EU tax competition and tax avoidance: A multiprincipal perspective

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EU TAX COMPETITION AND TAX AVOIDANCE: A MULTIPRINCIPAL PERSPECTIVE

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Abstract

Taxation is the cornerstone of intergovernmental fiscal relations and is especially at stake when authorities address mobile tax bases. The EU case is particularly interesting to tackle. Evidences prove the existence of important tax interactions among member states and both theoretical and empirical analysis shed light on the different mechanisms at work. Likewise, the improved knowledge relative to tax avoidance strengthens the need to take into account this kind of phenomenom. In this paper we propose to compare various alternative settings to the current system so as to be able to estimate the relevance of granting EU the power to tax and in which way. In order to adopt a general and comprehensive framework, we introduce information asymmetries and examine different kinds of governments' objective function. We show that the best outcome would be reach if the EU tier only were allocated the power to tax firms' profits but also prove that, in a context of national governments acting in a competitive way aimed at attracting firms, conferring the EU layer the capacity to apply a tax on a base alreeady subject to member states' taxation could improve the current issue.

Keywords : Vertical and horizontal tax externalities, Information asymmetry, Tax competition, EU taxation, Governments' objective function.

JEL Classification : D72, D82, H23, H30, H32, H71, H77.

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1 Introduction

Oates : "*There are fascinating times for the study of fiscal federalism. On the one hand, we are witnessing widespread efforts at devolution in both industrialized and developing nations as countries seek to improve the performance of the public sector by bringing decision-making closer to the people. On the other hand, we see in Europe the evolution of a new top layer of government that introduces more centralized policy-making. The multi-level character of government seem to be taking on an increasingly complex character.*" Fiscal federalism and European Union : Some reflections, 2002, Società italiana di economia pubblica, XIV conferenza.

Indeed, the issue of fiscal relationships between different levels of government comes up with a particular acuteness in the current context of the deepening and the advance of the decentralization process in many OECD countries and of the evolution of the European dimension with, in particular, the highly debated topic of the potential design of an own tax resource for the European budget.

Besides, as states must share a global tax base, the combination of tax competition between member states and tax optimization behaviors stemming from multinational firms represents a main issue for the EU and some authors have even pointed that the sustainibility, the stability of the long run system can be jeopardized by these phenomena.

On the one hand, taxation can be said to be especially at stake when authorities are vying for mobile tax bases.

Conventional public finance literature[1] has shown that in small open economies, vying for mobile tax bases leads benevolent governements to set inefficiently low levels of taxation and to provide insufficient supplies of public goods. Indeed, non cooperative behaviors trigger a wrong valuation of the real marginal cost of public funds. When policymakers are envisaged as Leviathan, competition may act in a corrective way towards pre-existing distorsions[2].

Though new strands of economic theory have greatly improved the comprehension and the knowledge about tax competition, sometimes modifying the nature of conclusions (e.g. the introduction of public goods of a specific nature, the use of economic geography tools...), many empirical papers have demonstrated the existence of strategic corporate tax competition, as Altschuler and Goodspeed (2002) or Devereux, Loretz and Rodeano (2008). With a more particular focus on the European dimension, Riedl and Rocha-Akis (2012) confirm the existence of tax base externalities and Redoano (2014) shows that EU member states react to each others' tax rates ; the impact of EU expansion on tax competition is also stressed in these works[3].

Furthermore, some clues may testify for the existence of tax competition among member states as, for instance, a very advantageaous parent-subsidiary regime in the Netherlands called the "dutch sandwich", the reduction of the UK corporate income tax performed in the recent years, the widespread Luxembourg "tax rulings" or the low taxation level in Ireland and its tax optimisation friendly climate (the "double Irish").

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[1] See for instance Oates (1972), Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1988), Wilson (1999)...

[2] See Brennan and Buchanan (1977).

[3] See Davies and Voget (2008), Devereux and Loretz (2013), Keuschnigg, Loretz and Winner (2014).

On the other hand, as far as tax avoidance and evasion are concerned, times appear particularly relevant to address such issues, as the recent scandals and the measures undertaken to fight these behaviours may suggest[4].

A growing literature highlights the drawbacks of the profit or location shifting strategies implemented by multinational firms (see Egger, Eggert and Winner (2010)[5]). This kind of mobility of firms is indeed very pervasive and empirical analysis have proved its impact (Bartelsman and Beetsma (2003), Clausing (2003), Grueber and Mutti (1991), Hines and Rice (1994), Hines (1999)).

One way to find a piece of solution could consist in giving to Europe the power to tax. According to the principle of "*No taxation without representation*", the supra-national level would thus be made accountable for the policies undertaken thanks to this resource and the lack of congruence between the structure of the European budget and the aims of the Union would be reduced.

A EU tax could be a handful tool both to tackle the issue of own resource and to avoid to some extend such problems that deprive member states from resources. One of the potential candidates could be a corporate income tax. It could lessen tax competition between member states and thus improve cohesion, enhance growth and competitiveness at a European level.

This tax would neither have be too weak - in which case it would fail to finance the European budget and wouldn't meet the previous goals - nor have to be too high - which might prevent states from collecting the tax receipts they need to finance their public investments or expenditures.

But would it be more relevant and implementable to choose an additional tax in the existing European fiscal landscape or a new and unique tax replacing some part of current tax schemes ? That's the issue we propound to ponder over in this paper.

This will lead us to take into account another kind of tax interactions : vertical tax externalities. Indeed, the decisions taken by different authorities are interdependent and distorsions may emerge if they don't take into account the impact of their choices upon the budget of the other tiers. As a result, tax externalities may develop when there are direct or indirect interactions between governments, either when these decisionmakers are same level authorities (horizontal externalities) or when they belong to different tiers of government (vertical externalities).The issue of tax stacking emerges when one questions the current EU financing scheme and the relevance of setting an own tax resource for the European level. Indeed, we can observe that, to some extent, the current system may involve a vertical tax externality as a part of the taxes collected at the national level are transferred towards the European tier. Furthermore, in an alternative conception, the supranational layer could tax bases upon which member states already levy taxes in order to finance European policies ; such taxes would replace contributions

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[4]In this respect, we can think about the 2010 US « Foreign Account Tax Compliance Act », the OECD Base Erosion and Profit Shifting Project (started in 2013 in partnership with the G20 leaders) and the EU Common Consolidated Corporate Tax Base (CCCTB) project, which aims at enabling groups of firms to set taxable income according to European common rules and to consolidate and share it among the Member States in which they operate.

[5]Many works deal more particularly with intangible assets, as Dischinger and Riedel (2011), Böhm, Karkinsky and Riedel (2012). Karkinsky and Riedel (2012).

based on national revenue. Would such an option be held, the definition of this tax and the mechanisms of collecting it would be key parameters. Last, a novative solution could be imagined : in order to rule out tax competition and to significantly lessen the scope of optimisation processes, the power to levy taxes upon corporate income could be allocated to the upper level only, i.e. the European tier, with a distribution mechanism built upon a sharing out key that would take into account such determinants as the number of employees, the level of investment, the amount of activity and turnover performed in the different member states...

Based on a modelisation borrowed from Lachet-Touya 2012, this paper aims at comparing the current system of EU financing (modelled as a mechanism/framework that mainly rests on transfers subject to national revenue made by member states to the supranational tier) with alternative schemes that could allow an own tax for the European level : a setting consisting in having a corporate tax set at the European level only, the receipts of which would be distributed among member states, then the addition of a European tax upon national corporate taxes which will allow us to simultaneously take into account horizontal and vertical externalities...

An important parameter of the model is the nature of governments' objective function : we may either consider benevolent governments (with an utilitarian welfare function), or decison-makers biased towards firm, or governments eager to maximise tax receipts. We will regard as a benchmark the case of a unique benevolent government.

Besides, it seems relevant to introduce in such settings information asymmetries. Indeed, in many circumstances, important information for appropriate policies may not be available for public decision-makers : agents (here the tax base) may have a better knowledge than governments concerning one relevant parameter or a private information concerning particular characteristics of them and use it in order to influence to their advantage the choices of political decisionmakers. For instance, the existence of tax credits, transfer prices between multinational firms and their affiliates makes the tax process not transparent enough and the taxable scope less certain.

Models analyzing the interactions between several principals can help improve the comprehension and knowledge of constitutional structures in which rival powers interact, especially as many principals (the governments) often contract with a unique and common agent (the taxpayer)[6]. Thus, in this work, corporate taxation by governments is considered as an agency relationship since firms have a private relevant information concerning the tax base for the contract that relate them to public decision-makers (for instance as regards costs). We will tackle this issue thanks to the multiprincipal theory which is particularly insightful in issues involving several governments[7]. Since the early 1990's, models of common agency game have introduced informational asymmetries, starting with Laussel and Lebreton (1993, 1994) and extending traditional results through the introduction of new assumptions as the seminal papers from Olsen and Osmundsen (2001, 2011) did in settings allowing for instance decisionmakers to seek capturing the rents of a large investor partly owned by local shareholders, the introduction of a joint cost or again the existence of spillovers correlated to the firm's productivity... and that led to results quite novative with respect to traditional common agency outcomes (higher tax rates, differentiation in the levels of investment between efficient and inefficient types...).

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[6]Martimort and Stole (2003), Page and Monteiro (2003).

[7]D. Martimort (1996) : "The Multiprincipal Nature of Government"

Beyond this aspect of information asymmetry, another strand of political economy literature examines the role of interest groups in the observed trends of corporate income taxes. Authors as Lorz (1998) or Lai (2010) introduces lobbying, which is considered to play a role in the determination of tax rates and some other works, as Chirinko and Wilson (2010) have empirically checked these mechanisms and stressed the effective impact of interest groups' actions upon tax choices.

This paper is organised as follows : section one describes the structure of the model and the assumptions made while section two characterizes the benchmark. The third part is dedicated to the current system of EU financing and the last two sections respectively tackle a setting conferring the power to tax to the EU level only and a case allowing member states and a European authority to exert their taxing power upon a same base. We will be able to derive some comparative results according the nature of governments' objective functions and thus draw some potential directions for the organisation of EU corporate taxation.

2 Framework and main assumptions

2.1 Players of the game : the principals

Let's consider two levels of public authorities : a European tier and member states.

Firms constitute the tax base that provides receipts both to member states and to the EU level.

We consider that the objective function of each layer of government is composed of :

- the tax receipts collected, which may be used to produce public goods and services for all economic agents, households and firms.

- the rent of the firm (which can, to some extent, be considered as a political argument since governments can be preoccupied with their future mandate or likely to be captured by lobbies).

- the beneficial effects triggered by the presence and the activity of firms (employment, consumption, environment...).

2.2 Players of the game : the agent

In this context, it is equivalent to consider a continuum of firms or a unique firm that generates a tax base, as in Laussel and Lebreton (1992, 1993). We could also assume the setting to deal with the choice made by a huge firm as far as settling is considered.

We assume a costless mobile firm. The tax levied is a tax on benefits, which contain some firm private information as some elements of operational costs for instance. The participation constraint of the firm writes $U \geq U_0 \geq 0$, since she can decide not to settle on the territory if it doesn't result profitable for her and choose another place or modify her activity. U_0 can be set equal to 0. The firm setting probability remains the unknown parameter.

The taxes voted by a member state i are τ_i. If the European level is enabled to tax the common base, this tax will be τ_E and the cumulated tax base to which is submitted the firm will be $\tau = \tau_i + \tau_E$, with $(\tau_i, \tau_E) \in R_+^2$. We will suppose $0 < \tau < 1$.

The firm settling probability is $\Pr[\theta - \tau \geq 0] = 1 - \Pr[\theta \leq \tau] = 1 - G(\tau)$. Let θ, random variable defined on the set $\Theta = [\underline{\theta}; \overline{\theta}]$, characterized by the density function $g(\theta)$ and the cumulative distribution function $G(\theta)$, and the monotone likelihood ratio property $\dfrac{d\left[(1 - G(\theta))/g(\theta)\right]}{d\theta} \leq 0$.

Through the paper, we will consider that the cumulative and the density function are the same whatever the level of government. Nevertheless, we could make a distinction between for instance the national level and the European tier and introduce first-order stochastic dominance.

2.3 Timing of the game

The game is an intrinsic common agency game[8] : the firm has to simultaneously accept or reject all the contracts offered to her. Externalities derive from this situation since each

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[8] See Bernheim and Whinston (1986), Martimort and Stole (2004).

principal is affected by the choices that the agent makes according her link with the other principal.

1) Governments know the distribution of the random variable θ and choose the taxes they are going to levy. We assume a sequential game with the European level playing first. Their *a priori* concerning θ are assumed identical.

2) The firm learns her profit and compares it to the global tax rate she is submitted to, then she decides to exert her activity on the territory or no.

3 Benchmark : the unique government case

3.1 Programme of the decisionmaker

Let a standard objective function of a government be made of tax receipts, an informational rent left to the firm and the potential effects induced by the presence of the firm (for instance employment...) :

$$B\left[1 - G\left(\tau\right)\right] + \left(1 + \alpha\right)\left(1 + \lambda\right)\tau\left[1 - G\left(\tau\right)\right] + \left(1 + \beta\right)\int_{\tau}^{\bar{\theta}} g\left(\theta\right)\left(\theta - \tau\right)d\theta \tag{1}$$

with

λ marginal cost of public funds for government i (it represents the budget constraint multiplier in a more complete model that would endogeneize it[9] ; it measures the loss suffered by society, i.e. distorsions generated, when additional resources are levied to finance government expenditures),

B the potential benefits triggered by the firm setting and activity for country i

$(1 + \alpha)$ the extra-weigth put on tax receipts, $0 < \alpha < 1$,

$(1 + \beta)$ the extra-weight put on the firm profit, $0 < \beta < 1$.

The programme of the government consists in setting the tax rate that maximizes her objective function.

A government called benevolent that equally takes into account the collection of tax receipts and the benefit of the firm has the following objective function :

$$B\left[1 - G\left(\tau\right)\right] + \left(1 + \lambda\right)\tau\left[1 - G\left(\tau\right)\right] + \int_{\tau}^{\bar{\theta}} g\left(\theta\right)\left(\theta - \tau\right)d\theta \ . \tag{2}$$

3.2 Tax level set by a unique benevolent decisionmaker

Optimizing with respect to τ leads to the following first-order condition :

$$\left(1 + \lambda\right)\overset{*}{\tau}^{B} = -B + \lambda\frac{1 - G\left(\tau^{B}\right)}{g\left(\tau^{B}\right)} \tag{3}$$

The problem exists and is quasi-concave in τ if

$$\frac{\lambda}{1 + \lambda}\frac{1 - G\left(\tau\right)}{g\left(\tau\right)} \geq \tau \quad \text{and} \quad -\left(1 + \lambda\right) + \lambda\frac{d}{d\tau}\left(\frac{1 - G\left(\tau\right)}{g\left(\tau\right)}\right) < 0$$

When the government raises her tax rate, she reduces costly rents and increases the amount of tax receipts. But, on the other hand, the positive effects for national residents are lessened

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[9]Cf. Laffont et Tirole (1993), chapter 4.

since the higher the tax rate, the less the firm is eager to settle or to stay in the country. Besides, an increase of the tax rate reduces the tax base available and thus the level of receipts likely to be collected.

Remark : In a perfect information setting, the government knows the rate that can be defined to rapt all the profit. With information asymmetries, on the other hand, the determination of the unique tax allows generating a kind of elasticity. Information asymmetries modify the strategy of the public decisionmaker through a mechanism analogous to a horizontal competition exerting a downward pressure upon tax rates.

3.3 When governments display a bias

3.3.1 If the government seeks to attract firms :

Her objective function and the corresponding tax rate become

$$B\left[1 - G\left(\tau\right)\right] + \left(1 + \lambda\right)\tau\left[1 - G\left(\tau\right)\right] + \left(1 + \beta\right)\int_{\tau}^{\overline{\theta}} g\left(\theta\right)\left(\theta - \tau\right)d\theta\ , \quad (4)$$

$$\left(1 + \lambda\right)\overset{*}{\tau}^{F} = -B + \left(\lambda - \beta\right)\frac{1 - G\left(\tau^{F}\right)}{g\left(\tau^{F}\right)} < \left(1 + \lambda\right)\overset{*}{\tau}^{B}$$

The tax rate is lower than the one a benevolent government would set since the government pursues a main goal of favoring the presence of the firm on the territory in order to enhance employment, competitiveness, economic development...

$$\Delta\overset{*}{\tau}^{F-B} = -\beta\frac{1 - G\left(\tau\right)}{g\left(\tau\right)} < 0$$

3.3.2 When the government focuses on tax receipts collection

She will seek a tax rate maximizing

$$B\left[1 - G\left(\tau\right)\right] + \left(1 + \alpha\right)\left(1 + \lambda\right)\tau\left[1 - G\left(\tau\right)\right] + \int_{\tau}^{\overline{\theta}} g\left(\theta\right)\left(\theta - \tau\right)d\theta\ , \quad (5)$$

$$\left(1 + \lambda\right)\overset{*}{\tau}^{R} = \frac{-B}{1 + \alpha} + \frac{\lambda + \alpha + \alpha\lambda}{1 + \alpha}\frac{1 - G\left(\tau^{R}\right)}{g\left(\tau^{R}\right)} > \left(1 + \lambda\right)\overset{*}{\tau}^{B}$$

$$\Delta\overset{*}{\tau}^{R-B} = \frac{\alpha}{1 + \alpha}\left(B + \frac{1 - G\left(\tau\right)}{g\left(\tau\right)}\right) > 0$$

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This programme maximization yields a higher tax rate than the one corresponding to the benchmark case.

Different motivations can lead a government to over-value tax receipts as, for instance, the wish or the need to finance important public expenditures and/or reduce public deficit. The resulting tax rate is too high with respect to the rate that would be applied if the government valued the same way the positive impacts of the firm's presence.

If we try to find out which is the greater gap, it appears that the relative magnitude depends on the relative values of the weights put on the firm and on tax receipts.

$$\left| \Delta \overset{*}{\tau}^{R-B} \right| > \left| \Delta \overset{*}{\tau}^{F-B} \right| \text{ if } \alpha > \frac{\beta \dfrac{1 - G(\tau)}{g(\tau)}}{B_i + (1 - \beta) \dfrac{1 - G(\tau)}{g(\tau)}} \quad ..$$

Conversely, if a huge weight is put on tax collection : $\beta > \dfrac{\alpha \left(B_i + \dfrac{1 - G(\tau)}{g(\tau)} \right)}{(1 + \alpha) \dfrac{1 - G(\tau)}{g(\tau)}}$, then the

tax rate is further from the socially optimal one.

3.3.3   Conclusion

There are differences in the level of tax rates in function of the nature of governments and their objective function. Three kinds of objectives appear quite consistent with what we can observe in EU behaviours, namely

- a utilitarist objective function that consists in maximizing an equally weighted programme made of the firm utility, tax receipts collection and the benefits derived from the presence of firms. This case is considered as the benchmark case

And two more extreme situations :

- a tax maximization strategy, which does not necessarily characterize a Leviathan government but also a country that provides a high level of public expenditure and public goods, or a country that faces a huge fiscal deficit and public debt (fiscal consolidation aim). Such a strategy can thus be either structural or conjunctural (short-term, temporary).

- a strategy aiming at attracting the firm and thus favoring its benefit with respect to the other elements making up the objective function.

4   Current system of EU financing

If another tier is added, through the levying by the EU level of a part of the tax receipts collected by member states to finance public goods at a supranational level, two effects will emerge. On the one hand, national net receipts will decrease as a fraction is shifted towards the EU tier but, on the other hand, the country will benefit from the expenditures undertaken at the supranational level.

In the current framework, member states collect tax receipts and transfer a part to the European level, and they benefit from communautary expenditures.

We will consider that European expenditures depend on the receipts received by the European level and, as a consequence, depend on the firm' setting probability. Thus, with n member states, and τ_i the tax applied by country i, these transfers write

$$\sum_{i=1}^{n} p_i \tau_i \left[1 - G\left(\tau_i\right)\right]$$

where p_i is the fraction of national tax receipts transferred to the European level, $p_i \in [0; 1[$.

A member state i will get the following part from these expenditures :

$$\gamma_i \times E(\sum_{i=1}^{n} p_i \tau_i \left[1 - G\left(\tau_i\right)\right])$$

where γ_i represents the part of European expenditures accruing to member state i, $\gamma_i \in [0; 1[$. For simplicity sake, we may consider that $E(\sum_{i=1}^{n} p_i \tau_i \left[1 - G\left(\tau_i\right)\right]) < \sum_{i=1}^{n} p_i \tau_i \left[1 - G\left(\tau i\right)\right]$: a fraction of the transfers finances all the costs associated with the provision of European public goods : operational costs, administrative costs, cost of public funds... Besides, we will assume that $E'\left(\cdot\right) > 0$ and $E''\left(\cdot\right) < 0$. It also seems quite consistent to assume that $\dfrac{dE}{d\tau_i} \leq 1$. Indeed, as on the one hand each country contribution to the EU tier only represents a fraction of national tax receipts and, on the other hand the number of member states participating to the process is important, then a rise in the tax rate defined by one country cannot trigger a greater rise in the level of European expenditures.

If we consider the member state behavior, she will set τ_i to maximize :

$$\begin{aligned} &B_i \left[1 - G\left(\tau_i\right)\right] + \left(1 - p_i\right)\left(1 + \alpha_i\right)\left(1 + \lambda_i\right)\tau_i \left[1 - G\left(\tau_i\right)\right] \\ &+ \left(1 + \beta_i\right)\int_{\tau_i}^{\overline{\theta}} g\left(\theta\right)\left(\theta - \tau_i\right)d\theta + \gamma_i E(\sum_{i=1}^{n}\left(1 + \lambda_i\right)p_i \tau_i \left[1 - G\left(\tau_i\right)\right]) \end{aligned} \tag{6}$$

The objective function of a benevolent government writes :

$$B_i \left[1 - G\left(\tau_i\right)\right] + \left(1 - p_i\right)\left(1 + \lambda_i\right)\tau_i \left[1 - G\left(\tau_i\right)\right] + \int_{\tau_i}^{\overline{\theta}} g\left(\theta\right)\left(\theta - \tau_i\right)d\theta + \gamma_i E(\sum_{k=1}^{n}\left(1 + \lambda_i\right)p_i \tau_i \left[1 - G\left(\tau_i\right)\right]) \tag{7}$$

and the optimal tax rate expresses as

$$(1 + \lambda_i) \tilde{\tau}_i^B = \frac{-B_i}{1 - p_i + p_i \gamma_i E'(\cdot)} + \frac{\lambda_i - p_i - \lambda_i p_i + p_i (1 + \lambda_i) \gamma_i E'(\cdot)}{1 - p_i + p_i \gamma_i E'(\cdot)} \frac{1 - G(\tau)}{g(\tau)} \tag{8}$$

Condition for the tax to be non negative :

$$p_i \leq \tilde{p}_i^B = \frac{-B_i + \lambda_i \dfrac{1 - G(\tau)}{g(\tau)}}{(1 + \lambda_i)(1 - \gamma_i E'(\cdot)) \dfrac{1 - G(\tau)}{g(\tau)}}$$

This condition can be completed with the assumption that p_i may not exceed a given threshold, quite low if we want to reflect the current setting. Let's for instance consider that p_i must be lower than 20%

The difference with respect to the benchmark case writes

$$
\begin{aligned}
\Delta^{C-B} &= (1 + \lambda_i) \tilde{\tau}_i^B - (1 + \lambda_i) \tilde{\tau}_i^{*B} \\
&= \frac{B - B_i + (\lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)} - p_i(1 - \gamma_i E'(\cdot)\left(B + (1 + \lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)}\right)}{1 - p_i + p_i \gamma_i E'(\cdot)}
\end{aligned}
\tag{9}
$$

Assuming that the access to the less distorsive taxes is according a decreasing order implying $0 < \lambda_E < \lambda < \lambda_i < 1$, calculations show us that the sign of this difference is necessarily negative (see annex 1 for more details).

For values of p_i lower than $\tilde{p}^B = \dfrac{B - B_i + (\lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)}}{(1 - \gamma_i E'(\cdot)\left(B + (1 + \lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)}\right)}$, i.e. when the part member states transfer to the upper tier does not exceed a given threshold, the current tax rate is higher than the socially optimal one. Yet, if countries allocate a great part of their tax receipts to the European level, they reduce their tax rate.

The higher the country participation, the lower the tax rate she will set (it can easily be checked that $d\tilde{\tau}_i^B /\delta p_i < 0$).

We can examine how this result is modified if we introduce some bias on behalf of the government.

First, when the government is biased towards firms,

$$(1 + \lambda_i) \tilde{\tau}_i^F = \frac{-B_i + (\lambda_i - p_i - \lambda_i p_i - \beta_i + (1 + \lambda_i) p_i \gamma_i E'(\cdot)) \dfrac{1 - G(\tau)}{g(\tau)}}{1 - p_i + p_i \gamma_i E'(\cdot)} \tag{10}$$

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The condition of tax non-negativity is

$$p_i \leq \tilde{p}_i^{F} = \frac{-B_i + (\lambda_i - \beta_i)\dfrac{1 - G(\tau)}{g(\tau)}}{(1 + \lambda_i)(1 - \gamma_i)\dfrac{1 - G(\tau)}{g(\tau)}}$$

If we compare to the benchmark case :

$$\Delta_F^{C-B} = \frac{B - B_i + (\lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)} - p_i(1 - \gamma_i E'(\cdot)\left(B + (1 + \lambda_i - \lambda + \beta_i)\dfrac{1 - G(\tau)}{g(\tau)}\right)}{1 - p_i + p_i\gamma_i E'(\cdot)}$$

(11)

This difference is necessarily negative (see annex 2), which means that the tax rate levied by a government biased towards firms is lower than in the benchmark case.

If $p_i \geq \tilde{p}$, then necessarily $p_i \geq \tilde{p}^{F}$ which means that the tax rate is more likely to be lower than the socially optimal one when governments are biased towards firms in a system close to the current one. The greater the weight put upon firms, the lower the tax rate.

However, if we compare this difference with the unique government setting, the gap appears smaller[10], which means that it is better to have a system similar to the current one with transfers to the EU level and benefits withdrawn from European expenditure rather than only one government behaving not benevolently.

When the government puts a heavy weight on tax receipts :

$$(1 + \lambda_i)\tilde{\tau}_i^{R} = \frac{-B_i + ((1 + \lambda_i)p_i\gamma_i E'(\cdot) + (1 - p_i + \lambda_i - \lambda_i p_i)(1 + \alpha_i) - 1)\dfrac{1 - G(\tau)}{g(\tau)}}{\alpha_i - p_i - p_i\alpha_i + p_i\gamma_i E'(\cdot)}$$

(12)

If $\alpha_i - p_i - p_i\alpha_i + p_i\gamma_i E'(\cdot) < 0$, the tax non-negativity condition is

$$p_i \geq \underline{p}_{-}^{C} = \frac{-B_i + ((1 + \lambda_i)(1 + \alpha_i) - 1)\dfrac{1 - G(\tau)}{g(\tau)}}{(1 + \lambda_i)(1 + \alpha_i - \gamma_i E'(\cdot))}$$

(13)

Otherwise, the necessary and sufficient condition is

$$p_i \leq \frac{\alpha_i}{1 + \alpha_i - \gamma_i E'(\cdot)}$$

(14)

Trying to find out whether the tax rate is higher or lower than in the benchmark case $\Delta_R^{C-B} =$

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[10] $\Delta_F^{C-B} < -\beta_i\dfrac{1 - G(\tau F)}{g(\tau_i^F)}$

$$-B_i + B\alpha_i + (\lambda_i + \alpha_i (1 + \lambda_i - \lambda)) \frac{1 - G(\tau)}{g(\tau)} - p_i(1 + \alpha_i - \gamma_i E'(\cdot) \left(B + (1 + \lambda_i - \lambda) \frac{1 - G(\tau)}{g(\tau)}\right)$$

$$\Delta_R^{C-B} \; < \; 0 \iff p_i \geq \tilde{p}^C \; == \; \frac{-B_i + B\alpha_i + \lambda_i \dfrac{1 - G(\tau)}{g(\tau)} + \alpha_i (1 + \lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)}}{(1 + \alpha_i - \gamma_i E'(\cdot)) \left(B + (1 + \lambda_i - \lambda) \dfrac{1 - G(\tau)}{g(\tau)}\right)}$$

we can observe that in the case of high levels of transfers, the government reduces her tax rate wrt the benchmark case as she cannot get the total part of the taxes collected. On the other hand, for low transfers towards the European layer, the government raises the tax rate as she can keep the main of it.

5 If the European is the only level endowed with tax authority

We consider that the EU level takes into account the benefit member states withdraw from redistribution. A special case will be addressed in annex 3 in order to compare this issue with a setting that doesn't make such an assumption.

The EU government maximisation programme yields

$$B_E \left[1 - G\left(\tau\right)\right] + \left(1 - \delta\right)\left(1 + \lambda_E\right)\tau\left[1 - G\left(\tau\right)\right] + \int_{\tau}^{\overline{\theta}} g\left(\theta\right)\left(\theta - \tau\right)d\theta + \Psi\left(\delta\left(1 + \lambda_E\right)\tau\left[1 - G\left(\tau\right)\right]\right) \tag{16}$$

$$\left(1 + \lambda_i\right)\tau^E = \frac{-B_E}{1 - \delta + \delta\dot{\Psi}} + \frac{\lambda_E - \delta - \lambda_E\delta + \delta\left(1 + \lambda_E\right)\dot{\Psi}}{1 - \delta + \delta\dot{\Psi}}\frac{1 - G\left(\tau^E\right)}{g\left(\tau^E\right)}$$

We assume $\quad 0 < \dot{\Psi} < 1$ and $\ddot{\Psi} < 0$

If we compare to the benchmark, the gap is positive. Indeed, the numerator of Δ^{E-B} is

$$\left(1 - \delta\left(1 - \dot{\Psi}\right)\right)\left[B - B_E + \left(\lambda_E - \lambda\right)\frac{1 - G\left(.\right)}{g\left(.\right)}\right] - \delta\left(1 - \dot{\Psi}\right)\left(B_E + \frac{1 - G\left(.\right)}{g\left(.\right)}\right) \tag{17}$$

$$\Delta^{E-B} < 0 \iff \delta < \frac{\left(B - B_E\right) + \left(\lambda_E - \lambda\right)\dfrac{1 - G\left(.\right)}{g\left(.\right)}}{\left(1 - \dot{\Psi}\right)\left(B_E + \left(1 + \lambda_E - \lambda\right)\dfrac{1 - G\left(.\right)}{g\left(.\right)}\right)}, \text{ which is impossible}$$

The tax rate results inefficiently high with respect to the benchmark case.

When calculating the difference between this setting and the current situation one with benevolent governments, we find a negative difference[11], which means that the tax rate set in this context is closer to the socially optimal tax rate than the tax decided in a framework similar to the current one.

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[11]

$$-B_E\left(1 - p_i\left(1 - \gamma_i E'\left(\cdot\right)\right)\right) + B_i\left(1 - \delta\left(1 - \dot{\Psi}\right)\right) - Bp_i\left(1 - \gamma_i E'\left(\cdot\right)\right)\delta\left(1 - \dot{\Psi}\right)$$

$$+\frac{1 - G\left(.\right)}{g\left(.\right)}\left[\left(\lambda_E - \lambda_i\right)\left(1 - \delta\left(1 - \dot{\Psi}\right)\right)\left(1 - p_i\left(1 - \gamma_i E'\left(\cdot\right)\right)\right) + p_i\left(1 - \gamma_i E'\left(\cdot\right)\right) - \delta\left(1 - \dot{\Psi}\right)\right]$$

6   Concurrent taxation

We allow a tax deductibility mechanism at the national level

If a part of the taxes paid to the EU level can be deduced from the national tax burden firms are subject to : for instance, we may assume that a firm can benefit from a μT tax credit on the taxes paid to the EU. As a result, EU recepits remain unchanged but national tax receipts become $\tau - \mu T$. The objective function of the upper level is not modified. On the other hand, the national government (who always plays second) now has to maximize the following objective function :

6.1   Level of taxation set with benevolent authorities

With a social-welfare maximizing objective function :

$$B_i \left[1 - G \left(\tau \right) \right] + \left(1 + \lambda_i \right) \left(\tau_i - \mu T \right) \left[1 - G \left(\tau_i \right) \right] + \int_{\tau_i}^{\bar{\theta}} g \left(\theta \right) \left(\theta - \tau_i \right) d\theta) \tag{18}$$

$$\left(1 + \lambda_i \right) \tau_i^B \left(T \right) = -B_i + \left(1 + \lambda_i \right) \mu T + \lambda_i \frac{1 - G \left(\tau_i^B \left(T \right) \right)}{g \left(\tau_i^B \left(T \right) \right)}$$

How does react a member state to an increase in the European tax rate ?

$$\frac{d\tau_i^B \left(T \right)}{dT} = \frac{\left(1 + \lambda_i \right) \mu + \lambda_i \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right)}{1 + \lambda_i - \lambda_i \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right)}$$

$$\frac{d\tau_i^B \left(T \right)}{dT} \geq 0 \iff \mu \geq \bar{\mu} = -\frac{\lambda_i}{1 + \lambda_i} \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right) \tag{19}$$

i.e. for high values of tax deductibility, tax rates are complement, whereas if a small part of the taxes paid to the EU level only can be deduced from national taxes, they are substitute.

Then, tax rates respectively set at the European level, by member state i and on the whole are :

$$-B_E + \frac{\lambda_E}{(1 + \lambda_i)(1 + \mu)} \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} - \frac{\lambda_E \lambda_i}{(1 + \lambda_i)(1 + \mu)} \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right) \tag{20}$$

$$-B_i + \lambda_i \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} + (1 + \lambda_i) \mu \left[-B_E + \frac{\lambda_E}{(1 + \lambda_i)(1 + \mu)} \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \left(1 - \lambda_i \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right) \right) \right]$$

$$-B_i + \lambda_i \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} + (1 + (1 + \lambda_i) \mu) \left[-B_E + \frac{\lambda_E}{(1 + \lambda_i)(1 + \mu)} \frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \left(1 - \lambda_i \frac{d}{dT} \left(\frac{1 - G \left(\cdot \right)}{g \left(\cdot \right)} \right) \right) \right]$$

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6.2 Tax vertical externality at work with benevolent decisionmakers

Comparing this result with the benchmark tax rate, it appears that in such a situation the tax rate levied is higher. The difference Δ^{V-B} is positive :

$$B-B_i+(\lambda_i-\lambda)\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}+(1+(1+\lambda_i)\mu)\left[-B_E+\frac{\lambda_E}{(1+\lambda_i)(1+\mu)}\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left(1-\lambda_i\frac{d}{dT}\left(\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right)\right]$$
(21)

If we make the comparison with the current framework, we find that the difference between the global tax rate found above and the tax rate firms are subject to in the current situation Δ^{V-C} is positive

$$\frac{(1+\lambda_i+\mu+\lambda_i\mu)p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\left[B_i+\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right]}{(1+\lambda_i)(1+\mu)\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)}$$

$$\frac{(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right))\left(1+\mu+\lambda_i\mu\right)\left[-B_E(1+\lambda_i+\mu+\lambda_i\mu)+\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right]}{(1+\lambda_i)(1+\mu)\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)}$$

$$-\frac{\lambda_E\lambda_i\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)\left(1+\mu+\lambda_i\mu\right)\frac{d}{dT}\left(\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)}{(1+\lambda_i)(1+\mu)\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)}\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}$$
(22)

We can conclude that the tax rate is higher in this case : due to the vertical tax externality, the inefficiency is exacerbated.

This proves that firms would be subject to a higher tax rate in a context allowing a stacking of two taxing powers (i.e. member states on the one hand and the European level on the other hand) than in the current framework that allows the European tier to receive transfers from national tax receipts.

Besides, we can observe that the gap wrt the benchmark is higher in this context than in a current setting. Indeed, the difference between both gaps amounts to $Num\left(\Delta^{V-B}-\Delta^{C-B}\right)=$

$$\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)\left(1+\mu+\lambda_i\mu\right)\left[-(1+\lambda_i)(1+\mu)B_E+\lambda_E\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left(1-\lambda_i\frac{d}{dT}\left(\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right)\right]$$

$$+(1+\lambda_i)(1+\mu)\left[B_i-B+p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\left(B+(1+\lambda_i-\lambda)\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right]$$

$$+\left(1-p_i\left(1-\gamma_iE'\left(\cdot\right)\right)\right)\left(1+\mu+\lambda_i\mu\right)-(1+\lambda_i)(1+\mu)(\lambda_i-\lambda)\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}$$

This difference is positive, which means that the inefficiency is exacerbated in such a context.

Let's compare to the case when only the European level taxes $Num\Delta^{V-E}=$

$$(1 + \lambda_i + \mu + \lambda_i\mu) \left[B_E \left(\delta \left(1 - \dot{\Psi} \right) (1 + \mu + \lambda_i\mu) - 2 - (1 + \lambda_i)\mu \right) - B_i \left(1 - \delta \left(1 - \dot{\Psi} \right) \right) \right] \quad (23)$$

$$+ (1 + \lambda_i + \mu + \lambda_i\mu)\frac{1 - G(\cdot)}{g(\cdot)} \left[(\lambda_i - \lambda_E) \left(1 - \delta \left(1 - \dot{\Psi} \right) \right) + \delta \left(1 - \dot{\Psi} \right) \right]$$

$$+ \frac{1 - G(\cdot)}{g(\cdot)} \left[\lambda_E \left(1 - \delta \left(1 - \dot{\Psi} \right) \right) \left(1 - \lambda_i \frac{d}{dT} \left(\frac{1 - G(\cdot)}{g(\cdot)} \right) \right) \right]$$

The gap is positive. The result of inefficiency enhanced remains valid.

To put it in a nutshell, it appears that concurrent taxation leads to an inefficiently high level of taxation. The mechanism of vertical externality is thus observable, despite the presence of information asymmetry that lessens its strength.

6.3 When member states are biased towards firms

A real issue is to try to model governments' behaviours in a way similar to what we attend to, i.e. to integrate the fact that some decisionmakers act non cooperatively to attract firms and get the lion share...

An interesting case to examine thus consists in assuming that national governments are eager to attract firms and set their tax rates accordingly

Indeed,

$$(1 + \lambda_i)\,\tau_i^F(T) = -B_i + (1 + \lambda_i)\,\mu T + (\lambda_i - \beta_i)\frac{1 - G(\cdot)}{g(\cdot)} \quad (24)$$

$$\frac{d\tau_i^F(T)}{dT} = \frac{(1 + \lambda_i)\,\mu + (\lambda_i - \beta_i)\dfrac{d}{dT}\left(\dfrac{1 - G(\cdot)}{g(\cdot)}\right)}{1 + \lambda_i - (\lambda_i - \beta_i)\dfrac{d}{dT}\left(\dfrac{1 - G(\cdot)}{g(\cdot)}\right)}$$

$$(1 + \lambda_E)\,T = -B_E + \frac{\lambda_E}{(1 + \mu)(1 + \lambda_i)}\frac{1 - G(\cdot)}{g(\cdot)}\left[1 - (\lambda_i - \beta_i)\frac{d}{dT}\left(\frac{1 - G(\cdot)}{g(\cdot)}\right)\right]$$

which yields a global tax rate

$$-B_i + (\lambda_i - \beta_i)\frac{1 - G(\cdot)}{g(\cdot)} + (1 + (1 + \lambda_i)\mu)\left[-B_E \frac{\lambda_E\left(1 - (\lambda_i - \beta_i)\dfrac{d}{dT}\left(\dfrac{1 - G(\cdot)}{g(\cdot)}\right)\right)}{(1 + \mu)(1 + \lambda_i)}\frac{1 - G(\cdot)}{g(\cdot)} \right]$$

With respect to the benchmark case, $Num\Delta_F^{V-B} =$

$$(1 + \lambda_i)(1 + \mu)\left[(B - B_i - B_E(1 + (1 + \lambda_i)\mu)) + (\lambda_i - \lambda - \beta_i)\frac{1 - G(\cdot)}{g(\cdot)} \right]$$

$$+ (1 + (1 + \lambda_i)\mu)\left[\lambda_E\frac{1 - G(\cdot)}{g(\cdot)}\left(1 - \lambda_i\frac{d}{dT}\left(\frac{1 - G(\cdot)}{g(\cdot)}\right)\right) \right]$$

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The tax rate is reduced for values of β_i higher than the threshold

$$
\begin{aligned}
\tilde{\beta} \;=\;& \frac{(1+\mu)(1+\lambda_i)\left[(B-B_i-B_E(1+(1+\lambda_i)\mu))+(\lambda_i-\lambda)\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right]}{\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left[(1+\mu)(1+\lambda_i)-(1+(1+\lambda_i)\mu)\lambda_E\dfrac{d}{dT}\left(\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right]} \\[2em]
&+\frac{(1+(1+\lambda_i)\mu)\lambda_E\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left(1-\lambda_i\dfrac{d}{dT}\left(\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right)}{\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left[(1+\mu)(1+\lambda_i)-(1+(1+\lambda_i)\mu)\lambda_E\dfrac{d}{dT}\left(\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right]}
\end{aligned}
$$

When governments put a low weight on firms, they rather increase the tax burden they impose upon firms.

If we compare to the current situation, $\Delta_F^{V-C} > 0$

$$
\begin{aligned}
(1+\mu)(1+\lambda_i) & \left[\begin{array}{l} B-B_i-B_E(1+(1+\lambda_i)\mu)+p_i\left(1-\gamma_i E'\left(\cdot\right)\right)\left(B_i+B_E(1+(1+\lambda_i)\mu)\right) \\ +\dfrac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left(\left(\left(\lambda_i-\lambda\right)\left(1-p_i\left(1-\gamma_i E'\left(\cdot\right)\right)\right)\right)+p_i\left(1-\gamma_i E'\left(\cdot\right)\right)\left(1+\beta_i\right)\right) \end{array}\right] \quad (25) \\[1em]
& +(1+(1+\lambda_i)\mu)\left(1-p_i\left(1-\gamma_i E'\left(\cdot\right)\right)\right)\lambda_E\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\left(1-\left(\lambda_i-\beta_i\right)\frac{d}{dT}\left(\frac{1-G\left(\cdot\right)}{g\left(\cdot\right)}\right)\right)
\end{aligned}
$$

As the gap is positive, we can conclude that this kind of double taxation can bring closer to social optimum when member states are eager to act non cooperatively in order to attract base.

With regard to a unique government case, it appears that double taxation leads biased governments to raise their tax rate, which can thus be considered as an improvement.

7   Main results

We have demonstrated that the framework close to the system currently implemented in EU led benevolent governments to set inefficiently high levels of taxation with respect to the socially optimal outcome. However, when decisionmakers seek to attract firms and thus display strategies of tax bill minimization, the tax rate ends up too low and it is all the more true as the weight they put on firms is strong. Besides, though lower than the tax rate that would be set by a unique government, we have shown that this inefficiency resulting from the choices of a government biased towards firm was lessened in this setting in comparison with a unique government frame.

If the taxing power is transferred to a EU tier, the tax rate implemented also results higher than the socially optimal rate. Nevertheless, the difference with the benchmark rate is reduced when compared to the current situation, which allows us to think that such a framework should be preferred. Indeed, in some respect it can be said that the horizontal externality is reduced, tax competition is lessened. Whereas in the previous case information asymmetries were related not only to the firm's private information but also to the presence of other same level governments which can be regarded as yardstick competition, the second mechanism disappears in the EU assumption.

When the EU decisionmaker is allocated a taxing power on a same base as national governments (member states), a vertical tax externality appears. Indeed, when tax bases are, at least partially, the joint property of different layers of government, if one of them does not take into account the impact of his choices upon the other tier, an excessively high degree of taxation arises with respect to the level that would be set by a unique government and also wrt the current framework. Any authority that raises her tax rate without internalizing the global effect this decision triggers upon the total amount of capital located in the area neglects the induced shrinkage in the common base that the other layer will suffer, and thus values the marginal cost of public funds at a lower level than the true marginal cost, which leads to excessively high taxes. Though this externality is, to a given extend, partially offset by a downward effect stemming from the fact that, as both governments ignore the setting potential of the firm, they have to grant her an informational rent, the vertical interaction can be observed.

Besides, considering a sequential-move game between the governments may strengthen the distortion since the first player may further increase her marginal rate and thus commit the follower policymaker not to raise her own degree of taxation; this is the case for value of μ

higher than $\dfrac{(1+\lambda_i)(B_E+B_i)-(1+\lambda_i)\lambda_i\dfrac{1-G(\cdot)}{g(\cdot)}+\lambda_E\dfrac{1-G(\cdot)}{g(\cdot)}\left(1-\lambda_i\dfrac{d}{dT}\left(\dfrac{1-G(\cdot)}{g(\cdot)}\right)\right)}{(1+\lambda_i)(B_E(\lambda_i+\mu+\lambda_i\mu)+B_i)-(1+\lambda_i)\lambda_i\dfrac{1-G(\cdot)}{g(\cdot)}}.$

However, if we consider governments biased towards firms, conclusions are modified to a great extend. Indeed, we have shown that the global tax rate was brought closer to the socially optimal outcome. As a consequence, it can be said that the addition of a European layer able to exert its taxing power upon a base already subject to taxation by member states would improve the current situation.

An important feature of the comparisons is the assumption made about the nature of the

decisionmaker objective function, which allows a more realistic modelling of the different situations that can be envisaged and a better comprehension of the outcomes that could be triggered by these settings.

To put it in a nutshell, though giving the EU level the taxing power on a base such as corporate benefits, above all with multinational enterprises, would be the most preferred solution, it appears that allowing this layer to apply a tax on a base already subject to national taxation would be relevant in the presence of member states implementing non cooperative (sometimes aggressive) strategies aimed at attracting firms on their ground.

8   Annexes :

8.1   Annex 1

When examining a situation similar to the current one, we have to study the sign of the difference wrt the benchmark

$$\Delta^{C-B} = \frac{B - B_i + (\lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)} - p_i(1 - \gamma_i E'(\cdot))\left(B + (1 + \lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)}\right)}{1 - p_i + p_i\gamma_i E'(\cdot)}$$

This difference is negative if

$$p_i \geq \frac{B - B_i + (\lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)}}{(1 - \gamma_i E'(\cdot))\left(B - (1 + \lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)}\right)}$$

As there is also a condition on p_i for the tax to be non negative, we must check whether

$$\left(\lambda_i\frac{1 - G(\tau)}{g(\tau)} - B_i\right)\left(B - (1 + \lambda_i - \lambda)\frac{1 - G(\tau)}{g(\tau)}\right) \geq \left(B - B_i + (\lambda_i - \lambda)\frac{1 - G(\tau)}{g(\tau)}\right)(1 + \lambda_i)\frac{1 - G(\tau)}{g(\tau)}$$

which is equivalent to

$$-B_i B + \frac{1 - G(\tau)}{g(\tau)}\left(2B_i(1 + \lambda_i) - B_i\lambda - B\right) + \left(\frac{1 - G(\tau)}{g(\tau)}\right)^2\left(\lambda(1 + 2\lambda_i) - 2\lambda_i(1 + \lambda_i)\right)$$

Considering this expression as a second degree equation, the delta is negative.

8.2   Annex 2

$$\Delta_F^{C-B} < 0 \iff p_i \geq \overline{p}^F = \frac{B - B_i + (\lambda_i - \lambda)\dfrac{1 - G(\tau)}{g(\tau)}}{(1 - \gamma_i E'(\cdot))\left(B + (1 + \lambda_i - \lambda + \beta_i)\dfrac{1 - G(\tau)}{g(\tau)}\right)}$$

If we check whether $\tilde{p}_i^F > \overline{p}^F$, it appears that it is the case if and only if

$$\beta_i \leq \lambda - \frac{B}{\dfrac{1 - G(\tau)}{g(\tau)}}$$

But, this expression is equivalent to having

$$0 \leq -B + (\lambda - \beta_i) \frac{1 - G(\tau)}{g(\tau)} \tag{1}$$

which is necessarily the case as this expression is no more than the tax rate a government biased towards firms would set in a unique government setting.

8.3 Annex 3 : The EU level doesn't take into account the benefit member states withdraw from redistribution

The EU government maximises

$$B_E \left[1 - G(\tau_i)\right] + (1 - \delta)(1 + \lambda_E) \tau \left[1 - G(\tau_i)\right] + \int_\tau^{\overline{\theta}} g(\theta)(\theta - \tau) d\theta$$

which yields

$$(1 + \lambda_i) \tau^E = \frac{-B_E}{1 - \delta} + \frac{\lambda_E - \delta - \lambda_E \delta}{1 - \delta} \frac{1 - G(\tau^E)}{g(\tau^E)}$$

If we look at the gap wrt the benchmark :

$$
\begin{aligned}
\Delta^{E-B} &= (1 + \lambda_i) \tau^E - (1 + \lambda_i) \overset{*}{\tau}^B \\
&= \frac{1}{1 - \delta} \left[-B_E + B(1 - \delta) + ((\lambda_E - \lambda)(1 - \delta) - \delta) \frac{1 - G(\tau)}{g(\tau)} \right] \leq 0
\end{aligned}
$$

If the decisionmarker does not keep the whole of her tax receipts, she can define an inefficiently low level of taxation.

Which is the greater difference ?

$$
\Delta^{E-B} - \Delta^{C-B} = \frac{
\begin{array}{c}
\dfrac{-B_E + B_i(1 - \delta) + (\lambda_E(1 - \delta) - \delta) \dfrac{1 - G(\tau)}{g(\tau)}}{1 - \delta} \\[3ex]
\dfrac{-p_i(1 - \gamma_i E'(\cdot)) \left[-B_E + \dfrac{1 - G(\tau)}{g(\tau)} ((\lambda_E - \lambda_i - 1)(1 - \delta) - \delta)\right]}{1 - \delta}
\end{array}
}{}
$$

This gap is positive, which means that

$$\left| \Delta^{E-B} \right| < \left| \Delta^{C-B} \right|$$

The tax level is closer to the social welfare optimum in such a framework.

A tax decided at the European level would minimize distorsions even if it is only a second best solution.

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