \frac{\alpha}{R}\frac{\tau^P(1-\theta)^2}{(1-\theta)K + \ell - R}\right] = 0 \tag{A.12}$$

Yet, replacing replacing τ^R from (A.11) in A as defined by (A.7) and developing its determinant, we obtain after some simple manipulations:

$$|A| = \frac{\alpha}{R}\frac{\tau^P(1-\theta)^2}{(1-\theta)K + \ell - R} + \frac{\alpha\ell}{RL}F_{KK} \tag{A.13}$$

which shows that the term between square brackets (A.12) is non zero, so that the government public good policy is characterized by:

$$\alpha\frac{R}{G} = 1 \tag{A.14}$$

which is the well-known Samuelson rule (see footnote 18).

We can now derive the budget constraint rules (BC^0) and (BC^1). Inserting (A.14) into the local government budget constraint (2.5) and solving for τ^P, we obtain:

$$\tau^P = \frac{R}{(1-\theta)K + L}\left(\alpha - \tau^R + \frac{f - \Lambda}{R}\right)$$

which is precisely the taxation rule (BC^0), for $\theta = 0$ and (BC^1), for $\theta = 1$.

[64] Public good provision is rather peripheral in this paper, but deriving the public good provision rule is necessary to derive the tax reduced forms.

A.4 Tax rate evolution in the presence of a revenue compensation

In this last subsection, we derive the tax rate change equations (2.10a) and (2.10b). In the presence of a revenue compensation $\Lambda = \tau^{P0}K^0$, from (2.8b) and (2.8a), we have:

$$\tau^{P1} - \tau^{P0} = \frac{f}{\ell} - \frac{\tau^{P0}K^0}{\ell} - (1-\kappa^0)\frac{f}{\ell}$$

Substituting τ^{P0} and ℓ using (2.8a) and (2.4), replacing κ^0 by its definition (ie. $K^0/(K^0+L^0)$) we obtain:

$$\tau^{P1} - \tau^{P0} = \frac{(R^0+L^0)(K^0+L^0) - (R^0+L^0+K^0)L^0}{K^0+L^0}\frac{f}{\ell^2} = R^0\frac{f}{\ell^2}\frac{K^0}{K^0+L^0} = \frac{\mathcal{P}}{\mathcal{L}}\frac{f}{\ell}\kappa^0, \tag{A.15}$$

where the last equality is obtained using the definition of κ^0, recalling that $R^0 = \mathcal{P}$ in the symmetric equilibrium and that by definition $n\ell = \mathcal{L}$. This proves the tax rate change equation (2.10a).

Let us now turn to evolution of the tax on resident. Replacing τ^{P0} using (2.8a) into (2.7a), we have:

$$\tau^{R0} = \alpha + \tau^{P0} + \frac{f}{\ell}\kappa^0 \tag{A.16}$$

Besides, using (A.15) so substitute τ^{P1} into (2.7b) yields:

$$\tau^{R1} = \alpha + \tau^{P0} + \frac{\mathcal{P}}{\mathcal{L}}\frac{f}{\ell}\kappa^0 \tag{A.17}$$

Finally, the difference between (A.17) and (A.16) gives the tax rate change equation (2.10b).

Appendix B Institutional setting of the different government layers

Table A.1. Indirect taxes available before and after the reform.

	$\leq$ 2009					$\geq$ 2011				
	TP	TP bis	TH	TFB	TFNB	CFE	CVAE	TH	TFB	TFNB
Mun./EPCI	x	x	x	x	x	x	x	x	x	x
County	x	x	x	x	x		x		x	
Region	x	x		x	x		x			

NOTE.—Crosses indicate that the jurisdiction — municipality , EPCI, county or region — has authority to vote its own tax rate. TP, TH, TFB and TFNB respectively stand for business property tax, housing tax, tax on developed property and tax on undeveloped property. CFE is the new business property tax relying exclusively on business land, and CVAE is the new business value added tax.

Appendix C Complementary descriptive statistics

Table A.2. Descriptive statistics on control variables in 2009.

	Mean	Standard deviation	Minimum	Maximum
Municipal characteristics				
Population (in thousands)	1.3	20.8	.009	2234
Density	0.1	0.7	3.5e-04	26
Number of firms per inhabitant	0.1	0.1	.012	.95
Metropolitan (dummy)	0.8	0.4	0	1
Median income *(in 10,000 €)*	1.8	0.3	.91	5.4
Share of commuters *(%)*	74.7	14.6	3.7	100
Share of left-wing voters *(%)*	42.4	10.9	0	94
Share of population below 15 year old *(%)*	32.7	6.0	2.9	68
Schooling rate *(%)*	92.9	4.1	50	100
Share of population per SPC (%)				
Farmers	3.9	5.1	0	67
Craftsmen	4.2	3.2	0	50
Managers	5.0	4.3	0	57
Temporary workers	12.2	6.0	0	100
Employees	15.4	5.4	0	65
Blue color workers	16.4	7.0	0	67
Retirees	30.1	10.1	0	100
Unemployed	12.9	5.3	0	80
Share of firms per sector (%)				
Industry	44.3	20.6	0	98
Fincance and real estate	2.2	3.1	0	50
Trade and retail	12.5	8.2	0	67
Other tertiary sector	26.7	13.2	1.4	100
Share of firms per size (%)				
No employee	70.4	12.5	0	100
Less than 10 employees	25.9	10.8	0	100
At least 10 employees	3.7	4.5	0	54

NOTE.—The sample includes all 11,896 municipalities for the year 2009. Density is the number of inhabitants (in thousands) per square kilometer. Share of left-wing voters is that of the presidential election of 2007. Schooling rate is the share of population below 17 year old enrolled in school.

Table A.3. Descriptive statistics per category of capital share intensity.

	2006	2007	2008	2009	2010	2011	2012
	A. Capital share below the median						
Capital share	.6909	.6891	.6859	.6741			
	(.2243)	(.2253)	(.2288)	(.2364)			
Business property tax rate	.1007	.1007	.1011	.1013	.184	.1857	.1869
	(.0574)	(.0575)	(.0578)	(.0584)	(.0683)	(.0665)	(.0665)
Housing tax rate	.0867	.0869	.0874	.0883	.089	.1578	.1584
	(.0374)	(.0374)	(.0376)	(.0379)	(.0403)	(.0496)	(.0499)
Observations	5948	5948	5948	5948	5948	5948	5948
	B. Capital share above the median						
Capital share	.9098	.9161	.9229	.9294			
	(.0675)	(.0582)	(.0448)	(.0354)			
Business property tax rate	.0897	.0897	.0901	.0906	.1749	.1746	.1756
	(.0466)	(.0467)	(.0467)	(.0467)	(.0535)	(.0549)	(.0555)
Housing tax rate	.075	.0751	.0757	.0764	.0769	.1453	.146
	(.0347)	(.0347)	(.0349)	(.0351)	(.0373)	(.0477)	(.0481)
Observations	5948	5948	5948	5948	5948	5948	5948

NOTE.—Each cell contains the variable mean and standard error in parentheses. Panel A (resp. Panel B) describe municipalities with a share of capital in the business property tax below (resp. above) the median. The sample median of the capital share in 2009 is 86.76%.

Table A.4. Correlation between net and gross business property tax base.

Year	Pearson's coefficient	Spearman's coefficient
2006	99.9949	99.3043
2007	99.9945	99.319
2008	99.9931	99.3118
2009	99.9928	99.2703
2010	99.981	97.2859
2011	99.9787	97.2934
2012	99.9836	97.5448

NOTE.—N=11,896. The table reports correlation coefficients between the gross tax base GB and the net tax base NB of the business property tax. In the pre-reform years 2006-2009, $GB = K + L$ and $NB = \alpha_K K + \alpha_L L$, where K (resp. L) is the capital (resp. business land) tax base, and α_K (resp. α_L) is the share of the tax base not exempted from tax. In the post-reform years 2010-2012, $GB = L$ and $NB = \alpha_L L$. The significance tests for all coefficients are below 10^{-6}, so that they strongly reject non significance of the correlation.

Appendix D Event study estimates

Table A.5. Event study coefficients for the continuous and discrete regressions.

	Dependent variable: Business property tax		Dependent variable: Housing tax	
	Coef.	95%CI	Coef.	95%CI
	A. Continuous treatment			
$Ratio \times Post^{06}$	−.00096	[−.00949 ; .00757]	.00045	[−.00133 ; .00223]
$Ratio \times Post^{07}$	−.00123	[−.00706 ; .0046]	.00023	[−.00097 ; .00142]
$Ratio \times Post^{08}$	−.00036	[−.00339 ; .00268]	.00009	[−.00053 ; .0007]
$Ratio \times Post^{10}$	.01552	[.00907 ; .02197]	−.00072	[−.00132 ; −.00013]
$Ratio \times Post^{11}$	.00371	[−.0038 ; .01123]	−.00031	[−.00175 ; .00113]
$Ratio \times Post^{12}$	.00009	[−.00909 ; .00926]	−.00054	[−.00245 ; .00136]
	B. Discrete treatment			
$High \times Post^{06}$	.00045	[−.00027 ; .00116]	.00041	[−.00015 ; .00097]
$High \times Post^{07}$	.00016	[−.00038 ; .00069]	.00026	[−.00013 ; .00065]
$High \times Post^{08}$	−.00019	[−.00055 ; .00017]	.00021	[−.00002 ; .00044]
$High \times Post^{10}$	.00129	[.00027 ; .00231]	−.00031	[−.00053 ; −.00009]
$High \times Post^{11}$	−.00075	[−.00188 ; .00038]	−.00075	[−.00183 ; .00033]
$High \times Post^{12}$	−.00136	[−.00258 ; −.00014]	−.00086	[−.00201 ; .00028]

Note.—The sample is all 11,896 municipalities from 2006 to 2012. The table reports the coefficients on $Ratio \times Post^j$ and $High \times Post^j$ of respectively the continuous and discrete event-study regressions. $Post^j$ is a time dummy for the year $20j$, $j = 06, 08, 10, 11, 12$. *Ratio* is the 2009 share of the eliminated capital tax base in the business property tax base consisting in capital and land. *High* is an indicator equal to one if a municipality has a 2009 capital share above the sample median, and zero otherwise. The regression also includes all the socio-demographic, political and economic variables described in the data section, individual time trends, and EPCI and county by year effects. Robust standard errors are clustered by 2009 EPCI.