

Document de treball de l'IEB 2015/28

MARKET STRUCTURE, THE FUNCTIONAL FORM OF DEMAND AND THE
SENSITIVITY OF THE VERTICAL REACTION FUNCTION

Agustin Redonda

Tax Systems Analysis

**MARKET STRUCTURE, THE FUNCTIONAL FORM OF DEMAND AND THE
SENSITIVITY OF THE VERTICAL REACTION FUNCTION**

Agustin Redonda

The **IEB** research program in **Tax Systems Analysis** aims at promoting high quality research in the field of taxation, taking into account not only the traditional approach to optimal taxation, but also administrative issues and the decentralization or globalization context. The ultimate aim of the program is to generate socially useful knowledge in this field. Special emphasis is put on empirical research, and on the analysis of the Spanish Tax System. The program enjoys the support from the **IEB-Foundation**.

The **Barcelona Institute of Economics (IEB)** is a research centre at the University of Barcelona (UB) which specializes in the field of applied economics. The **IEB** is a foundation funded by the following institutions: Applus, Abertis, Ajuntament de Barcelona, Diputació de Barcelona, Gas Natural, La Caixa and Universitat de Barcelona.

Postal Address:

Institut d'Economia de Barcelona
Facultat d'Economia i Empresa
Universitat de Barcelona
C/John M Keynes, 1-11
(08034) Barcelona, Spain
Tel.: + 34 93 403 46 46
ieb@ub.edu
<http://www.ieb.ub.edu>

The IEB working papers represent ongoing research that is circulated to encourage discussion and has not undergone a peer review process. Any opinions expressed here are those of the author(s) and not those of IEB.

**MARKET STRUCTURE, THE FUNCTIONAL FORM OF DEMAND AND THE
SENSITIVITY OF THE VERTICAL REACTION FUNCTION ***

Agustin Redonda

ABSTRACT: Tax incidence and tax competition have largely been studied separately. Models assessing the incidence of excise taxes do not consider strategic interaction and exclusively assess the pass-through of taxes to prices. These settings focus on imperfectly competitive markets where prices can react more (less) than proportionally to a variation in tax rates. On the other hand, tax competition models focus on the strategic interactions arising because of a shared tax base but assume producer prices to be constant. Hence, the pass-through of taxes is restricted to be fully on consumers. This paper extends Keen (1997) by relaxing this assumption and, thus, by allowing local governments to internalize the possibility that taxes are over-shifted (undershifted). Interestingly, market structure (that was absent in previous settings), turns out to be one of the determinants of the vertical reaction function in this model; particularly determining the sensitivity of local tax setters to a variation of higher-tier taxes.

JEL Codes: H22, H70, D43, L13

Keywords: Vertical tax competition, pass-through, market structure, excise taxes, tax incidence

Agustin Redonda
Council on Economic Policies (CEP)
Seefeldstrasse 60, 8008 Zürich, Switzerland
E-mail: ar@cepweb.org

* I thank Marius Brühlhart Michael P. Devereux, Mario Jametti, Patrick Lenain, Gilbert Metcalf, Mario Padula and Raphaël Parchet, and conference and workshop participants at ZEW (Mannheim), IEB (Barcelona), EconTax (Mons) and the University of Lugano for particularly helpful comments. Financial support from the Swiss National Science Foundation (grants Sinergia 130648 and 147668) is gratefully acknowledged. I am solely responsible for any remaining errors or omissions.

1 Introduction

The tax incidence literature is unconcerned about tax competition issues. Indeed, traditional tax incidence models usually consider tax rates to be exogenously determined and focus on the pass-through of taxes to consumer prices without taking the tax setting-process into account.¹ On the other hand, several strands of literature such as optimal taxation and tax competition do focus on the tax setting decision but do not consider tax incidence. Standard tax competition models, for example, consider the strategic tax setting by different levels of government (or different jurisdictions belonging to the same tier of government) sharing the tax base but implicitly assume that the incidence of taxes is fully on consumers by assuming producer prices to be constant.² Therefore, the potential under-/overreaction of prices to a variation in tax rates is ruled out.

Interestingly though, both strands of literature do have some common features. The functional form of demand, for instance, plays a key role in both frameworks. In a tax incidence setting, a linear demand function implies undershifting and an iso-elastic demand function results in overshifting of taxes.³ Similarly, in a vertical tax competition framework, the sign of the reaction function is determined by the curvature of demand. Keen (1997) is among the first to show the importance of the functional form of demand to determine the sign of the vertical reaction function. As it is standard in theoretical tax competition studies, the interpretation of the results goes through the analysis of two special cases: linear and iso-elastic demand functions. Whilst the former implies that taxes are strategic substitutes (i.e., the vertical reaction function is negative), the latter suggests strategic complementarity (i.e., the vertical reaction function is positive). Devereux et al. (2007) extend Keen's setting by allowing for horizontal competition (introduced by cross-border shopping). The authors show that, in the symmetric case, the horizontal reaction function between two states (i and j) is always positive i.e., ($\frac{dt_i}{dt_j} = \frac{dt_j}{dt_i} > 0$). Moreover, even in the presence of individual's preferences heterogeneity, sufficient conditions for this result to hold are not too strong. More recently, Agrawal (2015) goes one step forward by introducing multiple competing federal governments and, thus, by allowing for diagonal externalities i.e., fiscal externalities between neighboring jurisdictions that are of a different level of government. The author finds that diagonal interactions have the same sign as horizontal ones, but are smaller in magnitude.⁴ All these papers assume

¹Krzyzaniak and Musgrave (1963) were among the first to suggest that, in oligopolistic and monopolistic markets, taxes could be overshifted to final prices. Katz and Rosen (1985), Seade (1985) and Besley (1989) are among the main theoretical references having taken up their point. For a detailed review on tax incidence literature, see Fullerton and Metcalf (2002).

²See, for instance, Keen (1997) and Devereux et al. (2007).

³For the sake of correctness, two parameters define the under/overshifting condition in tax incidence models: the functional form of demand and cost functions. Though, as described by Seade (1985) and Besley (1989), under fairly standard assumptions and without too much loss of generality, the tax incidence condition is uniquely determined by the curvature of the demand function.

⁴Other papers explore different aspects of tax competition. Esteller-Moré et al. (2012), for instance, consider a similar setting to the one in this paper i.e., a federation with two layers of government, in which Leviathan policy makers levy excise taxes on a consumption good and that is produced in an imperfectly competitive market. Nevertheless, their focus is on the negative externality produced by the good and,

producer prices to be constant. Hence, the pass-through of taxes is restricted to be fully on consumers and, therefore, the possibility of an overreaction of prices to taxes is ruled out by construction. This is particularly striking because excise taxes are usually levied in oligopolistic, highly-concentrated markets such as those for cigarettes, gasoline or alcohol beverages. As it is well known from tax incidence literature, under imperfectly competitive markets prices can react more (less) than proportionally to a variation in tax rates i.e., taxes can be overshifted (undershifted). In other words, by assuming producer prices to be constant, previous tax competition models constraint taxes to be fully shifted to consumers and, thus, rule out any potential impact coming from tax incidence features.

To sum up, this paper extends the simplest model of tax competition in excise taxes that was set in Keen (1997), where only vertical interactions are considered, by relaxing the assumption that producer prices are constant and, therefore, by explicitly introducing the tax incidence features that were ruled out. By allowing prices to under/overreact to a variation in tax rates, market structure turns out to have a key role in determining the vertical reaction function. The sign of the reaction function (and, thus, the complementarity/substitutability condition) is not modified but, interestingly, the number of firms in the industry has now an impact on the sensitivity of the vertical reaction. In other words, the level of market concentration determines how reactive local taxes are to a variation in higher-tier tax rates.

The rest of the paper is structured as follows. In next section the model is set up and solved backwards. Section 3 derives the vertical reaction function in both settings. First, $\frac{dt}{dT}$ is derived by constraining taxes to be fully-shifted to prices as in Keen (1997) and, afterwards, without imposing any restriction on the shifting of taxes. Finally, Section 4 provides some concluding remarks.

2 The model

2.1 Setting

This model extends a vertical tax competition model *à la* Keen (1997) by adding a traditional Cournot setting as the one developed in Tirole (1988) as the second stage of the game. Moreover, given the scope of the paper, an excise tax ($\tau = t + T$) is added to the profit function of the firm. While t is the excise tax rate applied by the local government, T is the one applied by the higher-tier or federal government. Firms react in the same way no matter the level of government levying the tax.⁵

The goal of the model is to endogenize the (local) tax setting decision by assuming that particularly, on the influence that special interest groups may have on tax policy by lobbying the policy makers. The authors find that depending on market structure and on the level of the externality, lobbying can improve efficiency, and that tax-base sharing by the two levels of government can also be more efficient than taxation by a single layer.

⁵A few empirical papers such as Chouinard and Perloff (2007) and Marion and Muehlegger (2011) assess the differences in the pass-through depending on the level of government levying the tax. Nevertheless, this remains an empirical issue and, as it is standard in theoretical tax incidence models this distinction is not taken into account in this model.

lower-tier policy makers anticipate the reaction of firms to τ and adjust their decisions in consequence. In other words, local governments take firm's under/overshifting of taxes into account when setting the tax rates t .

There are three different agents in the economy: policy makers (federal and lower-tier governments), producers and consumers.⁶ The federal government sets a tax rate T that is assumed exogenous for the rest of the agents. Then, in the first stage of the game, local governments in each state $j = 1, \dots, S$ play Nash with respect to the federal government and react to T by setting t_j in order to maximize revenue $R_j = t_j X_j$, where X_j is the tax base. There are $i = 1, \dots, N$ profit-maximizing firms competing *à la* Cournot by choosing their level of output q_i so that $\sum_{i=1}^N q_i = Q$. Finally, following Keen (1997), I characterize consumers' preferences by the indirect utility function $\nu(P) + \Gamma(g, G)$, where $\nu_i(\cdot)$ and $\Gamma_i(\cdot)$ are strictly concave; g and G are the quantities of local and federal public goods, respectively and P is the consumer price of the taxed good. I assume additivity in (\cdot) in order to assure that the demand for the taxed good, $x(P) = -\nu'(P)$ (by Roy's identity), is independent of public expenditure.

The model is set as a two-stage game. In the first stage, the tax policy t is determined. In the latter one, firms maximize profits given the tax rates set in the previous stage and the equilibrium is determined. The model is solved backwards.

2.2 Backwards solution

2.2.1 Second stage

Firms play a Cournot-Nash game in which they compete by choosing their level of output q_i conditional on the expectations of their competitors' output levels. Let firm i 's profit function be:

$$\pi_i = P(q_i + Q_{-i})q_i - c(q_i) - \tau q_i, \quad (1)$$

where q_i is the level of output of firm i , Q_{-i} is the output of all other firms in the industry and $P(Q)$ is the inverse demand function for market demand Q . Finally, $c(\cdot)$ is the cost function that is assumed identical for each firm. Indeed, since the model focuses on symmetric equilibria, firms are assumed to be symmetric. Thus,

$$Nq = Q. \quad (2)$$

Hence, subscripts are dropped and Equation (1) is re-expressed as follows:

$$\pi = P(Nq)q - c(q) - \tau q. \quad (1.1)$$

⁶The lower tier of government will be called local or state government throughout the paper.

The first- and second-order conditions for a given firm are as follows:⁷

$$\frac{d\pi}{dq} = \frac{dP}{dq}q + P - \frac{dc}{dq} - \tau = 0 \quad (3)$$

$$\frac{d^2\pi}{dq^2} = \frac{d^2P}{dq^2}q + 2\frac{dP}{dq} - \frac{d^2c}{dq^2} < 0. \quad (4)$$

Finally, solving Equation (3) for q , one gets the following equilibrium expression for the firms' output:

$$\hat{q} = \frac{\frac{dc}{dq} + \tau - P}{\frac{dP}{dq}}. \quad (5)$$

2.2.2 First stage

As it was mentioned above, local tax rates are set in the first stage of the game. As the focus of the paper is on vertical interactions, states are assumed to be symmetric ($t_j = t$); each consisting of a single representative consumer. In addition, the tax base is assumed to be completely immobile across states. These two assumptions considerably simplify the model. First, by ruling out horizontal competition. Second, by imposing a single consumer one can define the tax base for each state equal to the individual demand of the single consumer living in that jurisdiction i.e., $X = x(P)$. Indeed, using the equilibrium condition ($X = Q$), one can define the tax base in each state as $X = x(P) = Q$.

Local governments are Leviathans and, thus, aim at maximizing revenue $R = tX = tQ$ by setting t . Therefore, the first- and second-order conditions of the revenue maximizing problem are the following ones:⁸

$$\frac{dR}{dt} = Q + t\frac{dQ}{dt} = 0 \quad (6)$$

$$\frac{d^2R}{dt^2} = 2\frac{dQ}{dt} + t\frac{d^2Q}{dt^2} < 0. \quad (7)$$

Now, solving Equation (6) for t by using the chain rule (i.e., $\frac{dQ}{dt} = \frac{dQ}{dP} \frac{dP}{dt}$), one obtains the following expression for the equilibrium tax rate:

$$\hat{t} = -\frac{Q}{\frac{dQ}{dP} \frac{dP}{dt}}. \quad (8)$$

⁷Note that tax incidence models usually use a slightly different notation than the one used in this stage of the game. For example, in Equation (3) most of these studies would have used π' to indicate "the derivative of the profit function with respect to q " rather than $\frac{d\pi}{dq}$. The reason to use a different notation is simply that this is the one used in tax competition settings and, thus, in the first stage of this model. In other words, given that tax incidence and tax competition models use different notations, I decided to stick to the one used in tax competition settings by adjusting the notation used in this stage of the game.

⁸The second-order condition is assumed to hold.

Finally, Equation (8) can be re-expressed in *ad-valorem* terms as follows:

$$\frac{\hat{t}}{P} = -\frac{1}{\frac{dQ}{dP} \frac{P}{Q} \frac{dP}{dt}} = \frac{1}{\epsilon \frac{dP}{dt}}, \quad (9)$$

where $\epsilon = -\frac{dQ}{dP} \frac{P}{Q} > 0$ is the elasticity of the aggregate demand function.

Traditional vertical competition models assume producer prices to be constant (sometimes they are even normalized to zero). Therefore, consumer prices are given by $P = \tau = t + T$ and, therefore $\frac{dP}{d\tau} = \frac{dP}{dt} = 1$. Hence, as expected, by assuming $\frac{dP}{d\tau} = 1$ (and, thus, $\frac{dP}{dt} = 1$), one is back to the standard formula present in previous tax competition settings indicating that the optimal tax rate (in *ad-valorem* terms) is inversely proportional to the elasticity of the tax base.⁹

By relaxing this assumption, this model explicitly allows policy makers to internalize tax incidence features when setting their tax rates. In other words, local governments recognize that taxes are not necessarily fully-passed to consumer prices but can also be under/overshifted and take this into consideration when setting t .

Next section shows how the vertical competition reaction function is modified once there is no constraint on $\frac{dP}{d\tau}$. The main outcome of the model (i.e., the comparability/substitutability condition) is not modified but, interestingly, market structure turns out to play a crucial role in determining the sensitivity of local tax rates (t) to a variation in T .

3 The vertical reaction function

One of the key features of the first stage of the game is given by the two tiers of government taxing the same good and, thus, sharing the tax base. From a tax competition perspective, the focus is on the strategic interactions arising because of this. In other words, one would like to assess how a variation in T affects the state's choice of t .

3.1 The vertical reaction function when $\frac{dP}{d\tau} = 1$ is imposed

As shown in Section 2 previous tax competition models obtain the standard expression that the tax rate (in *ad-valorem* terms) is inversely proportional to the elasticity of demand i.e., Equation (9) is simplified as follows:

$$\frac{\hat{t}}{P} = \frac{1}{\epsilon}. \quad (9.1)$$

Now, the goal of this paper is to assess the vertical reaction function i.e., the reaction of state governments to a variation in the federal tax rate. To say it differently, one would like to know how the equality in Equation (9.1) will be affected by a variation in T and, particularly, how t will adjust in order to restore it.

⁹See, for example, Keen (1997) and Devereux et al. (2007).

Unfortunately, it is impossible to solve tax competition models (i.e., to sign $\frac{dt}{dT}$) for the general case. Nevertheless, one can illustrate the main outcome of these models through the two most studied cases in the literature: iso-elastic and linear demand functions.

When demand is of the iso-elastic type ($\bar{\epsilon}$), an increase in T will rise the consumer price P and, thus, reduce the left hand side of Equation (9.1). Given that the elasticity of demand is constant, t has to increase in order to restore the equality in Equation (9.1). Thus, $\frac{dt}{dT} > 0$ and taxes are strategic complements.

If demand is of the linear type, Equation (9.1) can be re-expressed as follows:

$$\hat{t} = \frac{1}{-\left(\frac{Q'}{Q}\right)}. \quad (9.2)$$

An increase in T will rise the consumer price P and, thus, Q will decrease. Given that the elasticity of demand is linear, the slope of the demand curve is constant (Q') and, therefore, the equality in Equation (9.2) can only be restored by decreasing t . Thus, in the linear demand/cost case, $\frac{dt}{dT} < 0$ and taxes are strategic substitutes.

In other words, one can summarize the main outcome of previous vertical tax competition studies by the following proposition:

Proposition 1 *The vertical reaction function $\frac{dt}{dT}$ depends on the functional form of the demand function. First, if $x(P) = \bar{x}$ so that individual demand is inelastic, then in the neighborhood of Nash equilibrium, $\frac{dt}{dT} = 0$. Second, in the symmetric case, once the individual demand function is allowed to be elastic, the sign of the reaction function is undefined for the general case. Indeed, the sign of $\frac{dt}{dT}$ depends on the elasticity of the demand function and, interestingly, the two most analyzed cases in the literature have the following implications:*

- *If demand is iso-elastic, $\frac{dt}{dT} > 0$ (t and T are strategic complements)*
- *If demand is linear, $\frac{dt}{dT} < 0$ (t and T are strategic substitutes)*

3.1.1 Correspondence between $\frac{dP}{d\tau}$ and $\frac{dt}{dT}$.

Before showing how the tax competition setting is affected by allowing $\frac{dP}{d\tau} \neq 1$, it is worth highlighting the following feature shared by both tax incidence and tax competition models: the functional form of demand is the key parameter determining the main output in both settings.

Proposition 1 clearly shows how, from a tax competition perspective, the strategic complementarity/substitutability condition depends on the curvature of the demand function. A similar result is obtained by recalling the following condition, that was derived and discussed in previous tax incidence studies such as Fullerton and Metcalf (2002) or

Jametti et al. (2013):¹⁰

$$\frac{dP}{d\tau} = \frac{N}{N + (\eta + k)} \begin{cases} < 1 & \Rightarrow \textit{undershifting} \\ = 1 & \Rightarrow \textit{full shifting}, \\ > 1 & \Rightarrow \textit{overshifting} \end{cases} \quad (10)$$

where $\eta = Q \left(\frac{\frac{d^2 P}{dq^2}}{\frac{dP}{dq}} \right)$ is the elasticity of the slope of the inverse demand function and $k = 1 - \left(\frac{\frac{d^2 c}{dq^2}}{\frac{dP}{dq}} \right)$ measures the relative slopes of the demand and marginal cost curves.

Equation (10) is a well known result in tax incidence literature and has some implications that will be useful for the rest of the paper. First, market structure (N) does not determine tax incidence condition, in equilibrium. Note that, counter-intuitively, even highly concentrated markets may undershift taxes under non-cooperative profit maximization if $(\eta + k) < 0$. Second, market structure does, nevertheless, determine the degree of the tax shifting. Independently of whether taxes are under or overshifted, the absolute value of $\frac{dP}{d\tau}$ is always the furthest away from one (full shifting) when $N = 1$, and approaches full shifting as N tends to infinity (perfect competition).

Moreover, note that if costs are linear ($\frac{d^2 P}{dq^2} = 0$ and, thus, $k = 1$), a necessary and sufficient condition for taxes to be overshifted is that $\eta < -1$. If demand is of the constant elasticity type, this is always the case because a demand elasticity $\epsilon > 0$ implies that $\eta = -\frac{1+\epsilon}{\epsilon} < -1$ for all ϵ . In fact, in this case, Equation (10) can be re-expressed as follows:

$$\frac{dP}{d\tau} = \frac{N}{N - \frac{1+\epsilon}{\epsilon} + 1} > 1. \quad (11)$$

Thus, in the linear cost/iso-elastic demand case there is always overshifting.

Similarly, with linear costs and a linear demand function ($\eta = 0$), Equation (10) is simplified as follows:

$$\frac{dP}{d\tau} = \frac{N}{N + 1} < 1. \quad (12)$$

Thus, in the linear cost/linear demand case, taxes are always undershifted.

To sum up, there exists a correspondence between the outputs of tax incidence and tax competition models that is illustrated in Table 1 and formalized by the following conjecture:

Conjecture 1 *In the symmetric case, at symmetric Nash equilibrium, the following correspondence between the pass through of taxes to consumer prices and the vertical reaction function arises:*

- $\frac{dP}{d\tau} < 1 \Leftrightarrow \frac{dt}{dT} < 0$
- $\frac{dP}{d\tau} > 1 \Leftrightarrow \frac{dt}{dT} > 0$

¹⁰Equation (10) can be derived from the first stage of the model. The formal derivation is shown in the Appendix.

Despite this correspondence, these two strands of literature have not been studied in a comprehensive setting. Hence, the formalization of this result is a first contribution of this model to the public finance literature.

3.2 The vertical reaction function when no constraint on $\frac{dP}{d\tau}$ is imposed

As one can observe from Equation (10), the $\frac{dP}{d\tau} = 1$ condition is verified if and only if $\eta + k = 0$ or under perfect competition ($N \rightarrow \infty$). Assuming either of these two conditions to hold is quite a strong statement that deserves, at least, some comments. First, note that $\eta + k = 0$ is far from being the general rule or even from representing the most important cases in the literature. Indeed, under the two most analyzed scenarios given by linear costs ($k = 1$) and, either linear ($\eta = 0$) or iso-elastic ($\eta = -\frac{1+\epsilon}{\epsilon}$) demand functions, $\eta + k \neq 0$. Second, it would be even more striking to justify $\frac{dP}{d\tau} = 1$ by assuming perfect competition. In particular, because most of these tax competition models focus on excise taxes that are usually levied in highly concentrated industries such as gasoline, cigarette or alcohol beverages markets. In other words, assuming constant producer prices and, thus, imposing $\frac{dP}{d\tau} = 1$ considerably simplifies the model. Nevertheless, this seem to be a strong and hardly justifiable assumption.

Now, the crucial question is how the vertical reaction function is modified when no constraint on $\frac{dP}{d\tau}$ is imposed.

Plugging the tax incidence condition for the iso-elastic case given by Equation (11) in Equation (9), I obtain:

$$\frac{\hat{t}}{P} = \frac{1}{\epsilon} \left(1 - \frac{1}{\epsilon N} \right). \quad (9.3)$$

An increase in T will rise the consumer price P and, thus, reduce the left hand side of Equation (9.3). Given that the elasticity of demand is constant ($\bar{\epsilon}$), the only way to restore the equality (in the fixed- N case) is through an increase in t . Thus, in the iso-elastic demand/linear cost case, $\frac{dt}{dT} > 0$ and taxes are strategic complements.

Similarly, in the linear demand case the expression for the equilibrium tax rate is given by Equation (9):

$$\frac{\hat{t}}{P} = \frac{1}{\epsilon \frac{dP}{dt}}. \quad (9)$$

Once again, for the sake of simplicity, one can re-express Equation (9) as follows:

$$\hat{t} = \frac{1}{-\left(\frac{Q'}{Q}\right) \frac{dP}{dt}}. \quad (9.4)$$

Plugging the tax incidence condition for the linear demand case given by Equation (12) in Equation (9.4), one gets:

$$\hat{t} = \frac{1}{-\left(\frac{Q'}{Q}\right) \frac{N}{N+1}}. \quad (9.5)$$

An increase in T will rise the consumer price P and, thus, Q will decrease. Given that the elasticity of demand is linear, the slope of the demand curve is constant (\bar{Q}') and, therefore, the equality in Equation (9.5) can only be restored by decreasing t . Thus, in the linear demand/cost case, $\frac{dt}{dT} < 0$ and taxes are strategic substitutes.

3.3 Discussion of results

By comparing equations (9.3) and (9.5) to equations (9.1) and (9.2), respectively, one can already identify the main difference between previous models and this setting. Whereas the number of firms (N) was absent in previous tax competition models, it is now explicitly introduced as a determinant of the vertical reaction function. Note that the number of firms (N) does not define the sign of the vertical reaction function but determines how reactive local governments are to a variation in the federal tax rate. In other words, N does not modify the complementarity/substitutability condition (that is exactly the same as the one found in previous models) but defines the sensitivity of t to a variation in T . This is the main result of the paper.

A simple numerical application of the linear cost/iso-elastic demand case (based on the U.S. cigarette market) will help the reader by nicely illustrating the main result of the model discussed above. The model is calibrated by plugging the values for T , P and ϵ in order to show how the sensitivity of t to a 1% increase in T varies for different values of N . Prices and tax rates figures are taken from Orzechowski and Walker (2012).¹¹ Regarding the price elasticity of cigarette demand, an important variance among the different estimates is observed in the literature. The estimates seem to vary considerably depending, for instance, on the different methodologies and samples considered. As one could expect, the estimates seem to be highly dependent on the target group as well. Different studies focus on particular groups in order to cluster by age, sex, socioeconomic situation, educational attainment or even particular characteristics such as pregnancy.¹² The model is calibrated using the estimates of Ding (2003) and Hana and Chaloupka (2004) by setting an elasticity of demand equal to 1.4.¹³

Figure 1 illustrates the reaction functions when $\frac{dP}{d\tau} = 1$ is imposed (red-dashed line) and when there is no restriction on the shifting condition (blue-solid line).¹⁴ As one can observe, in both cases $\frac{dt}{dT} > 0$. This reflects the complementarity condition that holds under both frameworks. Now, the straight-dashed line indicates that the reaction function is constant ($\frac{dt}{dT} = 0.1789$) and does not vary with N . On the other hand, the solid line shows how, in this setting, the sensitivity of t to a variation in T decreases with the

¹¹The annual compendium on tobacco revenue and industry statistics known as The Tax Burden on Tobacco is produced by the economic consulting firm Orzechowski and Walker and published by the Federation of Tax Administrators.

¹²For a complete review on the estimates of the price elasticity of cigarette demand, see, Surgeon's General Report (2000).

¹³This is an arbitrary choice. Nevertheless, as already discussed throughout the paper, the results of the model are robust and hold for any $\epsilon > 0$.

¹⁴Figure 2 shows the results for the linear cost/linear demand case.

number of firms in the industry. Indeed, note that the highest value of $\frac{dt}{dT}$ equals 0.6261 for the monopoly case and it decreases as N increases. In the limit, when $N \rightarrow \infty$, it converges to 0.1789. This makes sense given that under perfect competition $\frac{dP}{d\tau} = 1$, which turns out to be the assumption made by previous tax competition studies.

To put it differently, in this setting, a 10% increase in T would be followed by a reaction of local governments roughly lying between 6.3% and 1.8%, depending on the level of concentration of the industry. Previous settings, would only consider the lowest bound (1.8%) which might be particularly misleading given the highest level of concentration observed in those industries where excise taxes are levied. For instance, the 2002 economic census published by the U.S. Department of Commerce shows that the largest four companies in the cigarette industry accounted for 95.3% of total shipments.¹⁵ In such a concentrated industry, one could expect the vertical reaction function to be very sensible and, thus, closer to the highest bound. In other words, unlike previous settings, this model not only allows the federal policy maker to know whether local governments would increase or decrease their tax rates after a variation of the federal tax rate, but also how important this reaction would be.

4 Conclusion

This model brings together tax incidence and tax competition, two strands of literature that in spite of several points in common have only been studied separately. In both cases the curvature of the demand function is the key parameter determining the main result of the model. From a tax incidence perspective, taxes are under-, fully, or over-shifted depending on η , a parameter accounting for the elasticity of the slope of the inverse demand function. Similarly, the elasticity of the demand function determines the complementarity/substitutability condition in a tax competition framework. Merging these two frameworks in a comprehensive setting and formalizing the existence correspondence between their main outputs is a nice contribution to public finance literature *per se*.

Nevertheless, the main contribution concerns market structure and its impact on the vertical reaction function $\frac{dt}{dT}$. This model extends a classical vertical tax competition model by allowing local governments to internalize the possibility that taxes are over-/undershifted. In order to do this, the assumption that producer prices are constant is explicitly relaxed. This assumption (standard in previous tax competition settings) implicitly constrains taxes to be fully-passed to consumers and, thus, rules out the impact of any tax incidence feature from the tax setting decision.

To put it differently, by relaxing the assumption that producer prices are constant, consumer prices are allowed to under/overreact to a variation of tax rates and, hence, tax incidence features are internalized into the tax setting process. As a consequence, market structure now plays a key role on the tax setting decision. In particular, it turns out to be one of the determinants of the vertical reaction function. Interestingly, even if the number of firms in the industry does not modify the strategic complementarity/substitutability condition from previous settings, it determines the sensitivity of local tax rates (t) to a

¹⁵ www.census.gov/prod/ec02/ec0231sr1.pdf

variation in higher-level tax rates (T). This is a crucial piece of information, with potential relevant policy implications, that was absent in previous tax competition models.

Appendix. Derivation of the tax incidence condition

Following the standard notation in tax incidence models that has been first defined in Seade (1980), one can rewrite the second-order condition in Equation (4) as follows:

$$\frac{d\left(\frac{dP}{dq}\right)}{dN}(\eta + N + Nk) < 0, \quad (\text{A.1})$$

where $\eta = Q\left(\frac{\frac{d^2P}{dq^2}}{\frac{dP}{dq}}\right)$ is the elasticity of the slope of the inverse demand function and $k = 1 - \left(\frac{\frac{d^2c}{dq^2}}{\frac{dP}{dq}}\right)$ measures the relative slopes of the demand and marginal cost curves.

Note that since $\frac{dP}{dq} < 0$, $\eta + N + Nk > 0$ is necessary and sufficient for the second-order condition to hold.

Now, using this notation, one can differentiate Equation (3) to get:

$$\frac{dq}{d\tau} = \frac{1}{\frac{dP}{dq}(\eta + N + k)}. \quad (\text{A.2})$$

Thus,

$$\frac{dQ}{d\tau} = \frac{N}{\frac{dP}{dq}(\eta + N + k)} \quad (\text{A.3})$$

and, therefore,

$$\frac{dP}{d\tau} = \frac{dP}{dq} \frac{dQ}{d\tau} = \frac{N}{N + \eta + k}. \quad (\text{A.4})$$

The standard tax incidence condition previously shown in Equation (10) is directly derived from Equation (A.4):

$$\frac{dP}{d\tau} = \frac{N}{N + (\eta + k)} \begin{cases} < 1 & \Rightarrow \textit{undershifting} \\ = 1 & \Rightarrow \textit{full shifting} \\ > 1 & \Rightarrow \textit{overshifting} \end{cases}$$

References

- Agrawal, David (2015) 'Local fiscal competition: An application to sales taxation with multiple federations.' *Journal of Urban Economics*
- Besley, Timothy (1989) 'Commodity taxation and imperfect competition : A note on the effects of entry.' *Journal of Public Economics* 40(3), 359–367
- Chouinard, Hayley H., and Jeffrey M. Perloff (2007) 'Gasoline price differences: Taxes, pollution regulations, mergers, market power, and market conditions.' *The B.E. Journal of Economic Analysis & Policy* 7(1), 8
- Devereux, M.P., B. Lockwood, and M. Redoano (2007) 'Horizontal and vertical indirect tax competition: Theory and some evidence from the usa.' *Journal of Public Economics* 91(3-4), 451–479
- Ding, Alexander (2003) 'Youth are more sensitive to price changes in cigarettes than adults.' *The Yale Journal of Biology and Medicine* 76(3), 115–124
- Esteller-Moré, Alejandro, Umberto Galmarini, and Leonzio Rizzo (2012) 'Vertical tax competition and consumption externalities in a federation with lobbying.' *Journal of Public Economics* 96(3), 295–305
- Fullerton, Don, and Gilbert E. Metcalf (2002) 'Tax incidence.' In *Handbook of Public Economics*, ed. A. J. Auerbach and M. Feldstein, vol. 4 of *Handbook of Public Economics* (Elsevier) chapter 26, pp. 1787–1872
- Hana, Ross, and Franck J. Chaloupka (2004) 'The effect of public policies and prices on youth smoking.' *Southern Economic Journal* 70(4), 796–815
- Jametti, Mario, Agustin Redonda, and Anindya Sen (2013) 'The power to pass on taxes. A test for tax shifting based on observables.' *Mimeo.*
- Katz, Michael L., and Harvey S. Rosen (1985) 'Tax analysis in an oligopoly model.' *National Bureau of Economic Research, Inc*
- Keen, Michael (1997) 'Vertical tax externalities in the theory of fiscal federalism.' IMF Working Papers 97/173, International Monetary Fund, December
- Krzyzaniak, Marian, and Richard A. Musgrave (1963) 'The shifting of the corporation income tax.' (Johns Hopkins Press, Baltimore)
- Marion, Justin, and Erich Muehlegger (2011) 'Fuel tax incidence and supply conditions.' *Journal of Public Economics* 95(9-10), 1202–1212
- Orzechowski and Walker (2012) 'The 63rd version of the annual compendium on tobacco revenue and industry statistics - The Tax Burden on Tobacco'

Seade, Jesus (1985) 'Profitable cost increases and the shifting of taxation : Equilibrium response of markets in oligopoly.' *The Warwick Economics Research Paper Series (TWERPS)*

Surgeon's General Report (2000) 'Reducing Tobacco Use: A Report of the Surgeon General.' *U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.*

Tirole, Jean (1988) *The Theory of Industrial Organization*, vol. 1 of *MIT Press Books* (The MIT Press)

Table 1: Correspondence: the vertical reaction function and the tax incidence condition

Tax incidence \ Tax competition	Strategic substitutes ($\frac{dt}{dT} < 0$)	Strategic complements ($\frac{dt}{dT} > 0$)
Undershifting ($\frac{dP}{dt} < 1$)	✓	Not possible
Overshifting ($\frac{dP}{dt} > 1$)	Not possible	✓

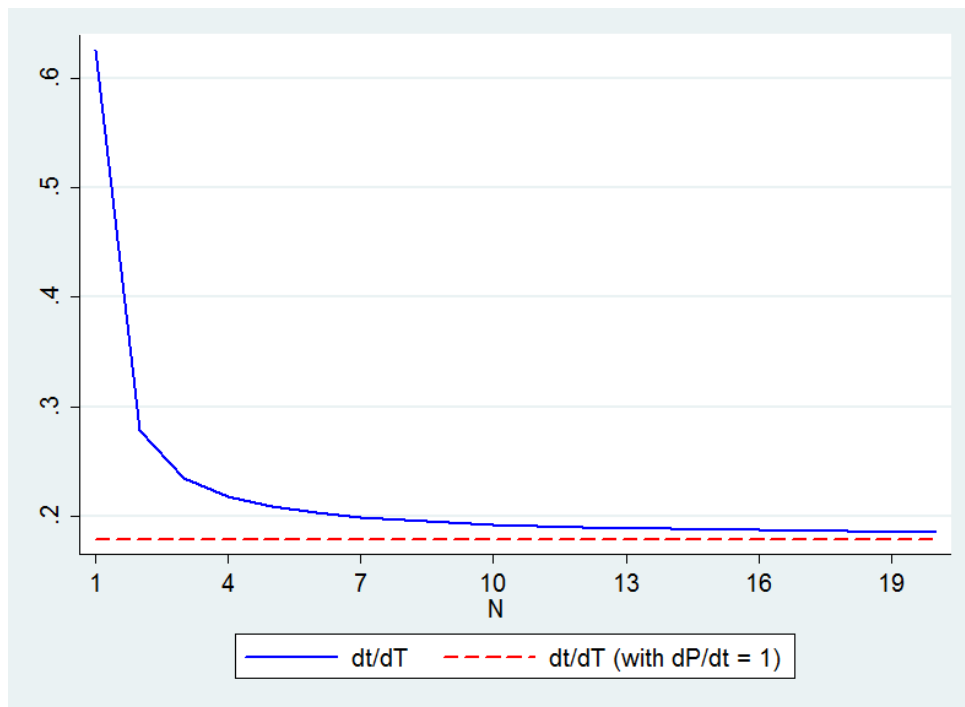


Figure 1: Sensitivity of the vertical reaction function (Iso-elastic demand)

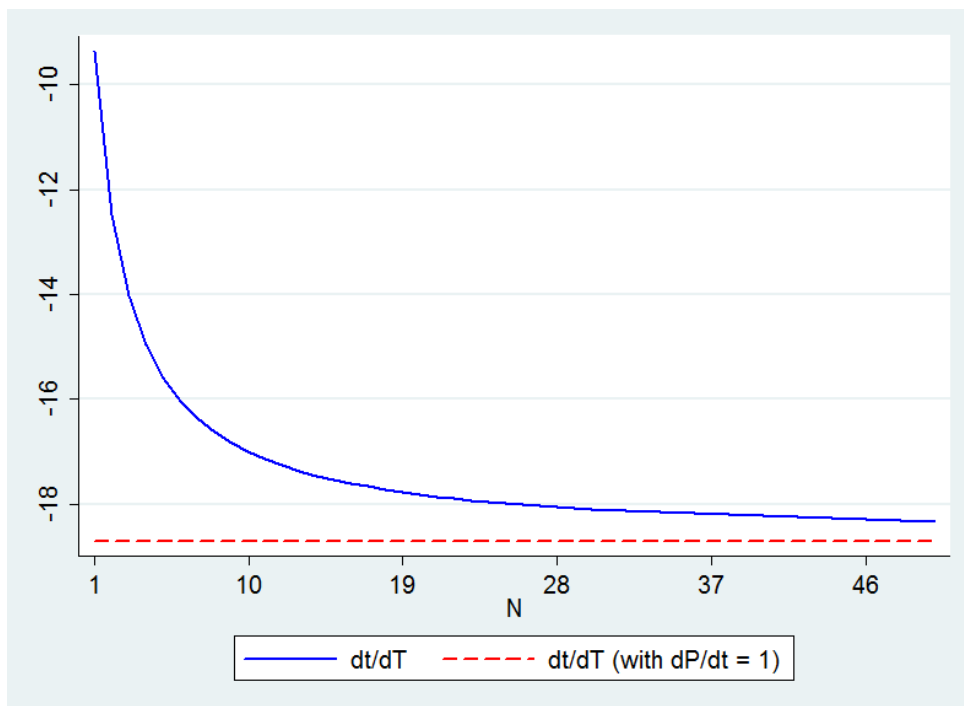


Figure 2: Sensitivity of the vertical reaction function (Linear demand)

2011

- 2011/1, **Oppedisano, V; Turati, G.:** "What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
- 2011/2, **Dahlberg, M; Edmark, K; Lundqvist, H.:** "Ethnic diversity and preferences for redistribution"
- 2011/3, **Canova, L.; Vaglio, A.:** "Why do educated mothers matter? A model of parental help"
- 2011/4, **Delgado, F.J.; Lago-Peñas, S.; Mayor, M.:** "On the determinants of local tax rates: new evidence from Spain"
- 2011/5, **Piolatto, A.; Schuett, F.:** "A model of music piracy with popularity-dependent copying costs"
- 2011/6, **Duch, N.; García-Estévez, J.; Parellada, M.:** "Universities and regional economic growth in Spanish regions"
- 2011/7, **Duch, N.; García-Estévez, J.:** "Do universities affect firms' location decisions? Evidence from Spain"
- 2011/8, **Dahlberg, M.; Mörk, E.:** "Is there an election cycle in public employment? Separating time effects from election year effects"
- 2011/9, **Costas-Pérez, E.; Solé-Ollé, A.; Sorribas-Navarro, P.:** "Corruption scandals, press reporting, and accountability. Evidence from Spanish mayors"
- 2011/10, **Choi, A.; Calero, J.; Escardíbul, J.O.:** "Hell to touch the sky? Private tutoring and academic achievement in Korea"
- 2011/11, **Mira Godinho, M.; Cartaxo, R.:** "University patenting, licensing and technology transfer: how organizational context and available resources determine performance"
- 2011/12, **Duch-Brown, N.; García-Quevedo, J.; Montolio, D.:** "The link between public support and private R&D effort: What is the optimal subsidy?"
- 2011/13, **Breuilé, M.L.; Duran-Vigeneron, P.; Samson, A.L.:** "To assemble to resemble? A study of tax disparities among French municipalities"
- 2011/14, **McCann, P.; Ortega-Argilés, R.:** "Smart specialisation, regional growth and applications to EU cohesion policy"
- 2011/15, **Montolio, D.; Trillas, F.:** "Regulatory federalism and industrial policy in broadband telecommunications"
- 2011/16, **Pelegrín, A.; Bolancé, C.:** "Offshoring and company characteristics: some evidence from the analysis of Spanish firm data"
- 2011/17, **Lin, C.:** "Give me your wired and your highly skilled: measuring the impact of immigration policy on employers and shareholders"
- 2011/18, **Bianchini, L.; Revelli, F.:** "Green politics: urban environmental performance and government popularity"
- 2011/19, **López Real, J.:** "Family reunification or point-based immigration system? The case of the U.S. and Mexico"
- 2011/20, **Bogliacino, F.; Piva, M.; Vivarelli, M.:** "The impact of R&D on employment in Europe: a firm-level analysis"
- 2011/21, **Tonello, M.:** "Mechanisms of peer interactions between native and non-native students: rejection or integration?"
- 2011/22, **García-Quevedo, J.; Mas-Verdú, F.; Montolio, D.:** "What type of innovative firms acquire knowledge intensive services and from which suppliers?"
- 2011/23, **Banal-Estañol, A.; Macho-Stadler, I.; Pérez-Castrillo, D.:** "Research output from university-industry collaborative projects"
- 2011/24, **Ligthart, J.E.; Van Oudheusden, P.:** "In government we trust: the role of fiscal decentralization"
- 2011/25, **Mongrain, S.; Wilson, J.D.:** "Tax competition with heterogeneous capital mobility"
- 2011/26, **Caruso, R.; Costa, J.; Ricciuti, R.:** "The probability of military rule in Africa, 1970-2007"
- 2011/27, **Solé-Ollé, A.; Viladecans-Marsal, E.:** "Local spending and the housing boom"
- 2011/28, **Simón, H.; Ramos, R.; Sanromá, E.:** "Occupational mobility of immigrants in a low skilled economy. The Spanish case"
- 2011/29, **Piolatto, A.; Trotin, G.:** "Optimal tax enforcement under prospect theory"
- 2011/30, **Montolio, D; Piolatto, A.:** "Financing public education when altruistic agents have retirement concerns"
- 2011/31, **García-Quevedo, J.; Pellegrino, G.; Vivarelli, M.:** "The determinants of YICs' R&D activity"
- 2011/32, **Goodspeed, T.J.:** "Corruption, accountability, and decentralization: theory and evidence from Mexico"
- 2011/33, **Pedraja, F.; Cordero, J.M.:** "Analysis of alternative proposals to reform the Spanish intergovernmental transfer system for municipalities"
- 2011/34, **Jofre-Monseny, J.; Sorribas-Navarro, P.; Vázquez-Grenno, J.:** "Welfare spending and ethnic heterogeneity: evidence from a massive immigration wave"
- 2011/35, **Lyytikäinen, T.:** "Tax competition among local governments: evidence from a property tax reform in Finland"
- 2011/36, **Brühlhart, M.; Schmidheiny, K.:** "Estimating the Rivalness of State-Level Inward FDI"
- 2011/37, **García-Pérez, J.I.; Hidalgo-Hidalgo, M.; Robles-Zurita, J.A.:** "Does grade retention affect achievement? Some evidence from Pisa"
- 2011/38, **Boffa, f.; Panzar, J.:** "Bottleneck co-ownership as a regulatory alternative"

- 2011/39, **González-Val, R.; Olmo, J.:** "Growth in a cross-section of cities: location, increasing returns or random growth?"
- 2011/40, **Anesi, V.; De Donder, P.:** "Voting under the threat of secession: accommodation vs. repression"
- 2011/41, **Di Pietro, G.; Mora, T.:** "The effect of the l'Aquila earthquake on labour market outcomes"
- 2011/42, **Brueckner, J.K.; Neumark, D.:** "Beaches, sunshine, and public-sector pay: theory and evidence on amenities and rent extraction by government workers"
- 2011/43, **Cortés, D.:** "Decentralization of government and contracting with the private sector"
- 2011/44, **Turati, G.; Montolio, D.; Piacenza, M.:** "Fiscal decentralisation, private school funding, and students' achievements. A tale from two Roman catholic countries"

2012

- 2012/1, **Montolio, D.; Trujillo, E.:** "What drives investment in telecommunications? The role of regulation, firms' internationalization and market knowledge"
- 2012/2, **Giesen, K.; Suedekum, J.:** "The size distribution across all "cities": a unifying approach"
- 2012/3, **Foremny, D.; Riedel, N.:** "Business taxes and the electoral cycle"
- 2012/4, **García-Estévez, J.; Duch-Brown, N.:** "Student graduation: to what extent does university expenditure matter?"
- 2012/5, **Durán-Cabré, J.M.; Esteller-Moré, A.; Salvadori, L.:** "Empirical evidence on horizontal competition in tax enforcement"
- 2012/6, **Pickering, A.C.; Rockey, J.:** "Ideology and the growth of US state government"
- 2012/7, **Vergolini, L.; Zanini, N.:** "How does aid matter? The effect of financial aid on university enrolment decisions"
- 2012/8, **Backus, P.:** "Gibrat's law and legacy for non-profit organisations: a non-parametric analysis"
- 2012/9, **Jofre-Monseny, J.; Marín-López, R.; Viladecans-Marsal, E.:** "What underlies localization and urbanization economies? Evidence from the location of new firms"
- 2012/10, **Mantovani, A.; Vandekerckhove, J.:** "The strategic interplay between bundling and merging in complementary markets"
- 2012/11, **García-López, M.A.:** "Urban spatial structure, suburbanization and transportation in Barcelona"
- 2012/12, **Revelli, F.:** "Business taxation and economic performance in hierarchical government structures"
- 2012/13, **Arqué-Castells, P.; Mohnen, P.:** "Sunk costs, extensive R&D subsidies and permanent inducement effects"
- 2012/14, **Boffa, F.; Pioletto, A.; Ponzetto, G.:** "Centralization and accountability: theory and evidence from the Clean Air Act"
- 2012/15, **Cheshire, P.C.; Hilber, C.A.L.; Kaplanis, I.:** "Land use regulation and productivity – land matters: evidence from a UK supermarket chain"
- 2012/16, **Choi, A.; Calero, J.:** "The contribution of the disabled to the attainment of the Europe 2020 strategy headline targets"
- 2012/17, **Silva, J.I.; Vázquez-Grenno, J.:** "The ins and outs of unemployment in a two-tier labor market"
- 2012/18, **González-Val, R.; Lanaspa, L.; Sanz, F.:** "New evidence on Gibrat's law for cities"
- 2012/19, **Vázquez-Grenno, J.:** "Job search methods in times of crisis: native and immigrant strategies in Spain"
- 2012/20, **Lessmann, C.:** "Regional inequality and decentralization – an empirical analysis"
- 2012/21, **Nuevo-Chiquero, A.:** "Trends in shotgun marriages: the pill, the will or the cost?"
- 2012/22, **Piil Damm, A.:** "Neighborhood quality and labor market outcomes: evidence from quasi-random neighborhood assignment of immigrants"
- 2012/23, **Ploeckl, F.:** "Space, settlements, towns: the influence of geography and market access on settlement distribution and urbanization"
- 2012/24, **Algan, Y.; Hémet, C.; Laitin, D.:** "Diversity and local public goods: a natural experiment with exogenous residential allocation"
- 2012/25, **Martínez, D.; Sjögren, T.:** "Vertical externalities with lump-sum taxes: how much difference does unemployment make?"
- 2012/26, **Cubel, M.; Sanchez-Pages, S.:** "The effect of within-group inequality in a conflict against a unitary threat"
- 2012/27, **Andini, M.; De Blasio, G.; Duranton, G.; Strange, W.C.:** "Marshallian labor market pooling: evidence from Italy"
- 2012/28, **Solé-Ollé, A.; Viladecans-Marsal, E.:** "Do political parties matter for local land use policies?"
- 2012/29, **Buonanno, P.; Durante, R.; Prarolo, G.; Vanin, P.:** "Poor institutions, rich mines: resource curse and the origins of the Sicilian mafia"
- 2012/30, **Anghel, B.; Cabrales, A.; Carro, J.M.:** "Evaluating a bilingual education program in Spain: the impact beyond foreign language learning"

- 2012/31, **Curto-Grau, M.; Solé-Ollé, A.; Sorribas-Navarro, P.:** "Partisan targeting of inter-governmental transfers & state interference in local elections: evidence from Spain"
- 2012/32, **Kappeler, A.; Solé-Ollé, A.; Stephan, A.; Vällilä, T.:** "Does fiscal decentralization foster regional investment in productive infrastructure?"
- 2012/33, **Rizzo, L.; Zanardi, A.:** "Single vs double ballot and party coalitions: the impact on fiscal policy. Evidence from Italy"
- 2012/34, **Ramachandran, R.:** "Language use in education and primary schooling attainment: evidence from a natural experiment in Ethiopia"
- 2012/35, **Rothstein, J.:** "Teacher quality policy when supply matters"
- 2012/36, **Ahlfeldt, G.M.:** "The hidden dimensions of urbanity"
- 2012/37, **Mora, T.; Gil, J.; Sicras-Mainar, A.:** "The influence of BMI, obesity and overweight on medical costs: a panel data approach"
- 2012/38, **Pelegrín, A.; García-Quevedo, J.:** "Which firms are involved in foreign vertical integration?"
- 2012/39, **Agasisti, T.; Longobardi, S.:** "Inequality in education: can Italian disadvantaged students close the gap? A focus on resilience in the Italian school system"

2013

- 2013/1, **Sánchez-Vidal, M.; González-Val, R.; Viladecans-Marsal, E.:** "Sequential city growth in the US: does age matter?"
- 2013/2, **Hortas Rico, M.:** "Sprawl, blight and the role of urban containment policies. Evidence from US cities"
- 2013/3, **Lampón, J.F.; Cabanelas-Lorenzo, P.; Lago-Peñas, S.:** "Why firms relocate their production overseas? The answer lies inside: corporate, logistic and technological determinants"
- 2013/4, **Montolio, D.; Planells, S.:** "Does tourism boost criminal activity? Evidence from a top touristic country"
- 2013/5, **García-López, M.A.; Holl, A.; Viladecans-Marsal, E.:** "Suburbanization and highways: when the Romans, the Bourbons and the first cars still shape Spanish cities"
- 2013/6, **Bosch, N.; Espasa, M.; Montolio, D.:** "Should large Spanish municipalities be financially compensated? Costs and benefits of being a capital/central municipality"
- 2013/7, **Escardíbul, J.O.; Mora, T.:** "Teacher gender and student performance in mathematics. Evidence from Catalonia"
- 2013/8, **Arqué-Castells, P.; Viladecans-Marsal, E.:** "Banking towards development: evidence from the Spanish banking expansion plan"
- 2013/9, **Asensio, J.; Gómez-Lobo, A.; Matas, A.:** "How effective are policies to reduce gasoline consumption? Evaluating a quasi-natural experiment in Spain"
- 2013/10, **Jofre-Monseny, J.:** "The effects of unemployment benefits on migration in lagging regions"
- 2013/11, **Segarra, A.; García-Quevedo, J.; Teruel, M.:** "Financial constraints and the failure of innovation projects"
- 2013/12, **Jerrim, J.; Choi, A.:** "The mathematics skills of school children: How does England compare to the high performing East Asian jurisdictions?"
- 2013/13, **González-Val, R.; Tirado-Fabregat, D.A.; Viladecans-Marsal, E.:** "Market potential and city growth: Spain 1860-1960"
- 2013/14, **Lundqvist, H.:** "Is it worth it? On the returns to holding political office"
- 2013/15, **Ahlfeldt, G.M.; Maennig, W.:** "Homevoters vs. leasevoters: a spatial analysis of airport effects"
- 2013/16, **Lampón, J.F.; Lago-Peñas, S.:** "Factors behind international relocation and changes in production geography in the European automobile components industry"
- 2013/17, **Guío, J.M.; Choi, A.:** "Evolution of the school failure risk during the 2000 decade in Spain: analysis of Pisa results with a two-level logistic mode"
- 2013/18, **Dahlby, B.; Rodden, J.:** "A political economy model of the vertical fiscal gap and vertical fiscal imbalances in a federation"
- 2013/19, **Acacia, F.; Cubel, M.:** "Strategic voting and happiness"
- 2013/20, **Hellerstein, J.K.; Kutzbach, M.J.; Neumark, D.:** "Do labor market networks have an important spatial dimension?"
- 2013/21, **Pellegrino, G.; Savona, M.:** "Is money all? Financing versus knowledge and demand constraints to innovation"
- 2013/22, **Lin, J.:** "Regional resilience"
- 2013/23, **Costa-Campi, M.T.; Duch-Brown, N.; García-Quevedo, J.:** "R&D drivers and obstacles to innovation in the energy industry"

- 2013/24, Huisman, R.; Stradnic, V.; Westgaard, S.: "Renewable energy and electricity prices: indirect empirical evidence from hydro power"
- 2013/25, Dargaud, E.; Mantovani, A.; Reggiani, C.: "The fight against cartels: a transatlantic perspective"
- 2013/26, Lambertini, L.; Mantovani, A.: "Feedback equilibria in a dynamic renewable resource oligopoly: pre-emption, voracity and exhaustion"
- 2013/27, Feld, L.P.; Kalb, A.; Moessinger, M.D.; Osterloh, S.: "Sovereign bond market reactions to fiscal rules and no-bailout clauses – the Swiss experience"
- 2013/28, Hilber, C.A.L.; Vermeulen, W.: "The impact of supply constraints on house prices in England"
- 2013/29, Revelli, F.: "Tax limits and local democracy"
- 2013/30, Wang, R.; Wang, W.: "Dress-up contest: a dark side of fiscal decentralization"
- 2013/31, Dargaud, E.; Mantovani, A.; Reggiani, C.: "The fight against cartels: a transatlantic perspective"
- 2013/32, Saarimaa, T.; Tukiainen, J.: "Local representation and strategic voting: evidence from electoral boundary reforms"
- 2013/33, Agasisti, T.; Murtinu, S.: "Are we wasting public money? No! The effects of grants on Italian university students' performances"
- 2013/34, Flacher, D.; Harari-Kermadec, H.; Moulin, L.: "Financing higher education: a contributory scheme"
- 2013/35, Carozzi, F.; Repetto, L.: "Sending the pork home: birth town bias in transfers to Italian municipalities"
- 2013/36, Coad, A.; Frankish, J.S.; Roberts, R.G.; Storey, D.J.: "New venture survival and growth: Does the fog lift?"
- 2013/37, Giulietti, M.; Grossi, L.; Waterson, M.: "Revenues from storage in a competitive electricity market: Empirical evidence from Great Britain"

2014

- 2014/1, Montolio, D.; Planells-Struse, S.: "When police patrols matter. The effect of police proximity on citizens' crime risk perception"
- 2014/2, García-López, M.A.; Solé-Ollé, A.; Viladecans-Marsal, E.: "Do land use policies follow road construction?"
- 2014/3, Piolatto, A.; Rablen, M.D.: "Prospect theory and tax evasion: a reconsideration of the Yitzhaki puzzle"
- 2014/4, Cuberes, D.; González-Val, R.: "The effect of the Spanish Reconquest on Iberian Cities"
- 2014/5, Durán-Cabré, J.M.; Esteller-Moré, E.: "Tax professionals' view of the Spanish tax system: efficiency, equity and tax planning"
- 2014/6, Cubel, M.; Sanchez-Pages, S.: "Difference-form group contests"
- 2014/7, Del Rey, E.; Racionero, M.: "Choosing the type of income-contingent loan: risk-sharing versus risk-pooling"
- 2014/8, Torregrosa Hetland, S.: "A fiscal revolution? Progressivity in the Spanish tax system, 1960-1990"
- 2014/9, Piolatto, A.: "Itemised deductions: a device to reduce tax evasion"
- 2014/10, Costa, M.T.; García-Quevedo, J.; Segarra, A.: "Energy efficiency determinants: an empirical analysis of Spanish innovative firms"
- 2014/11, García-Quevedo, J.; Pellegrino, G.; Savona, M.: "Reviving demand-pull perspectives: the effect of demand uncertainty and stagnancy on R&D strategy"
- 2014/12, Calero, J.; Escardíbul, J.O.: "Barriers to non-formal professional training in Spain in periods of economic growth and crisis. An analysis with special attention to the effect of the previous human capital of workers"
- 2014/13, Cubel, M.; Sanchez-Pages, S.: "Gender differences and stereotypes in the beauty"
- 2014/14, Piolatto, A.; Schuett, F.: "Media competition and electoral politics"
- 2014/15, Montolio, D.; Trillas, F.; Trujillo-Baute, E.: "Regulatory environment and firm performance in EU telecommunications services"
- 2014/16, Lopez-Rodriguez, J.; Martinez, D.: "Beyond the R&D effects on innovation: the contribution of non-R&D activities to TFP growth in the EU"
- 2014/17, González-Val, R.: "Cross-sectional growth in US cities from 1990 to 2000"
- 2014/18, Vona, F.; Nicolli, F.: "Energy market liberalization and renewable energy policies in OECD countries"
- 2014/19, Curto-Grau, M.: "Voters' responsiveness to public employment policies"
- 2014/20, Duro, J.A.; Teixidó-Figueras, J.; Padilla, E.: "The causal factors of international inequality in co2 emissions per capita: a regression-based inequality decomposition analysis"
- 2014/21, Fleten, S.E.; Huisman, R.; Kilic, M.; Pennings, E.; Westgaard, S.: "Electricity futures prices: time varying sensitivity to fundamentals"
- 2014/22, Afcha, S.; García-Quevedo, J.: "The impact of R&D subsidies on R&D employment composition"
- 2014/23, Mir-Artigues, P.; del Río, P.: "Combining tariffs, investment subsidies and soft loans in a renewable electricity deployment policy"

- 2014/24, **Romero-Jordán, D.; del Río, P.; Peñasco, C.:** "Household electricity demand in Spanish regions. Public policy implications"
- 2014/25, **Salinas, P.:** "The effect of decentralization on educational outcomes: real autonomy matters!"
- 2014/26, **Solé-Ollé, A.; Sorribas-Navarro, P.:** "Does corruption erode trust in government? Evidence from a recent surge of local scandals in Spain"
- 2014/27, **Costas-Pérez, E.:** "Political corruption and voter turnout: mobilization or disaffection?"
- 2014/28, **Cubel, M.; Nuevo-Chiquero, A.; Sanchez-Pages, S.; Vidal-Fernandez, M.:** "Do personality traits affect productivity? Evidence from the LAB"
- 2014/29, **Teresa Costa, M.T.; Trujillo-Baute, E.:** "Retail price effects of feed-in tariff regulation"
- 2014/30, **Kilic, M.; Trujillo-Baute, E.:** "The stabilizing effect of hydro reservoir levels on intraday power prices under wind forecast errors"
- 2014/31, **Costa-Campi, M.T.; Duch-Brown, N.:** "The diffusion of patented oil and gas technology with environmental uses: a forward patent citation analysis"
- 2014/32, **Ramos, R.; Sanromá, E.; Simón, H.:** "Public-private sector wage differentials by type of contract: evidence from Spain"
- 2014/33, **Backus, P.; Esteller-Moré, A.:** "Is income redistribution a form of insurance, a public good or both?"
- 2014/34, **Huisman, R.; Trujillo-Baute, E.:** "Costs of power supply flexibility: the indirect impact of a Spanish policy change"
- 2014/35, **Jerrim, J.; Choi, A.; Simancas Rodríguez, R.:** "Two-sample two-stage least squares (TSTLS) estimates of earnings mobility: how consistent are they?"
- 2014/36, **Mantovani, A.; Tarola, O.; Vergari, C.:** "Hedonic quality, social norms, and environmental campaigns"
- 2014/37, **Ferraresi, M.; Galmarini, U.; Rizzo, L.:** "Local infrastructures and externalities: Does the size matter?"
- 2014/38, **Ferraresi, M.; Rizzo, L.; Zanardi, A.:** "Policy outcomes of single and double-ballot elections"

2015

- 2015/1, **Foremny, D.; Freier, R.; Moessinger, M-D.; Yeter, M.:** "Overlapping political budget cycles in the legislative and the executive"
- 2015/2, **Colombo, L.; Galmarini, U.:** "Optimality and distortionary lobbying: regulating tobacco consumption"
- 2015/3, **Pellegrino, G.:** "Barriers to innovation: Can firm age help lower them?"
- 2015/4, **Hémet, C.:** "Diversity and employment prospects: neighbors matter!"
- 2015/5, **Cubel, M.; Sanchez-Pages, S.:** "An axiomatization of difference-form contest success functions"
- 2015/6, **Choi, A.; Jerrim, J.:** "The use (and misuse) of Pisa in guiding policy reform: the case of Spain"
- 2015/7, **Durán-Cabré, J.M.; Esteller-Moré, A.; Salvadori, L.:** "Empirical evidence on tax cooperation between sub-central administrations"
- 2015/8, **Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Analysing the sensitivity of electricity system operational costs to deviations in supply and demand"
- 2015/9, **Salvadori, L.:** "Does tax enforcement counteract the negative effects of terrorism? A case study of the Basque Country"
- 2015/10, **Montolio, D.; Planells-Struse, S.:** "How time shapes crime: the temporal impacts of football matches on crime"
- 2015/11, **Piolatto, A.:** "Online booking and information: competition and welfare consequences of review aggregators"
- 2015/12, **Boffa, F.; Pingali, V.; Sala, F.:** "Strategic investment in merchant transmission: the impact of capacity utilization rules"
- 2015/13, **Slemrod, J.:** "Tax administration and tax systems"
- 2015/14, **Arqué-Castells, P.; Cartaxo, R.M.; García-Quevedo, J.; Mira Godinho, M.:** "How inventor royalty shares affect patenting and income in Portugal and Spain"
- 2015/15, **Montolio, D.; Planells-Struse, S.:** "Measuring the negative externalities of a private leisure activity: hooligans and pickpockets around the stadium"
- 2015/16, **Batalla-Bejerano, J.; Costa-Campi, M.T.; Trujillo-Baute, E.:** "Unexpected consequences of liberalisation: metering, losses, load profiles and cost settlement in Spain's electricity system"
- 2015/17, **Batalla-Bejerano, J.; Trujillo-Baute, E.:** "Impacts of intermittent renewable generation on electricity system costs"
- 2015/18, **Costa-Campi, M.T.; Paniagua, J.; Trujillo-Baute, E.:** "Are energy market integrations a green light for FDI?"
- 2015/19, **Jofre-Monseny, J.; Sánchez-Vidal, M.; Viladecans-Marsal, E.:** "Big plant closures and agglomeration economies"

- 2015/20, Garcia-López, M.A.; Hémet, C.; Viladecans-Marsal, E.:** "How does transportation shape intrametropolitan growth? An answer from the regional express rail"
- 2015/21, Esteller-Moré, A.; Galmarini, U.; Rizzo, L.:** "Fiscal equalization under political pressures"
- 2015/22, Escardíbul, J.O.; Afcha, S.:** "Determinants of doctorate holders' job satisfaction. An analysis by employment sector and type of satisfaction in Spain"
- 2015/23, Aidt, T.; Asatryan, Z.; Badalyan, L.; Heinemann, F.:** "Vote buying or (political) business (cycles) as usual?"
- 2015/24, Albæk, K.:** "A test of the 'lose it or use it' hypothesis in labour markets around the world"
- 2015/25, Angelucci, C.; Russo, A.:** "Petty corruption and citizen feedback"
- 2015/26, Moriconi, S.; Picard, P.M.; Zanj, S.:** "Commodity taxation and regulatory competition"
- 2015/27, Brekke, K.R.; Garcia Pires, A.J.; Schindler, D.; Schjelderup, G.:** "Capital taxation and imperfect competition: ACE vs. CBIT"

