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TAX COMPETITION AND PUBLIC INPUT

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Abstract

This paper assesses the extent and policy implications of simultaneous competition among countries on both corporate tax rates and the provision of public goods used by firms as production factors ('public factors'). First, we derive the relevant theoretical results in a unified framework where a corporate tax is used to finance a public good that raises both household utility and firm productivity. Then, the relevance of such simultaneous competition is tested using data on foreign direct investment from the US to EU member states.

Both the theoretical analysis and the empirical results presented in this paper suggest that focusing on the tax side of the competition for the location of multinationals is misleading. It shows that there are grounds for the coexistence of high tax/spending countries and low tax/spending ones. Furthermore, provided multinationals are heterogeneous concerning their use of public factors, the competition for attracting them could take the form of a vertical or horizontal specialisation, whereby each government would seek to attract a certain type of activity through the adequate provision of certain public factors. In this framework, international competition could act as a vector for raising public-sector efficiency rather than as a standardisation factor.

Classification JEL: F21, F23, H25, H41, H54.

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Contents

Summary

This paper studies the extent and policy implications of simultaneous competition on both corporate tax rates and the provision public goods used by firms as production factors ('public factors'). First, we derive the relevant theoretical results in a unified framework where a corporate tax is levied in order to finance a public good that raises both household utility and firm productivity. We then study the case where a second household-specific good must be financed by the same corporate tax and the case of an inefficient public sector. Finally, we consider the case where the firms are heterogeneous concerning their use of public factors.

In the second part of the paper, the relevance of such simultaneous competition on taxes and the provision of public factors is tested on the basis of foreign direct investment (FDI) flowing from the US to the various EU member states over 1994-2003. We find that nominal corporate tax rates and two public factors (road infrastructure and public R&D spending) are significant in explaining inward FDI. The orders of magnitude found suggest that a trade-off is indeed possible between low taxation and the high provision of public goods.

Both the theoretical analysis and the empirical results presented in this paper suggest that focusing on the tax side of the competition for the location of multinationals is misleading. It shows that there are grounds for the coexistence of high tax/spending countries and low tax/spending ones. Furthermore, provided multinationals are heterogeneous concerning their use of public factors, the competition for attracting them could take the form of a vertical or horizontal specialisation, whereby each government would seek to attract a certain type of activity through the adequate provision of certain public factors. In this framework, international competition could act as a vector for raising public-sector efficiency rather than as a standardisation factor.

The policy implications for high tax countries such as France or Germany are clear. These countries have already taken the approach of high taxation and the high provision of public goods. Hence the question for them is less the absolute level of taxes rather than the efficiency of the public sector. These countries could find a way to preserve their attractiveness despite high taxation through providing public infrastructures and services of high quality. Nevertheless, providing high-quality public factors to multinationals could have a cost in terms of the need to also provide household-specific public goods such as health care or interpersonal redistribution. Thus the pressure on the public sector to raise its efficiency will be more acute the higher the desired provision of these household-specific public goods.

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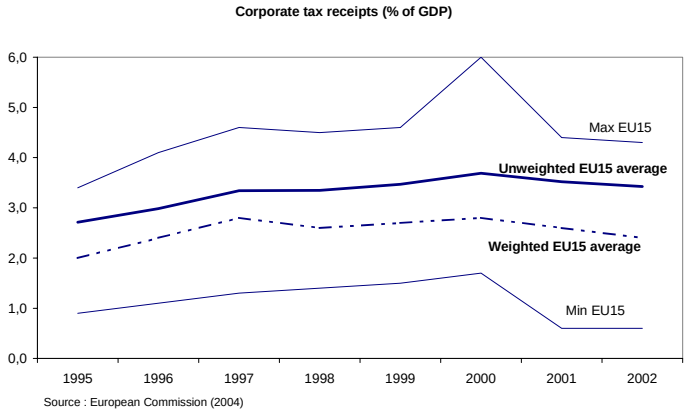
1. Introduction

The public discourse on tax competition often gives rise to a debate between two opposing and unduly simple opinions. On the one hand, supporters of tax harmonisation fear that tax competition may lead to a 'race to the bottom' and hence a hollowing-out of mobile tax revenues. On the other hand, advocates of tax competition fear that harmonisation will compel low tax countries to increase public expenditures. Ironically, both opinions agree with some tax equalisation, either downwards (in the competition case) or upwards (in the harmonisation case).

Over the long term, the taxation of corporate profits has not resulted in a hollowing-out of tax receipts. The tax receipts have been stable as a proportion of GDP. The non-weighted average ratio of corporate taxes to GDP even rose between 1995 and 2002 in the EU-15, whereas the weighted average ratio remained stable (Figure 1). In fact, this ratio rose in 'small' EU countries as well as in France and Spain. This trend does not contradict a fall in tax rates since small countries may have seen their tax bases increase following tax cuts.

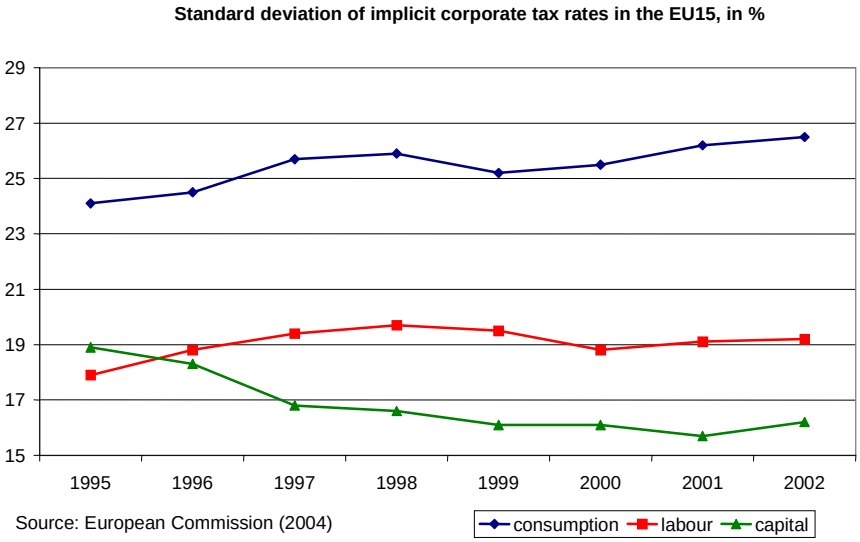
Figure 1. Corporate tax receipts



Indeed, effective tax rates, which account for both tax rates and the perimeter of tax bases, fell from 1980 to 2002, even if this trend hid a crosscutting effect between falling rates and rising bases. According to Devereux et al. (2002), effective average tax rates (EATR) have fallen more markedly than effective marginal tax rates (EMTR). They suggest that this could be the result of more profitable firms (including multinationals) becoming relatively more mobile than less profitable ones.

On the whole, a downward convergence of corporate tax rates can be observed in the European Union. Such a convergence means that the diversity of preferences across EU member states concerning the provision of public goods will rely more and more on other taxes. This phenomenon is illustrated in Figure 2, on the basis of implicit tax rates provided by the European Commission. Implicit tax dispersion is less pronounced for capital taxation than for the taxation of labour and especially consumption. This pattern tends to become more acute over time.

Figure 2. Standard deviation of implicit corporate tax rates



According to the canonical model of tax competition (Zodrow & Mieszkowski, 1986), capital mobility leads to a sub-optimal provision of public goods. Yet this model assumes that, in a closed economy, an optimal combination of public and private goods is reached. The latter assumption is quite restrictive, and one research avenue has entailed relying on a less ideal vision of public action. According to this alternative literature, tax competition allows a weakening in the tendency of the public sector to grow more than is actually required by the people (Edwards & Keen, 1996; Wrede, 2001). This divide is difficult to reconcile. As a matter of fact, the most popular version of the tax competition model relies on many simplifications. One is that only households enjoy the public goods.[1] But some of the goods financed by the public sector are used as production factors by the firms, as was already accounted for by Zodrow & Mieszkowski. These goods can be labelled 'public factors'. Infrastructure,[2] expenditure aimed at protecting property rights or enforcing contracts and labour training are examples of public factors. To a certain extent, public R&D expenditures can also be viewed as a public factor.

Thus the question is what should theoretically happen in the case of competition on both tax rates and on the provision of public factors, and whether such a scenario is grounded empirically. Finally, to what extent does accounting for the provision of public factors impact on policy recommendations?

Section 2 derives the relevant theoretical results when all firms are assumed to be identical with regard to their use of public factors, before addressing the case of heterogeneous firms. Original empirical results based on foreign direct investment (FDI) flowing from the US towards EU member states are presented in section 3. The question posed is whether the competition to attract US FDI relies on tax rates, on public factors or on both. Policy conclusions are derived in section 4.

[1] See Wilson (1999) and Krogstrup (2002) for surveys.

[2] See Rychen (1999).

2. Theoretical analysis

In the following analysis, a distinction is made between a public good, which is used by households only, and a public input (or factor), which is used by firms as well and raises the productivity of other production factors. The production function of each firm depends on its capital stock, on employment and on the quantity of public input which, according to Samuelson's taxonomy, is assumed to be a pure public good within the country's frontiers.[3] It is assumed that there is no congestion in the use of this public input; hence the quantity available to each firm does not depend on the number of firms.[4] In other words, the public good is assumed to be 'factor-augmenting' rather than 'firm-augmenting', which would mean that the quantity available to each firm would be a decreasing function of the number of firms. Certainly some public factors such as services related to firm creation can be viewed as 'firm-augmenting'. This factor is the exception, however, rather than the rule, with most public factors being of the 'firm-augmenting' type.

We first assume all firms to be identical concerning their use of a public factor. Therefore an aggregate production function can be used. In a second step, some heterogeneity in the use of the public factor is introduced: some firms need more of the public factor or the type of public factor needed is not the same across the firms.

2.1 All firms are homogenous concerning their use of the public input

The literature accounting for the productive dimension of public goods, although much less voluminous than the literature that ignores it, is rooted on Zodrow & Mieszkowski's (1986) seminal paper. Oates & Schwab (1988), Sinn (1997), Keen & Marchand (1997) and Matsumoto (1998, 2000a, 2000b and 2004) complement this limited literature.

Here the basic model of Zodrow & Mieszkowski (1986) is adapted to account for a public good that is used both by households and firms.[5] Of course, some public goods such as sports and cultural infrastructures are mainly directed at households rather than firms, whereas others such as public R&D are mainly directed at firms. Yet transport and communication infrastructures, public education, police and judicial institutions, for instance, are used by both households and firms. Hence, a large proportion of public goods seems to be used by households and firms, which justifies our modelling choice.[6]

There are two private production factors: capital and labour. Capital is assumed to be mobile internationally whereas labour is not.[7] The marginal productivity of each factor is assumed to be positive and decreasing. The public factor is assumed to be a complement to capital: the marginal productivity of capital rises with the quantity of the public factor. This assumption reflects what happens with public infrastructures, for instance.[8] Public education and R&D can

[3] From an international point of view, it is a local public good.

[4] See Hillman (1978), McMillan (1979) and Feehan (1989).

[5] In Zodrow & Mieszkowski's (1986) model, as in the other papers listed above, the public factor is distinct from the public good used by households.

[6] Inter-individual redistribution and social expenditures directed towards the elderly are major exceptions that are addressed at the end of this sub-section.

[7] In Zodrow & Mieszkowski's (1986) model, the immobile factor is land.

[8] Various specifications of the role of infrastructure in the production function have been proposed in the literature. In Sinn (1997), for instance, infrastructures are not a direct argument of the production function.

also be viewed as complements to capital. The utility of the representative household depends on its consumption of the private good and of the collective public good, which is identical to the public factor used by the firms. The transformation rate of the private good into a public good is assumed to be unity, if not mentioned differently. Both private and collective goods are produced through the same production process, which uses capital, labour and public factors.

In a closed economy, capital and labour resources are fixed. The condition for economic efficiency then stipulates that the provision of public goods should be such that the marginal rate of substitution between the public good and the private one (i.e. the amount of private good the consumer agrees to lose in order to consume one extra unit of public good) is equal to 1 less the marginal productivity of the public factor. Indeed, raising the production of a public good by one unit leads to a rise in the production of a private good by an amount equal to the marginal productivity of the public factor. Hence the optimal allocation of resources between the production of the two goods must take into account this dividend, which must be deducted from the marginal transformation rate, the latter being unity. With x denoting the private good and g the public good, $MRS_{g/x}$ the marginal rate of substitution and f'_g the marginal productivity of the public factor, the benchmark formula is:

$$MRS_{g/x} = 1 - f'_g \tag{1}$$

With a non-productive public good, the marginal rate of substitution consistent with the efficient allocation of resources would be unity. Since $MRS_{g/x}$ is a decreasing function of the quantity of the public good, the fact that this good is productive leads to higher optimal provision of this good. Because both capital and labour are supplied in fixed quantities (in a closed economy), a tax on either factor is equivalent to a lump sum tax and the way the public good is financed is irrelevant to the efficiency of resource allocation.

In an open economy, capital is assumed to be perfectly mobile internationally, whereas labour is assumed immobile. Two alternative assumptions are usually considered. In the small country hypothesis, the world capital return is independent of what happens in the small country, whereas it is not the case in the large country scenario, where each country may have an impact on the world equilibrium post-tax return (see Wildasin, 1988; Laussel & Le Breton, 1998; Wooders et al., 2003). The impact of tax competition is only dampened, however, not reversed, in the large country case compared with the small country one. Since the small country case is more tractable, this is the hypothesis used here.

For simplicity, the public good is assumed to be financed by a single tax, which is a source tax t on the capital stock k available in the country, whether it is owned locally or internationally.[9] The (static) budget constraint of the public sector reads:

$$tk = g \tag{2}$$

Assuming free capital mobility and no risk, the arbitrage condition states that the post-tax capital return should be equal to its world exogenous level r. With f'_k denoting the marginal productivity of capital, this leads to the following condition:

[9] Hence for simplicity it is a tax on the capital stock, not on its return. The important point, however, is that the tax is levied under the source principle (like the corporate tax) rather than under the residence principle (like capital income taxes). This scheme excludes the case whereby repatriated capital income from a foreign affiliate is applied at the mother-country tax rate, which can be the case in the credit system. Our choice fits the European reality where repatriated profits are generally taxed according to the exemption scheme.

$$f'_k - t = r \tag{3}$$

The effective mobility of capital will be reduced by the fact that a fall in the capital stock k raises its marginal productivity f'_k. The larger this effect, the lower the capital outflow following a rise in the domestic tax rate. This is illustrated in Equation (4), which measures the reaction of capital in percentages following a 1% rise in the tax rate without any compensation in terms of the public factor. This equation can easily be recovered by differentiating Equation (3), which leads to: $f''_k\, dk = dt$. Defining

$$e^0_{k/t} = -\frac{dk/k}{dt/t}$$

as the capital elasticity to the tax rate with a constant public factor. Equation (4) states that if $-f''_k > 0$ is large (which means that the rise in capital productivity is rapid when the stock of capital falls), then the capital elasticity to the tax rate is lower:

$$e^0_{k/t} = -t/kf''_k > 0 \tag{4}$$

As a **first case**, we assume that **the public good is not productive**. Then, the above elasticity is the only factor that should be accounted for when comparing resource allocation in the small open-economy case compared with autarky. Indeed, it can be shown that resource allocation in the small economy is governed by the following condition:[10]

$$MRS_{g/x} = 1 + \frac{e^0_{k//t}}{1 - e^0_{k//t}} \tag{5}$$

The marginal rate of substitution between the public and the private good $MRS_{g/x}$ is higher in this case than in autarky where it is equal to 1 ($f'_g = 0$ in Equation (1)): compared with autarky, capital mobility introduces a distortion in resource allocation favouring the private good at the expense of the public one. This is the case whether the country is a net exporter of capital or a net importer of capital. The term in $e^0_{k//t}$ measures the pressure due to the arbitrage condition in the international capital market. This term will be present in all the cases considered in the following analysis, although with different concepts of capital elasticity. Assuming a 0.3 elasticity, this term is equal to 3/7; hence for an open economy, the marginal rate of substitution between the public good and the private good could be almost 50% higher than for a closed economy. This means that the impact of capital mobility is far from negligible as far as resource allocation is concerned.

Nevertheless, Equation (5) only represents a marginal condition. It shows the direction in which resource allocation is directed by financial openness, here towards higher opportunity cost for the public good. It does not enable us to conclude what quantity of public good will be provided at equilibrium, which can either rise or fall depending on the parameters of the model, whatever the international status of the country (as either a net capital exporter or a net capital importer). Without ambiguity, capital openness raises the welfare of a net capital-importer country. In the case of a net exporter, the impact of capital opening on welfare is less clear. If the marginal utility of the public good is very high, and if the capital elasticity to the tax rate is high, welfare can indeed fall.

[10] This is the constrained optimal allocation of resources; therefore, it is a second-best optimum.

As a **second case**, we assume that **the public good is a public factor**, i.e. it is productive. The capital elasticity $e^0_{k/t}$ is no longer the right one to study the impact of capital mobility on resource allocation. Indeed, a rise in taxation now allows the public sector to provide more of the public factor, and thus to raise capital productivity, which puts a break on capital outflow. Hence Equation (5) must be modified to account for the impact of a rise in the provision of the public factor on both private good production (f'_g) and capital productivity (f''_{kg}). The allocation of resources now follows:

$$MRS_{g/x} = \frac{1}{1 - e^1_{k/t}} - f'_g = 1 + \frac{e^1_{k/t}}{1 - e^1_{k/t}} - f'_g \qquad (6)$$

The difference between Equations (5) and (6) hinges on the public factor marginal productivity f'_g and on the elasticity of capital to taxation $e^1_{k/t}$, which now accounts for the fact that more public factor (allowed by more taxes) raises the marginal productivity of capital, hence the equilibrium stock of capital. This new elasticity $e^1_{k/t}$ is:[11]

$$e^1_{k/t} = -t/k \frac{1 - k f''_{kg}}{f''_{kk} + t f''_{kg}} \leq e^0_{k/t} \qquad (7)$$

If the public good is not productive, then $f'_g = f''_{kg} = 0$, $e^1_{k/t} = e^0_{k/t}$ and Equation (6) is the same as (5). Now if the public good is productive, it is possible to show that, under classical assumptions concerning production functions, $e^1_{k/t}$ lies between 0 and 1 (see Gugl, 2003), which allows us to draw the following conclusions.

First, the distortion in favour of the private good at the expense of the public one is robust to the assumption that the public good is productive. Indeed, comparing Equations (6) and (1) shows that the marginal rate of substitution between the public good and the private one at equilibrium is higher for a small open economy than for a closed one. This means that the amount of the private good that the consumer is prepared to give up in order to obtain one extra unit of public good is higher at equilibrium. The quantity of the public good consumed is usually lower, especially in the case of a net capital exporter. This result is not a surprise. The important point is the underlying mechanism.

Second, the distortion in favour of the private good at the expense of the public one is smaller when the marginal productivity of capital is highly sensitive to the amount of public input. This rise in marginal capital productivity following an increase in public factor provision slows down capital flight when taxation rises. This point is made clear from the comparison between Equation (6') (which is equivalent to (6)) and Equation (5):[12]

$$MRS_{g/x} = 1 + \frac{e^0_{k/t}}{1 - e^0_{k/t}} (1 - k f''_{kg}) - f'_g \qquad (6')$$

Among the policy implications, two specifically relate to both EU member states and for the EU as a whole, which are exposed to tax competition both within and outside the EU.

[11] Equation (7) is obtained by differentiating the arbitrage condition (3) and accounting for the budget constraint (2).

[12] Here we use the fact that $1 - k f''_{kg} < 1$.

Policy implication 1: Since tax competition leads to a redirection of resource allocation away from public goods towards private goods, there is ground for producing some public goods (such as infrastructures or R&D) at the EU level.

Such a policy would aim at correcting the detrimental bias on resource allocation stemming from tax competition. In the political arena, the centralisation of some expenditures at the EU level could be exchanged for the withdrawal of any project concerning tax floors. Indeed, our model shows that such an exchange would not be detrimental to capital-importing countries.

Policy implication 2: Any policy leading to a rise in the private return on public factors may reinforce the country's attractiveness *vis-à-vis* foreign investors. This mechanism also holds for the EU as a whole.

Hence, a policy aiming at raising the quality or the efficiency of the public factor may slow down tax-related capital outflows.

Several variants of the baseline model can then be studied. First, the assumption that resource allocation would be a first-best optimum in autarky is questionable. Such an assumption makes sense for private goods owing to the competition among producers, which induces them to minimise unit costs. Conversely, assuming that the public sector would minimise the costs can be viewed as rather hazardous. Here we assume that there is a specific inefficiency in the public sector that leads to a transformation rate between the private good and the public good of $1+c$ ($c>0$) instead of 1. Equation (6) is modified accordingly:

$$\mathrm{MRS}_{g/x} = \frac{1+c}{1-e^{2}_{k/t}} - f'_{g} \tag{8}$$

The elasticity $e^{2}_{k/t}$ included in Equation (8) accounts for the waste of public money due to the extra cost c of public good provision compared with private good provision:

$$e^{2}_{k/t} = -t/k\frac{1+c-kf''_{kg}}{(1+c)f''_{kk}+tf''_{kg}} > e^{1}_{k/t} \tag{9}$$

If $c = 0$, then Equation (8) is equivalent to (6). Otherwise, $e^{2}_{k/t}$ can be shown to be an increasing function of c. Hence the MRS is higher with this public sector inefficiency (compare (6) to (8) with $c > 0$): the bias away from the provision of public goods is magnified because capital flight is accelerated by public sector inefficiency. Capital per capita falls, as well as the living standard.

Assume now that public inefficiency can be reduced by an effort from the public sector, which is costly in itself. Then it is possible to show that tax competition raises the optimal level of effort for a given provision of a public good. This variant is telling regarding the constraints on economic policy posed by tax competition.

Policy implication 3: Tax competition is expected to provide incentives for governments to raise public sector efficiency.

In this sense, tax competition could deliver results similar to yardstick competition, wherein voters compare the achievements of their own governments to those of others (Schleifer, 1985). Although yardstick competition may well be significant in the US (Besley & Case, 1995a and 1995b), cultural and linguistic differences are impediments too large for such a mechanism to apply in the EU. Tax competition may then appear as a substitute, inducing governments to either reduce public expenditures or make them more efficient. Such a policy raises

understandable discontent, however, since the median voter may not benefit from tax competition. Hence policy-makers are stuck between capital market and electoral requirements. This position is difficult to sustain, and the fact that policy-makers are often not re-elected may be partly related to this contradiction.

A second variation around the benchmark model consists of allowing for a second public good, which would be directed towards households only. Theatres, concert halls, sports facilities or health expenditures for inactive persons are examples of non-productive public goods. Zodrow & Mieszkowski (1986) account for these goods in their model, which includes two separate public goods for households and firms. They show that tax competition may lead to a sub-optimal provision of both kinds of goods, the under-provision of public factors having a side effect on the provision of household-specific public goods through lower national income. Keen & Marchand (1997) extend this view by showing that, for any level of taxation, capital mobility leads to a realignment in the choice of public good provision towards public factors at the expense of household-specific public goods. Under some additional assumptions, this result is robust to the inclusion of labour taxation aside from capital taxation.

As previously mentioned, a large proportion of public goods is used by both households and firms. Yet, public expenditures directed towards the elderly (e.g. pensions and health care) and inter-personal redistribution do not assist productivity. Since their share in public expenditures tends to rise over time, it may be appropriate to introduce a household-specific public good aside from the multi-functional one in our model. Without any additional assumptions, the addition of a household-specific public good in the model leads to the following conclusions.

First, tax competition is detrimental to the provision of the household-specific public good as a result of the arbitrage with the private good and with the public factor.

Second, consistent with previous results, introducing a specific inefficiency in the public sector raises the bias in favour of the private good at the expense of both public goods. But the bias in favour of the public factor at the expense of the household-specific good is now reduced. Intuitively, the gain from providing the public factor rather than the household-specific good is reduced if public inefficiency reduces the impact of the public factor on private productivity.

Policy implication 4: Tax competition redirects goods that are only used by households. Hence it has an expenditure-shifting effect.

Since voters are households rather than firms, this bias creates additional discontent among voters, although households are also concerned with employment, hence by the location of firms.

Policy implication 5: The most surprising conclusion is that tax competition-led efforts by the public sector to reduce inefficiencies will raise the composition bias of public expenditures in favour of public factors at the expense of household-specific public goods.

This result occurs because the falling cost of public factors induced by higher efficiency of the public sector will stimulate more demand for this factor, which will supplant the provision of household-specific public goods.

The models referred to above do not account for the possible financing of public goods by taxes other than the capital tax. Using a similar model as in Razin & Sadka (1991), for instance, it is possible to recover a *tax-shifting* effect where tax competition shifts the tax burden towards the less mobile tax base – labour. This tax-shifting effect is qualified by Bucovetsky & Wilson (1991) when competing countries are large: the fact that each one can have an impact on the post-tax capital return limits its incentive to implement lower capital taxation. Still, the fact that capital is more mobile than labour leads to a downward convergence of capital taxation.

The analysis presented here does not account for possible agglomeration economies, which would prevent marginal capital productivity from declining when capital accumulates. Models of the 'new economic geography' (Krugman, 1991; Ludema & Wooton, 1997; Andersson & Forslid, 1999; Baldwin & Krugman, 2003) underline the existence of location rents for 'central' countries, which would allow them to keep their capital tax rates above those of 'peripheral' countries. Hence, geographic diversity would allow the retention of some tax diversity. In this framework, public investment in infrastructures or R&D can favour agglomeration effects, and hence tax diversity.

2.2 Heterogeneity in the use of public factors

In the previous section, we assumed a single public factor. Introducing a set of public factors that can be differentiated horizontally (varieties) or vertically (qualities) opens the way to national differentiation strategies.

There are many examples of firms having different needs in terms of public factors. For instance, the productivity of a road-transport company depends on the quantity and quality of roads, whereas a call centre is dependent on telecommunication networks. On this basis, public jurisdictions can elaborate horizontal differentiation strategies in order to attract certain types of activities (Justman et al., 2004; Wooders & Zissimos, 2004; Bucovetsky, 2004), with the implication of weaker competition on tax rates. This first kind of differentiation, however, could well apply to local jurisdictions rather than national ones, except of course when the size of the country is close to that of a region, as is the case of Luxembourg. Owing to fixed costs, a local jurisdiction needs to develop or attract a specific type of activity through specific education and infrastructure expenditures. For a relatively large country, a wide range of activities can be attracted and the differentiation strategy will likely be more vertical than horizontal.

Vertical differentiation will translate, for instance, into the education strategy. Attracting research centres necessitates spending public resources in higher education including PhD programmes. Such expenditures are not needed for attracting call centres, which employ less-educated workers. More generally, economic activities can be ranked according to a quality scale corresponding to the amount and quality of public factors they use rather than to the type of public factors. In Justman et al. (2002), marginal capital productivity depends on the quality of public infrastructures, in different ways across the various industries. Justman et al. then study the conditions under which each country can take advantage of vertical differentiation, i.e. from differentiation in the quality of its infrastructures and in the level of its taxes. Two conditions emerge: first, the cost of improving the infrastructure quality must not be prohibitive. Second, firms' heterogeneity concerning their use of public factors must be sufficiently strong. In all cases, only a limited number of countries can play the differentiation game, owing to increasing returns of scale in the use of the public factor.[13] The fixed cost of public factor quality must be distributed across a sufficiently large number of firms. This leads to a tax externality, which is a generic property of *clubs*. Here, the club of firms enjoying the public factor is a spatial club, hence the tax externality leads to a spatial concentration of firms, independently of any network externality highlighted by the new economic geography literature. When there are more countries than allowed by the minimisation of public factor costs, new countries can participate in the vertical differentiation strategy only if other countries leave. It is empirically difficult to tell whether such a threshold has already been reached in the EU, but new member states are clearly in a difficult position compared with the EU-15.

[13] This finite property was first obtained in industrial organisational models of product differentiation – see Shaked & Sutton (1983).

On the whole, the theoretical literature predicts that some corporate tax diversity could survive depending on:

- the existence of some competition in the quality of public factors aside from tax competition;
- the relative mobility of capital and labour;
- the extent of geographical inequalities (size and distance from the centre).

3. Empirical evidence

The empirical literature devoted to the competition on tax rates and the provision of public factors has been rather limited so far. Such hypotheses can be tested either on the local level or on the international one. At the local level, Gabe & Bell (2004) study the impact of public expenditures and property tax rates on the choice of corporate locations in Maine (US) from 1993 to 1995. They find that a 10% rise in education spending leads to a 6% increase in firms settling there. Hence their study confirms that firms look at the provision of public factors when considering location. According to them, a strategy of low taxation and a low provision of public factors appears less rewarding than the opposite strategy of high taxation with a high provision of public goods.

At the international level, there is extensive literature looking at the impact of corporate taxation on FDI. The meta-analysis proposed by de Mooij & Ederveen (2001) shows that on average, among 371 recorded semi-elasticities of FDI to corporate tax rates, a 1 percentage point fall in the corporate tax raises inward FDI by 3-4%. Yet the authors do not compare the results to determine whether public factors are included or not in the regressions. Bénassy-Quéré et al. (2004) show that for bilateral FDI across OECD countries, a 1 percentage point rise in the effective average tax rate (EATR) leads to a fall in inward FDI by 3%, which is consistent with de Mooij & Ederveen's results. But they also find that a 1 percentage point rise in public investment as a share of total public expenditures raises inward FDI by 13%. Hence, a country that would simultaneously raise its EATR by four percentage points and its public investment ratio by 1 percentage point would keep inward FDI unchanged, other things being equal. This shows that there is indeed a trade-off to be made between taxation and the provision of public infrastructures. Nevertheless, this study relies on aggregate flows of bilateral FDI. It does not allow us to study the possible differentiation among member states according to the type of activities they seek to attract.

The empirical test proposed below relies on US FDI to EU member states. We test whether competition among EU member states to attract US FDI hinges on taxation and public factors simultaneously. Although the data does not allow us to assess whether a qualitative differentiation would make sense in Europe (the sectors are too large), the very existence of simultaneous competition (on tax rates and on public factors), if empirically supported, would in itself have important policy implications, as developed in the theoretical section of this paper.

3.1 The empirical specification

In this section we explain FDI flowing from the US to 18 EU member states for 11 industries over 1994-2003. Following the literature on FDI, we explain inward FDI by the size of the host country (which covers demand factors) and by a set of supply factors that include labour costs, corporate taxation and the provision of public factors. For the dependent variable, we successively use the flow and the stock of inward FDI. Both measures are used in the literature. By definition, the flow is more reactive than the stock to changes in economic conditions;

however its high volatility makes it difficult to estimate its determinants. Here both measures are used for robustness. Indexing dependent and explanatory variables by *i* for the host country, by *j* for the sector and by *t* for time, the estimated equation is the following:

$$FDI_{ijt} = \alpha_i + \gamma_j + \beta_1 \log GDP_{it} + \beta_2 WCOST_{it} + \beta_3 TAX_{it} + \beta_4 INFR_{it} + \beta_5 HEAL_{it} + \beta_6 RD_{it} + u_{ijt} \qquad (10)$$

where FDI_{ijt} successively represents the inward flow of FDI (denoted $FLOW_{ijt}$) and logarithm of the stock ($\log STOCK_{ijt}$).[14] Explanatory variables are detailed in the box. Inward FDI is explained by the economic size of the host ($\log GDP_{it}$), by its wage cost ($WCOST_{it}$), by its statutory corporate tax rate (TAX_{it}) and by three public good variables, namely the road infrastructure ($INFR_{it}$), health expenditures ($HEAL_{it}$) and public R&D expenditures (RD_{it}).

In order to increase the power of the regressions, we use pooled ordinary least squares. Thus time effects are neglected. This assumption is justified by preliminary regressions showing that dummy variables for time are not significant in explaining inward flows.[15] In the case of FDI stocks, there is a strong correlation over time between, on the one hand, aggregate FDI for all host countries and all sectors, and on the other hand, average R&D for all host countries. Both series follow a U-shape over the period, and this shape does not fit the business cycle. We prefer using the R&D variable rather than introducing dummies for time, which would not be interpretable.

As a first step, we systematically include country and sector dummies in the regressions. As detailed below, however, these dummies are rarely significant, so we only report the results obtained with significant dummies.

3.2 The data

As note above, the sample covers FDI from the US towards 18 EU countries for 11 sectors.[16] The data comes from the Bureau of Economic Analysis (BEA). Unfortunately, not all the new member states are covered by the database, although the largest ones are included. The data is annual for 1994-2003 (flows) or 1994-2002 (stocks). The data sources for explanatory variables are detailed in Box 1.

Note that the data coverage is not exactly the same for FDI flows and stocks: flows cover the usual definition of FDI, i.e. foreign direct investment leading the foreign investor to hold at least 10% of the target firm; the stock variable uses a more restrictive definition wherein only investments from foreign investors holding at least 50% of the capital are recorded.

[14] The negative values of some flows exclude using the logarithms of the flows; hence estimated coefficients cannot directly be interpreted as (semi-) elasticities.

[15] The market size variable ($\log GDP_{it}$) accounts for most of the time effects. Bénassy-Quéré et al. (2004) do not introduce time effects either.

[16] The 18 EU countries are the EU-15 countries plus the Czech Republic, Hungary and Poland. The 11 sectors are food, chemicals, metals, non-electrical machinery, electric and electronic components, transportation equipment, wholesale trade, finance (except banking) insurance, information, other services (hotels, business services, health services, education, recreation, etc.), and other (agriculture, mining, construction, transportation, utilities, retail trade, etc.).

Box 1. The variables used in the regressions

$FLOW_{ijt}$ denotes the inflow of FDI in country *i* and sector *j* for year *t*, in $US millions deflated by the price index of investment in the host country *i*. This variable is not in logarithms due to some negative observations. (Source: BEA.)

log$STOCK_{ijt}$ denotes the logarithm of the stock of capital expenditures by US mother companies in country *i*, sector *j*, year *t* (at least 50% ownership), deflated the same way as the flow variable. (Source: Bureau of Economic Analysis.)

logGDP_{it} is the logarithm of real GDP in country *i* at year *t*, converted into $US at current exchange rates. (Source: OECD.)

$WCOST_{it}$ is an index of the cost of labour per hour in current $US for the manufacturing sector. (Source: OECD.)

TAX_{it} is the statutory corporate tax rate in country *i* and year *t*. (Source: Michael Devereux's web page.)

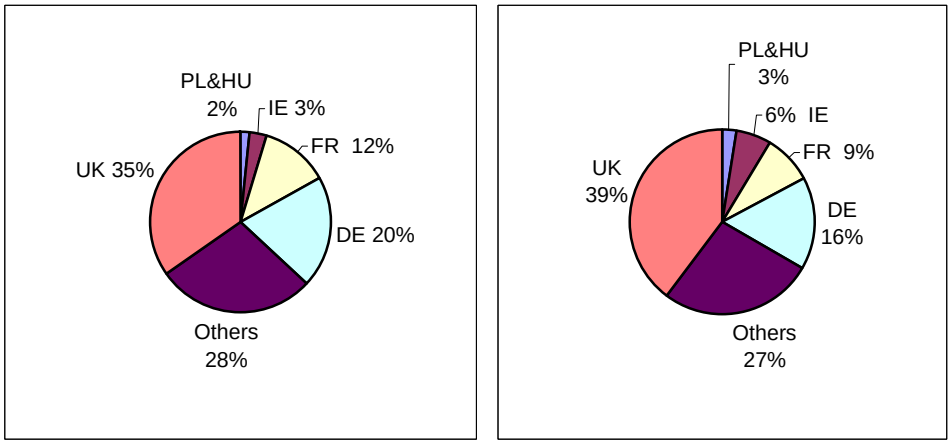
$INFR_{it}$ is the length of roads (in kilometres) per square meter, i.e. the total number of kilometres in country *i* at time *t* divided by the surface of country *i*. (Source: World Bank.)

$HEAL_{it}$ denotes health expenditures as a share of GDP in country *i* at time *t*. (Source: OECD.)

RD_{it} is the amount of public R&D expenditures as a share of GDP in country *i* at time *t*. (Source: Eurostat.)

The evolution of the distribution of US FDI stock in Europe is illustrated in Figure 3. Over 1994-2002, Anglo-Saxon countries and new member states increased their share at the expense of France and Germany. The share of France in 2002 (9%) is little more than half its weight in the EU's GDP whereas the share of the UK largely exceeds its weight in the EU's GDP.

Figure 3. The distribution of US FDI stock in Europe

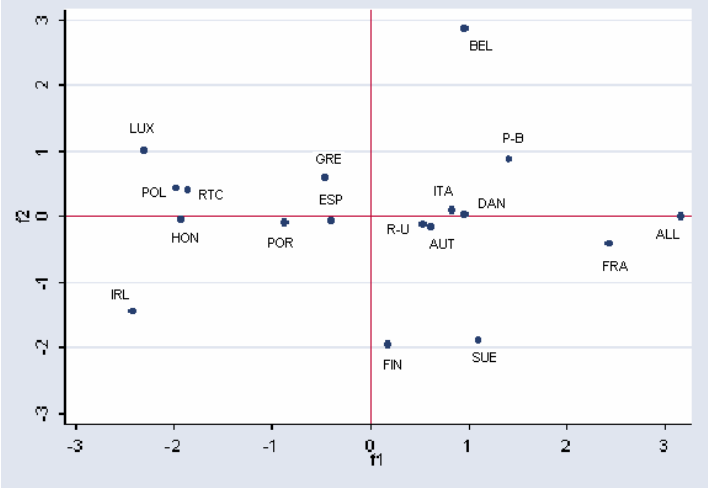


1994 2002

Source: BEA.

As far as the explanatory variables are concerned, it is interesting to note that there is a wide range of both tax rates and public factor provision across the countries of the sample. To give a synthetic picture of the data, we performed a principal component analysis on the explanatory variables of FDI, retaining the period average for each country. The results are reported in Figure 4.

Figure 4. Principal component analysis of the countries



Notes: Country abbreviations: ALL = Germany; AUT = Austria; BEL = Belgium; LUX = Luxembourg; DAN = Denmark; ESP = Spain; FIN = Finland; FRA = France; GRE = Greece; HON = Hungary; IRL = Ireland; ITA = Italy; P-B = the Netherlands; POL = Poland; POR = Portugal; RTZ = the Czech Republic; R-U = the UK; SUE = Sweden.

The interpretation of the principal component analysis is given by the contributions of the variables in the definition of the two axes (f1 and f2):

f1 = 0,51 st(HEAL) + 0,49 st(logGDP) + 0,48 st(RD) + 0,42 st(WCOST) + 0,25 st(TAX) + 0,10 st(INFR)

f2 = 0,74 st(INFR) + 0,55 st(TAX) + 0,01 st(HEAL) – 0,046 st(logGDP) – 0,05 st(WCOST) – 0,37 st(RD)

where st( ) is a standardisation operator.

Source: Authors' calculations.

Consistent with the theoretical analysis, which highlights possible competition on both tax and spending, the first axis represents the choice of each country between, on the right-hand side, high taxation with high provision of public factors, and on the left-hand side, low taxation with low provision of public factors. The second axis then represents a vertical differentiation with upside countries providing infrastructures but low public R&D whereas the downside countries provide the opposite combination.

France and Germany are clearly located on the right-hand side of the graph (high taxation, high public factor provision), whereas Ireland and Luxembourg are on the left-hand side. Note that for a given provision of public goods together with a given level of taxation, larger countries are further to the right of the graph and smaller ones further to the left, owing to the contribution of GDP to the first axis.

Belgium appears at the top of the graph (with a high degree of infrastructure and low R&D spending) whereas Finland and Sweden are in the opposite situation. Ireland shows up with low R&D spending, but owing to low taxation, it is located in the lower half of the vertical axis. France and Germany have high R&D spending and a high degree of infrastructure, hence they do not show any vertical differentiation. The three new EU member states of the sample (the Czech Republic, Hungary and Poland) are in a symmetrical situation, with a low provision of public factors and no vertical differentiation.

3.3 The results

According to preliminary estimations (not reported here), country dummies are not significant, which means that explanatory variables, especially GDPs are sufficient to explain country

differences in the ability to attract FDI. Among the sector dummies, only the one on the finance sector appears to be significant. Hence the results reported in this section include only this dummy variable (labelled *FIN*). There is a strong, positive correlation between labour costs and GDP, which could stem from the two variables being expressed in dollars and/or from a business cycle phenomenon. The labour cost, like GDP, is found to have a positive impact on FDI inflows. This classical result of the literature has a demand-side interpretation: the larger the purchasing power, the larger the FDI inflow, although this also means that labour is expensive. To avoid multicolinearity, we have to eliminate one of the two variables. Since the impact of labour costs reflects a demand effect rather than a supply effect, we keep GDP but exclude labour costs in the estimated equation.

3.3.1 Results with FDI inflows as the dependent variable

The results with FDI inflows as the dependent variable are reported in Table 1. As expected, the economic size of the host country has a positive, significant impact on FDI inflows, which confirms that the prime motivation of FDI is market access.[17] Corporate nominal taxation has a negative impact on FDI inflows, and this impact is significant at the 10% level. Elasticity calculations show that a 1 percentage point rise in the tax rate leads to a 3.5% fall in inward FDI.[18] This order of magnitude is in line with the existing literature (see the introduction of this section).

Table 1. Pooled estimation, dependent variable = FDI inflow

Dependent variable	FLOW
Constant	546.1***
	(214.5)
LogGDP	225.1***
	(58.8)
TAX	-783.6*
	(404.3)
HEAL	-262.1***
	(61.5)
INFR	172.1***
	(45.3)
RD	141614.2***
	(37908.4)
FIN	2030.2***
	(496.1)
Number of observations	699
Adjusted R-sq	0.21

*** significant at 1%; ** significant at 5%; *significant at 10%

The two variables accounting for public factors – road infrastructure (*INFR*) and public R&D expenditures (*RD*) – have a positive impact on FDI inflows at the 1% confidence level. Elasticity calculations show that a 1% rise in road density raises FDI by 0.7%, whereas a 1% increase in R&D expenditures leads to a 1.1% increase in FDI. These figures mean that a

[17] Business surveys generally place proximity to a large market at the top of their location criteria, well above cost factors.

[18] Conversely, a 1 point drop in the tax rate raises FDI by 3.5%, other things being equal. This semi-elasticity, however, only applies for small tax variations.

country could choose to raise its corporate tax rate by 1 percentage point and at the same time raise R&D spending by 3% (or road density by 5%) without changing FDI inflows.[19]

Conversely, health expenditures seem to have a detrimental impact on FDI inflows, which is significant at the 1% level. Since half of health expenditures are related to the last couple of life years, they can hardly be seen as a public factor. Thus their impact on FDI can theoretically be either insignificant or negative (if it signals a high redistribution level and/or future rise in tax pressure). Still, this first regression has a low explanatory power, which can be related to the high variability of the dependent variable. Hence the results need to be confirmed by the analysis performed on the stock of FDI.

3.3.2 Results with the log of inward FDI stocks as the dependent variable

The results with stocks rather than flows are reported in Table 2. As in the flow case, corporate taxation has a negative, significant impact on inward FDI (this time at the 1% confidence level), whereas both public factors (road infrastructure and public R&D spending) have a positive, significant impact. Finally, health expenditures still seem to repel FDI.

Table 2. Pooled estimation, dependent variable = log of inward FDI stock

Dependent variable	LogSTOCK
Constant	-1.19***
	(0.37)
LogGDP	1.40***
	(0.05)
TAX	-5.58***
	(0.89)
HEAL	-0.23***
	(0.04)
INFR	0.47***
	(0.04)
RD	63.28**
	(28.33)
FIN	-1.07***
	(0.14)
Number of observations	707
Adjusted R-sq	0.58

***significant at 1%; **significant at 5%; *significant at 10%

A 1 percentage point increase in the corporate tax rate reduces inward FDI by 5.6%. This figure is slightly higher than in the flow case. It is difficult to provide a clear interpretation given the level of aggregation of FDI data (for instance, the way FDI is financed is not provided; still it can be different for 10% and 50% affiliates, which could explain the difference in the tax coefficient when the dependent variable is the FDI stock and when it is the FDI flow).

Turning to public factors, a 1% increase in road density raises inward FDI by 0.8%, while a 1% increase in public R&D spending raises FDI by 0.2%. Hence the elasticity of FDI to the road

[19] Road density is of course related to human density. Hence, there is less road infrastructure in Finland and Sweden than in Belgium or the Netherlands. Consistently, our analysis shows that taxation must be lower to compensate for less infrastructure. If road density is measured per capita rather than by square meter, then the road density effect disappears but this is explained by a high and negative correlation between road density and taxation.

infrastructure is similar for stocks as for flows, but the elasticity to R&D spending is lower in the stock case. One possible interpretation is that US multinationals are less sensitive to this factor than US investors with smaller holdings (10% or less) in European firms. It is possible that US multinationals tend to locate production and distribution units rather than research centres in Europe.

3.3.3 Results with the log of inward FDI stocks as the dependent variable, sector regressions

As suggested by theory, the various sectors may not react the same way to the provision of public factors. The sector dimension of our sample allows us to test for this possibility, although the desegregation is rather rough and the number of observations by sector is limited. Here we only study seven sectors, with the largest numbers of observations ranging between 72 and 86 each. The results are reported in Table 3.

Table 3. Sector estimations, dependent variable = log of inward FDI stock

Dep. variable	Wholesale trade	Finance	Other services	Food	Metal	Transport equipment	Chemicals
Constant	-0.64	-1.42**	-3.21***	-1.54*	-2.04***	-2.40*	1.30*
	(0.52)	(0.70)	(0.67)	(0.93)	(0.73)	(1.32)	(0.72)
logGDP	0.94***	1.38***	1.71***	1.33***	1.45***	1.52***	1.29***
	(0.06)	(0.14)	(0.13)	(0.14)	(0.14)	(0.24)	(0.09)
TAX	-1.54	-7.6***	-3.41*	-3.58	-4.72***	1.65	-8.05***
	(0.97)	(1.48)	(1.95)	(2.42)	(1.74)	(2.34)	(1.52)
HEAL	-0.03	-0.35**	-0.35***	-0.22*	-0.34***	-0.35*	-0.28***
	(0.07)	(0.17)	(0.09)	(0.11)	(0.11)	(0.19)	(0.09)
INFR	0.26***	0.60***	0.67***	0.61***	0.42***	0.15	0.71***
	(0.05)	(0.15)	(0.09)	(0.12)	(0.12)	(0.15)	(0.08)
RD	82.41***	287***	181.75***	-89.95	118.78*	-55.53	63.22*
	(28.45)	(69.4)	(55.23)	(78.39)	(71.62)	(105.28)	(43.65)
Nobs	82	72	76	74	81	72	72
R-sq	0.83	0.74	0.85	0.68	0.72	0.6	0.78

***significant at 1%; **significant at 5%; *significant at 10%

When significant, the estimated coefficients are always of the same sign as in the pooled estimation. Taxation is no longer significant for two tertiary sectors (wholesale trade and other services) or for transport equipment. It stays significant, however, for the three manufacturing sectors (food, metal and chemicals) and for finance. R&D expenditures have a significant impact for all sectors but food and transport equipment. Road density is important everywhere except for transport equipment. In fact, only size seems to matter for the latter sector. Finally, health expenditures have a negative impact on inward FDI in all sectors but wholesale trade.

3.3.4 Results with the level of inward FDI stocks as the dependent variable

As shown in Figure 3, large EU countries tend to receive more FDI than small ones do. Yet as a percentage of GDP things are different: the UK, Ireland and Luxembourg receive relatively more than other EU countries. In the above equations, these differences across countries appear to be captured by the various explanatory variables since country dummies are not significant. Still, country effects may have been played down by the instability of FDI flows (such flows are hardly explained by a constant by country) or by the logarithmic transformation of FDI stocks (which squashes high values). Here we test for robustness by using FDI stock levels for the

dependent variable. The results are displayed in Table 4. In the first column, explanatory variables are exactly the same as for the estimation on logarithms. The coefficients are of course different than for the log specification, but their signs and significance levels are similar.

The second column reports the results when a dummy variable for the UK (labelled *UK*) is introduced because it now happens to be significant.[20] The sign and significance level of other explanatory variables is unchanged except for health expenditures, which now have a positive impact on FDI. In fact, health expenditures are small in the UK in terms of GDP, compared with continental EU countries. Since the UK is the most popular destination for US investors (owing to language, culture and also the importance of the city of London), it is possible that the negative coefficient on health obtained in previous regressions (without the UK dummy) stems from the impact of the UK being attractive for Americans. In the third column of Table 4, the *UK* dummy is multiplied by the *HEAL* variable in order to capture a specific effect of UK health expenditures. Health expenditures are now shown to repel FDI in the UK, but they seem to attract FDI in other countries. Hence the detrimental effect of health expenditures on FDI that was found above looks rather fragile here. The fact that it is robust for the UK could be related to the Beveridgian system in this country, with health expenditures being financed by redistributive taxes.

Conversely, the other results – the impact of corporate taxation and the two public factors – are robust to all specifications, and the orders of magnitude tend to imply that a trade-off can be made between attractive taxation and the provision of public factors.

Table 4. Pooled estimation, dependent variable = inward FDI stock

Dependent variable	STOCK	STOCK	STOCK
Specification	1	2	3
Constant	-399.6***	-656.8***	-666.3***
	-113.6	-100.5	-100.5
LogGDP	230.7***	118.9***	118.1***
	20.3	9.5	9.3
TAX	-894.1***	-848.8***	-864.9***
	-178.5	-174.9	-174.7
UK	–	817.7***	11946.6**
		-125.7	-6112.3
UK*HEAL	–	–	-1594.9*
			-872.1
HEAL	-71.75***	36.5***	–
	-23.4	12.3	
(1-UK)*HEAL	–	–	39.1***
			12.3
INFR	51.5***	36.3***	36.1***
	8.7	7.3	7.3
RD	39172.4***	33396.2***	32992.8***
	9024.8	8243	8148.6
FIN	-180.5***	-195.1***	-193.5***
	-31.7	-28.01	-28.9
Number of observations	720	720	720
R-sq	0.29	0.43	0.44

***significant at 1%; **significant at 5%; *significant at 10%

[20] Other country dummies are still not significant; hence they are not included in the regression.

4. Conclusion

Both the theoretical analysis and the empirical results presented in this paper suggest that focusing on the tax side of competition for the location of multinationals is misleading. It has been shown that allowing capital taxation to finance public factors can qualify the 'race-to-the bottom' conclusion. As a consequence, there are grounds for the coexistence of high tax/spending countries and low tax/spending ones. Furthermore, provided multinationals are heterogeneous concerning their use of public factors, the competition for attracting them could take the form of a vertical or horizontal specialisation, whereby each government could choose to attract a certain type of activity through the adequate provision of certain public factors. In this framework, international competition could act as a vector for raising public sector efficiency rather than as a standardisation factor.

The policy implications for high tax countries such as France and Germany are clear. These countries have already chosen policies involving high taxation and the high provision of public goods. Hence the question for them is less the absolute level of taxes than the efficiency of the public sector. These countries could find a way to preserve their attractiveness despite high taxation through providing public infrastructures and services of high quality. Yet providing high-quality public factors to multinationals could have a cost in terms of also meeting the need for household-specific public goods, such as health care or interpersonal redistribution. The pressure on the public sector to raise its efficiency will be more acute the higher the desired provision of these household-specific public goods.

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