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Abstract : *This article presents both theoretical and empirical findings in the field of optimal local taxation i.e neutral in locational decision. This topic should throw light on the question of tax policy and tax reform. We extend Wildasin's (1987) model, including mobile capital. In this way, we include his marginal cost of congestion taxation rule relating to mobile households (proposition 1). This extension provides us with a new rule (proposition 2): the optimal share-out of taxes among household residents and firms in municipalities. To illustrate these results, we discuss the French municipal tax system properties and we pick out its main distortions.*

1 Introduction

Tax incidence and the question of optimal taxation are important topics for economic analysis. (see Ramsey (1927), Diamond and Mirlees (1971) or Slemrod (1990) concerning main traditional results). More recently, tax incidence has been the subject of many applied studies (see Sundar C. and al (2000) about taxes on capital gains, Castañer and al (2004) or Thurston (2002) on the subject of personal income tax, Giosa and De Piñeres (1999) concerning factor prices distortions resulting from trade tax policies).

Here, we focus on the valuation of local taxation. Traditionally, in tax incidence theory, territories are treated as closed. By contrast, in local public economics, the openness of the jurisdictions plays a major part. In this article, factors and population freely flow across jurisdictions. Indeed, capital tax effects on investment are neglected. Further, the total supply of capital in the economy is supposed fixed. Finally, we search the local tax structure causing no distortions or neutral in location decisions, i.e. which will be considered as justified by mobile taxpayers. They will not have incentives to migrate.

This article is organized around two sections. The first section models how local government tax policy affects the locational choices of mobile factors across jurisdictions, and we ask under what conditions these policies lead to an efficient equilibrium. The model extends Wildasin's analysis (1987) including mobile capital across jurisdictions. In this way, we are able to distinguish between the congestion costs, due to household and production activity. First, we recall the marginal cost of congestion taxation rule, also developed by Wildasin (1987). Furthermore, we are also able to discuss a major new topic: the optimal share-out of taxation among household residents and capital owners in municipalities. The second section discusses the French municipal taxes in the light of the above theoretical results.

2 Model of the locational assignment of factors.

The fundamental goal of this section is to understand how local government taxes affect resource allocation. We undertake three steps. The first one is to specify the efficient assignment of the two mobile factors to localities. In the second one, we define the corresponding equilibrium conditions. To finish, we compare the previous results to establish the conditions under which the locational equilibrium will be efficient. The efficiency depends on the structure of municipal taxes: If taxes are set appropriately, they will generate no distortions and mobile factors will not have incentives to migrate in order to avoid paying taxes.

2.1 Locational efficiency

Let us assume there is a fixed number of municipalities $M \geqq 2$, within which factors (capital and household workers) are mobile. Each locality provides a fixed amount of homogeneous land T_i. N stands for the total household population and K for the total capital supply to be invested in the economy. We suppose that all household taxpayers are identical (in tastes and endowment), so the government need not be concerned with questions of vertical or horizontal equity. See for example Moreland (2004) upon the question of optimal income tax rates level when wages rates differ.

Each unit of capital k_i and labor n_i are employed in only one locality (see (2) and (3)). Let $F_i(n_i, k_i, T_i, g_i)$ be a well-behaved constant returns to scale production function for the jurisdiction i to produce a single private numeraire good x_i and local public services. Equation (1) establishes full-employment of private production. Let $U(x_i, g_i)$ be the utility function of a household resident in locality i, which depends on its private consumption and on the local public services.

Each jurisdiction provides some public services G_i which are consumed by residents and jointly used with capital in the production process. Public goods exhibit congestion when the total amount provided by the local government (G) differs from the level actually consumed at the individual level (g), i.e. when $\alpha_n > 0$ and $\alpha_k > 0 : g = \frac{G}{n^{\alpha_n} k^{\alpha_k}}$. The degree of residential congestion is measured by α_n (respectively α_k for industrial congestion). To produce G_i units of local public goods, we need $C_i(G_i, n_i, k_i)$ units of numeraire. Then, considering the mobile factor n_i for instance, when $\frac{\partial C_i}{\partial n_i} = 0$, the local public good is pure. By contrast, when the corresponding marginal congestion cost $\frac{\partial C_i}{\partial n_i} > 0$, then the local public good is subject to congestion or impure. The term $\frac{\partial C_i}{\partial n_i} > 0$ (or equally $\frac{\partial C_i}{\partial k_i} > 0$) means that additional local public spending is required if public services' users marginally increase, with a given individual level g.

Several conditions must be satisfied to reach an efficient allocation of resources. As for a closed economy, markets for goods and factors must be efficient as well as the public goods provision. Furthermore, in our system of open economy, mobile factors and households must also be assigned in an efficient way. All in all, locational efficiency conditions can be derived from the following maximization problem :

$$\text{Max } \mathrm{U}_1(x_1, g_1) \; u.c. \begin{cases} U_i(x_i, g_i) = U_1(x_1, g_1), i = 2..M \\ (1) \sum_{i=1}^{n} [F_i(n_i, k_i, T_i, g_i) - n_i x_i - C_i(n_i, k_i, G_i)] = 0 \\ (2) \; N - \sum_i n_i = 0 \\ (3) \; K - \sum_i k_i = 0 \end{cases}$$

First-order conditions lead to the following equations (λ, μ, π and ρ are Lagrange multipliers):

$$(4) \qquad \frac{\partial U_1}{\partial x_1} - \sum_{i \neq 1} \lambda_i \frac{\partial U_1}{\partial x_1} - \mu = 0$$

$$(5) \qquad \lambda_i \frac{\partial U_i}{\partial x_i} - \mu = 0 \qquad i = 2...N$$

$$(6) \qquad -\mu x_i - \mu \frac{\partial C_i}{\partial n_i} + \mu \frac{\partial F_i}{\partial n_i} - \pi = 0$$

$$(7) \qquad -\mu \frac{\partial C_i}{\partial k_i} + \mu \frac{\partial F_i}{\partial k_i} - \rho = 0$$

$$(8) \qquad \lambda_i \frac{\partial U_i}{\partial g_i} + \mu \frac{\partial F_i}{\partial g_i} - \mu \frac{\partial C_i}{\partial G_i} \frac{\partial G_i}{\partial g_i} = 0$$

Condition (6) implies that $\frac{\partial F_i}{\partial n_i} - x_i - \frac{\partial C_i}{\partial n_i} = \frac{\partial F_j}{\partial n_j} - x_j - \frac{\partial C_j}{\partial n_j}$ and describes the efficient distribution of population. Efficiency is achieved when the marginal productivity of labor, minus the private consumption and the marginal congestion cost that households impose, is equalized everywhere in the economy. The same condition holds where there is mobile capital used jointly with labor and public goods in the production process: the efficient distribution of capital condition (7) means that the additional output, obtained by adding one more capital unit in the local production process net of the corresponding marginal crowding costs, must be equated across jurisdictions. To finish, combining (5) with (8) leads to the condition for efficient public expenditure.

We have now depicted the locational efficiency conditions; we still have to discuss the competitive equilibrium conditions for this economy.

2.2 Competitive equilibrium

Here, we describe the agents' behavior in our economy. Firms maximize their profits in competitive markets. Furthermore, two budget constraints (one for the local government and one for the representative household resident) are depicted.

Each jurisdiction raises revenue by levying various kinds of local taxes: tax on land rents (σ_i^r), on capital returns (σ_i^k), and residential head taxes (σ_i^n). Then, the balanced-budget constraint for municipality i is:

$$(9) \qquad C(n_i, k_i, G_i) = n_i \sigma_i^n + \sigma_i^r r_i T_i + \sigma_i^k s k_i$$

Indeed, households are equally endowed with ownership of the land and capital, outside of the locality of residence ($j \neq i$). Then, in locality j, land rents denoted r_jT_j and net return of capital sk_j are taxed at source. Then, the budget constraint for a household in jurisdiction i can be written:

$$(10) \qquad x_i = w_i - \sigma_i^n + \sum_j (1-\sigma_j^r) r_j \frac{T_j}{N} + \sum_j s \frac{K_j}{N} = \; w_i - \sigma_i^n + \theta$$

The individual capital share (respectively land share) is supposed to be $\frac{K_j}{N}(\frac{T_j}{N})$ and w_i represents the gross local wage. Let us denote as θ the total income stemming from land and financial investments.

Profit maximization by local competitive firms leads to the following three conditions :

$$(11) \qquad w_i = \frac{\partial F_i}{\partial n_i}$$
$$(12) \qquad r_i = \frac{\partial F_i}{\partial T_i}$$
$$(13) \qquad (1+\sigma_i^k)s = \frac{\partial F_i}{\partial k_i}$$

To reach an efficient competitive equilibrium, one must satisfy the two locational efficiency conditions for mobile capital (7) and labor (6). Locational efficiency can be achieved for mobile households in the economy if we combine equations (6) with (10) and (11) to obtain :

$$(14) \qquad \frac{\partial F_i}{\partial n_i} - x_i - \sigma_i^n = -\theta$$

Finally, as total income investment is the same in all the jurisdictions, with a special value equal to $\frac{-\pi}{\mu}$, the local head tax on mobile households must equal the corresponding marginal cost of congestion: $\sigma_i^n = \frac{\partial C_i}{\partial n_i}$. Conversely when public services are pure, the optimal tax level on mobile households is then equal to zero. Identically, combining (7) with (13) leads to the second efficient equilibrium condition:

$$(15) \qquad (1+\sigma_i^k)s - \frac{\partial C_i}{\partial k_i} = \frac{\rho}{\mu}$$

If $s = \frac{\rho}{\mu}$ is an unchanging value in all the jurisdictions, we obtain the efficient capital taxation level: $\sigma_i^k s = \frac{\partial C_i}{\partial k_i}$.

Finally, the conditions necessary for locational efficiency are summarized in the two following propositions:

Proposition 1 ***The marginal cost of congestion taxation rule, Wildasin (1987) :***

When public goods exhibit congestion, the marginal cost of congestion $\frac{\partial C_i}{\partial n_i}$ *is an efficient taxation level to internalize congestion externality, that is to say the cost of providing the extra public good to maintain individual public services when faced by an expanded household population. With expenditure held fixed, an increase in the number of public users, necessarily mobile, causes a deterioration of public services, which must be internalized to reach an efficient solution. If local public goods are pure, efficiency does not require the taxation of mobile residents. Whatever the nature of local public goods, land rent taxation is justified, setting* σ_i^r so as to satisfy (9). *Several authors including Arnott and Stiglitz (1979), and then Yinger (1982) have shown that land rent taxation is efficient because public services increase land value by a capitalization effect.*

Proposition 2 ***The optimal share-out of taxes among mobile household residents and capital owners***

The same rule must be applied to mobile capital as long as production jointly employs public services and generates crowding effects. All in all, an efficient local taxation requires one to distinguish and measure exactly the marginal cost of congestion from the two different mobile users of public goods. In other words, we must share precisely the tax pressure between capital owners and household residents to internalize the cost of congestion induced respectively by each kind of public services user.

All in all, many kinds of taxes could potentially play the role of an efficient tax to internalize congestion, irrespective of the tax base definition. The marginal cost of congestion taxation rule only requires consideration of the amount of tax paid. Each household and each owner of one unit of capital must pay the local authority a total amount equal to the cost of providing the extra public good to maintain individual public services when faced by an expanded public services user.

We have now established the efficient local taxation rules, and we now need to discuss the properties of the French municipal taxes. The French public sector has two major hierarchical levels: central government and local (so called 'territorial') authorities. The latter can be divided into three, although interrelated, tiers whose lowest level is the municipality. We concentrate on that final jurisdiction here.

3 French municipal tax distortions

The two main forms of municipal taxation on household residents in France include Taxe d'Habitation (TH) and Taxe Foncière Bâtie (TFB) due from building occupants and landlords respectively. They are proportional to the property and renting values assessed by the land registry. The local business tax called Taxe professionnelle (TP) is paid by firms based in the municipality. This tax is calculated on the whole value of tangible assets, that is to say the value of capital (including buildings). Lastly, the tax on land property is the Taxe Foncière non Bâtie (TFNB). To discuss the optimality of this tax system, we will first discuss proposition 2, to see if the French municipal tax system is consistent with an optimal spreading of taxes among mobile household residents and capital owners. Next, we examine whether the French local taxes match the marginal cost of congestion taxation rule.

3.1 Optimal spreading of taxes among mobile household residents and capital owners

Most empirical studies show that local public services exhibit a high degree of congestion (see Borcherding and Deacon (1972)). In France, similar conclusions are reached in Guengant, Josselin and Rocaboy (1995, 2002). However, to illustrate the application of Proposition 2, we must focus our attention on particular studies which include two different sources of crowding effects: mobile household residents and capital or firms' production activity. To our knowledge, this kind of analysis is rare, probably because relevant data to measure capital is not easy to collect. In France, only two contributions can be used even if they are not fully satisfactory.

In Guengant, Josselin and Rocaboy (1995), production activity congestion is assessed by temporary labor migration in the municipality. Their study uses a set of 799 French municipalities of at least 10,000 inhabitants. They estimate a specification similar to Borcherding and Deacon's formulation. Using a similar methodology, Guengant (1992) gets comparable results:

congestion costs induced by household residents is preponderant with a congestion elasticity equal to 0.8 (respectively 0.2 for firms activity). All in all, despite the imperfect measure of congestion from production activity, these studies show that tax on mobile household resident should be predominant.

We now focus on the share of local tax receipts for the numerous municipalities of less than 10,000 inhabitants; relevant values are shown in table 1.

Table 1. Tax receipts (per capita) by population size, 1996

share of receipts	- 700	700-2,000	2,000-5,000	5,000-10,000	whole
TFB	27%	28%	28%	28%	28%
TFNB	23%	10%	4%	2%	7%
TH	23%	24%	22%	22%	23%
TP	28%	38%	46%	48%	42%
M	25249	6908	2655	898	35710

M is the number of municipalities. TP tax receipts for the municipalities of at least 10,000 inhabitants are presented in the table below:

Table 2: TP tax receipts by population size, 1996

	10-20,000	20-50,000	50-100,000	100-300,000	+300,000	whole
TP	47,9%	47,5%	50,3%	44,9%	37,2%	46,8%
N	470	306	70	33	4	883

Among these local taxes, TP ranks first giving the highest revenue (more than 40% in most of these municipalities). Tax on building occupants (TH), compared to mobile household residents is smaller (between 20 and 25%), which seems to refute the optimal spreading of taxes principle.

3.2 French municipal taxes and the marginal congestion cost rule

To assess the main four French municipal taxes in the light of proposition 1, we first discuss their tax base. Furthermore, we also propose to work out the optimal tax paid by mobile taxpayers in a set of small French municipalities.

3.2.1 French municipal tax bases

According to Wildasin (1987) locational efficiency requires the use of a land rent taxation, paid by immobile landlords. The basis on which TFB and TFNB are currently assessed on building and land values dates from land registry computation of the 1970s. These tax bases no longer reflect today's land and building monetary values. Therefore, they are not proportional to the current rent return and differ from the efficient taxation rule.

Until 1999, the business tax TP was set at 18% of total wages, plus the whole value of tangible assets (that is to say building and capital values used in the production process). The 1999 tax reform consisted in removing total wages from the tax base. From then on, only the use of capital was included in TP, excluding production activity congestion assessed by temporary labor migration in the municipality. This tax reform, on account of employment, still seems to move away from the efficient taxation rule which consists in internalizing all congestion costs due to local production.

3.2.2 Optimal taxation of mobile household municipal taxpayers

The optimal taxation level which must be levied on mobile municipal taxpayers can easily be computed using a congestion specification similar to Borcherding and Deacon (1972), which includes all sources of congestion :

$$f(N, A, K) = N^{-\alpha_n} A^{-\alpha_A} K^{-\alpha_k} \quad (16)$$

where N, A and K measure respectively total household population, working people residing temporarily and capital units invested in the municipality. In this way we identify all public services users. One alternative model of congestion is often used in the literature. As suggested by Edwards (1980) or De Mello (2002), the Camaraderie effect means that there may be a population level where sharing congestible goods increases benefits to each user until these are eroded by crowding. But these studies can't be used here because the corresponding estimates only include residential crowding effects.

Consequently, the public spending level actually consumed at the individual level can be written:

(17) $g = N^{-\alpha_n} A^{-\alpha_A} K^{-\alpha_k} G$

Thus, we can deduce the efficient taxation level upon mobile residents as the cost of providing the extra public good to maintain individual public services in the face of an expanded user population :

$\frac{\partial G}{\partial N} = \frac{\alpha_n}{N} G$

This efficient level can be compared to the TH (taxe d'habitation) actually paid by building occupants in a sample of 32 small French municipalities belonging to the same suburban area in 1996. Thus this constitutes a quite relevant sample of municipalities of less than 10,000 inhabitants. Data have been taken from AUDIAR (Greater Rennes Inter-Municipality Development Agency) and offer a detailed measurement of variables.

Results appear in the table given in appendix. The first columns give the efficient tax levels with different fixed values for the congestion parameter α_n. G is measured according to the total expenditure in each jurisdiction used by the total household population settled in the municipality. Column TH gives the average amount paid in each municipality. However, in France more than 20 % of building occupants are tax-exempt and nearly 30% enjoy partial tax relief. In this case, CTH measures the corrected average amount paid by real taxpayers. For most municipalities, CTH is the efficient tax level with $\alpha_n = 0.2$. When the residential crowding parameter is greater than 0.3, CTH is under the optimal level. Overall, despite the imperfect measure of congestion in the empirical literature, these preliminary results seem to demonstrate that tax on mobile household residents should be higher in France in order to be efficient.

4 Concluding remarks

This article presents both theoretical and empirical findings in the field of optimal local taxation. The model extends Wildasin's analysis (1987), including mobile capital across jurisdictions. In this way, we recall his marginal cost of congestion taxation rule. Furthermore, we are also able to discuss a major new topic: the optimal share-out of taxation among household residents and capital owners in municipalities. Having developed this theory, we are able to illustrate many of the distortions in the French municipal tax system.

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6 Appendix

Town	$\alpha_n = 0,1$	$\alpha_n = 0,2$	$\alpha_n = 0,5$	TH	CTH
Acigné	1306	2612	6530	1787	2904
Betton	1608	3217	8041	1937	3148
Brécé	1521	3041	7603	1730	2811
Bruz	1507	3014	7536	1854	3013
Cesson-Sévigné	1739	3478	8695	1309	2127
Chantepie	1665	3330	8325	1202	1953
Chapelle Fougeretz	1553	3106	7764	2071	3365
Chapelle Thouarault	1160	2320	5800	1546	2512
Chartres	2966	5931	14828	1196	1944
Chavagne	1929	2858	7144	1775	2884
Chevaigne	1381	2763	6907	1474	2395
Cintré	1743	3485	8713	1999	3248
Clayes	1318	2637	6591	1228	1996
Geveze	1673	3347	8367	1311	2130
L'Hermitage	1333	2665	6663	1300	2113
Montgermont	2483	2966	7416	1950	3169
Mordelles	1454	2907	7269	1688	2743
Noyal-Chatillon	1380	2759	6898	1787	2904
Noyal s/ Vilaine	1700	3400	8500	1206	1960
Pacé	1605	3210	8024	2038	3312
Parthenay	1202	2404	6009	1055	1714
Pontpéan	1033	2067	5166	1400	2275
Le Rheu	1541	3081	7703	2006	3260
StErblon	1473	2946	7365	1735	2819
StGilles	1569	3139	7846	2110	3429
StGrégoire	1829	3658	9145	1933	3141
StJacques	1397	2794	6986	1741	2829
StSulpice	1232	2463	6159	1485	2413
Thorigné	1698	3397	8492	2237	3635
Leverger	1930	3859	9648	1248	2028
Vern	1504	3007	7518	1456	2366
Vézin	1732	3463	8658	1696	2756
Rennes	1568	3137	7242	2062	3351