Nordic Journal of Political Economy

Volume 24 1997 Pages 89-104

Tax Competition and Tax Evasion

Helmuth Cremer Firouz Gahvari

Helmuth Cremer and Firouz Gahvari *

Tax Competition and Tax Evasion

The ongoing process of economic integration in Europe has spawned many debates and a growing body of literature. Some of the most important economic questions concern fiscal issues. Chief amongst them is the question of tax competition. A major theme of this literature, and the earlier fiscal federalism literature on which it is based, has been the potential loss in tax revenues as a result of tax competition. It is generally believed that the integration process will exert a negative influence on the ability of the member countries to generate an "adequate" level of tax revenues to finance their social policies. Serious concerns have been raised about the prospects of less than optimal expenditures on public goods and redistributive policies in Europe. This is reflected in Sinn's (1994) warning that "In the end, all countries will settle at an equilibrium where only benefit taxes are charged, and no redistribution policies are carried out" (p. 100).[1]

The reasons for this concern are simple enough. International economic integration entails the dismantling of barriers to free movements of people, capital and goods among nations. From the perspective of national governments, this increased mobility may be viewed as an opportunity to move other countries' tax bases into one's own. Each country will then try to compete with the others in order to attract the tax bases that are being made mobile. A simple and effective way to achieve this is by lowering one's tax rates. As countries try to undercut one another's tax rates, it is not difficult to envisage an end result in which the tax rates, and the corresponding levels of government services, will be less than optimal.[2]

The above argument mirrors earlier such

* Helmuth Cremer, IDEI and GREMAQ, University of Toulouse and Institut Universitaire de France. Firouz Gahvari, Department of Economics, University of Illinois at Urbana-Champaign, Champaign, IL 61820, USA. We thank an anonymous referee for helpful comments.

1. Examples of the recent literature include Sinn (1990, 1994), Kanbur and Keen (1993), and Edwards and Keen (1996). On the earlier literature on fiscal federalism, see, e.g., Oates (1972), Wilson (1986), Zodrow and Mieszkowski (1986), Mintz and Tulkens (1986) or Wildasin (1989).
2. One must point out, however, that this is not the only potential outcome. It is possible that tax competition may result in "excessive" tax rates. See, e.g., Mintz and Tulkens (1986). However, it is the less-than-optimal-tax-rates result which has received the greatest share of attention.

concerns in the fiscal federalism literature. It has been long recognized in that literature that mobility of tax base between lower level jurisdictions, creates a potential for an efficiency loss due to noncooperative tax setting. That literature was particularly concerned with the prospect of inefficiently low levels of local public spending financed by local property taxes. It pointed out that while taxing capital income at the national level may entail no excess burden, taxing it unilaterally at the local level will. This is the case because when capital is mobile, its supply to a particular jurisdiction will be elastic even if the aggregate supply in the country is fixed. When a locality takes this excess burden into account, in trading the cost of raising tax revenues off with the benefits of spending, it undertakes less expenditures, than it would otherwise. These ideas were developed and elaborated upon by Wilson (1986) and Zodrow and Mieszkowski (1986). Building on the same theme, Wildasin (1989) has argued that the inefficiency of local spending may alternatively be seen to be due to a "fiscal externality": A unilateral increase in a jurisdiction's tax rate causes capital to flow to other localities thus benefitting them by increasing their tax revenues.

Tax competition, and the inefficiency associated with it, is due to noncooperative behavior on the part of national (or local) governments. Not surprisingly, then, the contributors to the literature have generally advocated tax coordination policies as means of correcting this problem. Countries who form an economic union must agree, as part of the integration process, to implement a coordinated tax policy. If the policy is chosen "correctly", then the final outcome will not be that which is feared. The simplest form of coordination is tax harmonization where all countries follow identical tax policies. When countries are similar, they will tend to benefit from following the same set of policies. This may not be the case if the countries are dissimilar in some fundamental ways. Keen (1989) has examined conditions under which indirect tax harmonization can be Pareto improving. Kanbur and Keen (1993) discuss circumstances under which harmonization can harm one of the parties. Instead, they advocate imposition of minimum tax rates.

The discussions of tax competition and tax coordination have greatly increased our understanding of the fiscal issues pertaining to international economic integration. Nevertheless the literature remains lacking in one major respect. It has thus far ignored the problem of tax evasion. This is a serious omission as tax evasion has important implications for tax competition and fiscal coordination. It is the aim of the current paper to help fill this gap.

The tax evasion literature is built around the fact that taxpayers can manipulate their tax payments by false declarations. Tax revenues are raised through the levying of rates on tax bases. However, tax administrations do not typically observe the value of the base directly and/or perfectly. Such information, even if possible to obtain, will come at a cost. For example, the tax administration may learn the characteristics of taxpayers through audits. But auditing is costly, and it would be prohibitively expensive to audit everyone. The tax administration must thus rely, at least to some extent, on the taxpayers' own reports. This enables taxpayers to try to lower their tax payments by under-reporting their taxable activities. Consequently, an individual's (or a firm's) tax liability will be based in part on his report and on the degree of tax enforcement (as well as on the "legislated" tax rates). This also suggests that one must make a distinction between legislated and "effective" tax rates.

The possibility of tax evasion has two important implications. First, the behavior of individuals and firms must be modelled in the light of it. Second, the design of optimal tax policy must take this phenomenon into account. On the one hand, the government must take the individuals' responses into account in setting its optimal policy. On the other hand, the government will have more instruments at its disposal to effect its desired outcome. Tax revenues are determined not just by legislated tax rates but also through the government's audit policy.[3]

In turn, this implies that the interaction of tax and audit policies must be taken into consideration by the governments in setting their optimal policies.

In the context of economic integration, the interaction between tax and audit policies assumes a new light. As we observed earlier, in the presence of tax evasion, tax revenues are determined by the countries' enforcement policies as well as their legislated tax rates. Audit strategy thus becomes a second important instrument for fiscal competition. A country may try to increase its tax base not only by cutting its tax rate but also by loosening up on its tax enforcement.

The possibility of fiscal competition through tax enforcement also points to the inadequacy of tax coordination policies to achieve efficiency. Banned from competing in tax instruments, the competing countries will resort to their audit strategies to engage in fiscal competition. Effective coordination will have to be comprehensive to include tax enforcement policies. This poses some problems of its own. Coordinating audit strategies is no simple a task. Legislated tax rates are publicly observable; they can be checked by all countries. On the other hand, audit policies are, by nature, confidential. The government of one country can hardly observe and can never verify the enforcement efforts of the other countries.

In Cremer and Gahvari (1996b) we make a first attempt to address these issues and to shed some light on the implications of tax evasion for tax competition and tax coordination. There, we prove two general results for symmetric countries. First, fiscal competition drives countries to choose less than optimal values for their tax *and* audit rates. Second, *any* "harmonized" (i.e., equal) tax rate will lead to a less than optimal audit rate.[4] The present paper covers the same grounds as Cremer and Gahvari (1996b). However, rather than being concerned with proving general results, it brings out the main issues and findings by examining a few

3. The original paper on tax evasion is Allingham and Sandmo (1972). They formally model the individuals' behavior in the presence of income tax evasion and also discuss taxpayers' responses to changes in public policy. The bulk of the literature that has followed Allingham and Sandmo's pioneering work, has continued to concentrate on evading of income taxes. Usher (1986) discusses indirect tax evasion but in the context of individuals' behavior. Tax evasion by firms was first studied by Marrelli (1984) in a monopolistic setting, and later by Virmani (1989) and Cremer and Gahvari (1992, 1993) for competitive firms. The literature on optimal policy design in the presence of tax evasion is enormous. See, among others, Sandmo (1981), Reinganum and Wilde (1985), Border and Sobel (1987), Cremer et.al. (1990), and Cremer and Gahvari (1994, 1996a). For a survey of the subject, see Cowell (1990).

4. Cremer and Gahvari (1996b) also studies the implications of different countries having different attitudes towards tax evasion, or having different evasion technologies, for tax competition and tax harmonization. Specifically, we show that integration may turn an honest country into an evading one. We also show that in this case tax harmonization alone may be a bad policy in that it can make both countries worse off. It may also cause a hitherto honest country to turn to evasion. Interested readers should consult that paper.

specific examples. The examples enable us to capture the insights of Cremer and Gahvari (1996b) in a simple and straightforward manner.

The paper first examines the questions of tax competition and tax harmonization in the absence of tax evasion. This is done for a very simple model of tax competition. It consists of two symmetric countries, a taxed private good and a public good. The tax is collected from firms and used to finance the provision of the public good. National governments maximize their residents' welfare. We trace the equilibrium values of tax rates, public good supplies and the residents' utilities in both countries under three regimes (i) when borders are closed, (ii) when borders are open, and (iii) when the countries follow a harmonized tax policy. We show that tax competition leads to too low levels of tax rates, public good supplies and utilities. We also show that in this case tax harmonization can restore efficiency.

Next, we introduce tax evasion into the model. Tax evasion is modelled along the lines of Cremer and Gahvari (1993) where firms under-report their sales. There are random audits and firms that are caught cheating have to pay a fine over and above their due taxes. As previously, we trace the equilibrium values of the variables of our model, which now also include the audit probabilities, under the three mentioned regimes. We observe that in this case, economic integration results in less than optimal values for tax and audit rates. Moreover, we see that tax harmonization will continue to leave the audit rate at too low a level. It appears that, when faced with a specified tax rate, the countries will engage in fiscal competition by cutting their audit probabilities. In effect, they will follow a policy which implicitly encourages tax evasion. The policy response to this calls for the countries to harmonize their taxes at a rate different from its first-best value.

The setting

Consider two neighboring countries, h and f. The population in each country is uniformly distributed over the space it occupies. The two countries are of the same size, populated with persons of identical tastes, and have the same production technologies. These assumptions help us isolate the pure impacts of fiscal interaction between them with the "opening up of the borders". We normalize the population size in both countries at one.

There is one private good and one public good in each country. Consumers will purchase one unit of the private good if its cost to them is less than its reservation price; otherwise they will consume none. The reservation price is the same in both countries and sufficiently high to ensure that each person will purchase the good. Consumers have preferences which are linear in the private good and logarithmic in public goods. The assumption on preferences allows us to derive closed-form solutions for the variables of our model. One can thus write the utility, u, of an individual who pays p to consume the private good as

$$u=v-p+\ln y \qquad (1)$$

where v denotes the reservation price. When the economies of the two countries are closed, the residents of country i can buy only the goods that are produced in i. The simplest way to model this is to assume that the consumers are able to make their purchases at their place of residence.[5] This is like having one's place of residence on the top of a store. The production technology is linear. Firms behave competitively producing the private good at constant marginal and average costs.

There is a tax on consumption of the private good. The tax, levied at t per unit, is collected from the firms. Tax revenues are used to finance the provision of the public good. Each country will provide the public good to its own residents only. The objective of a country's government is to maximize the welfare of its residents.

Prior to "economic integration", there is no trade between the two countries. Integration enables the citizens of each country to purchase the private good both at home and from abroad. To buy goods from the foreign country, one must travel there. Travelling entails costs. Whether a particular person in, say country h, would shop from f depends on the travelling cost and the price differential between the two countries. He will not make the trip, if the cost exceeds the potential gain from buying at lower prices. To model this aspect most easily, we assume that to purchase foreign goods, one need only travel to the border and no further. Goods can be bought from firms located at the border. Moreover, matters will be simplified further if we assume that countries are spatially linear. Specifically, let the two countries lie on the interval [-1, 1] with a border between them at the origin. Thus all foreign purchases are made at the origin. To travel to this point and back costs δ per unit of distance.

Finally, integration also implies that cross-border shoppers will face no tariff upon bringing the good back to their home country. Nor will they get a tax rebate from the foreign country. However, integration does not allow the residents of either country to take up residency in the other country. For that matter, residential mobility within a country is also ruled out.

Tax competition with honest taxpayers

Consider two countries that do not engage in tax evasion. This is the set-up considered by all contributors to the literature. In this case, perfect competition implies that the consumer price of the private good will be equal to its unit cost of production plus the per unit tax, t. That is, in each country, we have

$$p_i = c + t_i \qquad i = h, f. \tag{2}$$

Assume that the economies of the two countries are initially closed. The government of country i determines the level of its public good provision, y_i, and tax rate, t_i, in order to maximize the utility of a representative consumer. The government must of course also satisfy its budget constraint which has a very simple structure:

$$t_i - y_i = 0 \tag{3}$$

Note that, given our assumption of a population which is uniformly distributed over the unit interval, with its size normalized at one, t_i and y_i also show country i's aggregate tax revenues and public good consumption levels. The equilibrium values of t_i and y_i are then easily found to be (see the Appendix):

$$y_i = t_i = 1 \qquad i = h, f. \tag{4}$$

5. This is the model in Cremer and Gahvari (1996b). Kanbur and Keen (1993) have used a similar set-up to examine the role of size in determining the impacts of tax competition and tax coordination. There are two differences between their model and ours. First, they allow only for private goods. We have both private and public goods. Second, they assume that the objective of the government is to maximize tax revenues. We, on the other hand, consider a government which is welfare-maximizer.

With opening of the borders, the citizens of a given country may find it advantageous to travel to the border and shop from the other country. As we discussed earlier, whether a particular individual would do that or not, depends on how far the person lives from the border, the transportation cost and the price differential between the two countries. Assume $p_f < p_h$. Then a resident of h who lives at the border will go to f to purchase the private good. This yields him a net benefit of $p_h - p_f$. As one's distance from the border increases, the transportation cost makes it less and less profitable for the person to make the trip. A person in h residing at a distance s from the border will have to incur a transportation cost of δs to purchase the good from country f. When $p_h - p_f = \delta s$, the individual will be indifferent between buying at home and buying from abroad. Given the uniform distribution of the population, we will then have the following partition. All residents of h who live at a distance less than $s = (p_h - p_f)/\delta$ will buy from f; the rest will buy at home.[6] Substituting for p_i $(i=h, f)$ from (2), one may alternatively rewrite this as $(t_h - t_f)/\delta$.

The opening of borders complicates the decision problem of the governments. When the borders are closed, the size of the tax rate essentially determines the division of the internal resources between private and public goods. The "tax base" (number of taxpayers) is the size of the population and is fixed. When borders open, the tax base itself becomes endogenous varying with the size of the price differential between the two countries. The government of each country may thus be able to affect it by the choice of its tax rate. This introduces an strategic interaction between the countries that did not exist before. We shall follow the literature on fiscal competition and model this interaction using the Nash equilibrium concept. The government of each country will be assumed to choose its own tax rate treating as given the tax rate set by the other (while taking into account the impact on cross-border shopping). There is a further implication of opening of borders to which governments of the two countries must pay attention. This aspect concerns the welfare of cross-border shoppers. While each person is free to shop from the other country, it does not follow that the people who do and the people who do not are equally well-off. Indeed, again suppose that $p_f < p_h$. As we argued above, a citizen of country h who resides at the border and buys from country f will have an *additional* surplus of $(p_h - p_f)$ over his fellow countrymen who purchase at home. This extra surplus diminishes for cross-border shoppers as one moves away from the border. It will be zero for the person who lives at a distance of $s = (p_h - p_f)/\delta$. Given the uniform distribution of people who reside over the interval $[0, s]$, the additional consumers' surplus of cross-border shoppers will sum up to $s(p_h - p_f)/2 = (p_h - p_f)^2/2\delta$. Substituting for p_i from (2), one may alternatively rewrite this as $(t_h - t_f)^2/2\delta$. In setting their tax rates, governments must also take this additional surplus into account. For the purpose of welfare aggregation, we shall assume below that governments use a utilitarian framework.

Assume country h is the higher-price country. The government of h determines the level of public good provision and its tax rate, treating the tax rate of the other country as

6. In this discussion, we assumed that $P_h > P_f$ for expositional ease. The assumption is not necessary as one can allow for negative numbers. A negative outflow of persons from country h, indicates a positive inflow of shoppers into country h.

fixed, in such a way as to maximize the sum of the utilities of all its residents:

$$v-(c+t_h)+\frac{(t_h-t_f)^2}{2\delta}+\ln y_h \qquad (5)$$

This is maximized subject to the government's budget constraint

$$t_h\left(1-\frac{t_h-t_f}{\delta}\right)-y_h=0 \qquad (6)$$

Similarly, one can write the problem of the government of country f (the lower-price country) as to maximize the sum of the utilities of its residents:

$$v-(c+t_f)+\ln y_f \qquad (7)$$

subject to its budget constraint

$$t_f\left(1+\frac{t_h-t_f}{\delta}\right)-y_f=0 \qquad (8)$$

Note that, in contrast to h, the welfare of f's residents does not contain the additional surplus of $(t_h-t_f)^2/2\delta$. Moreover, $(t_h-t_f)/\delta$ appears with a positive sign in the budget constraint of government of f, as opposed to a negative sign for h. The reason for these, as was pointed out earlier, is that, if prices are as stated, some of the residents of h will purchase their goods in f. When the two countries are of the same type, one can easily prove that there must exist a symmetric equilibrium such that $t_h=t_f$ and $y_h=y_f$; see Cremer and Gahvari (1996b). One can then easily show that the equilibrium in this case will be (see the Appendix):

$$t_h=y_h=t_f=y_f=\frac{1}{1+1/\delta} \qquad (9)$$

Table 1.

	Closed borders	Economic integration
t	1.0	0.8333
y	1.0	0.8333
u	1.0	0.9844

Recall that when the economies were closed, in equilibrium, we had $t_h=y_h=t_f=y_f=1$. Clearly, with $\delta>0$, it follows from (9) that integration lowers the equilibrium values of both t and y. These values appear to depend on the transportation cost δ. In particular, the higher is δ, the smaller will be the impact of tax competition on public good supply and tax rate. Indeed, as the transportation cost becomes prohibitively expensive (i.e. as $\delta\to\infty$), the equilibrium will resemble that of a closed economy. High transportation costs will impede all mobility in this case. On the other hand, if the transportation cost becomes negligible (i.e. if $\delta\to 0$), then both y and t will fall to zero. In this case, the smallest lowering of the tax rate by a country will enable it to sell to the *entire* residents of the other country. This means that tax competition will continue unabated until the tax rate falls to zero.

Equation (9) justifies the concerns of many economists and policy makers that economic integration would result in too low a level of tax rates and public good supplies. In this comparison, it is important to remember that when the two countries are of the same-type, the closed-economy solution also corresponds to the optimal solution under integration. The latter being defined to be the outcome that maximizes the aggregate

welfare of residents of both countries. Consequently, one may deduce that economic union implies a less than optimal tax rate and public good provision. The reason for the sub-optimality is the unilateral attempt by each country to raise its own tax revenue at the expense of the other country. Each country tries to "lure" the other country's taxpayers by cutting its own tax rate. It does this without taking into account its detrimental impact on the other country. For concreteness, it will be instructive to look at a specific example. To this end, and throughout the paper, we will set $c=0$, $v=2$ and $\delta=1$. Table 1 presents a summary of the variables of interest.

The policy remedy for correcting this type of inefficiency is very simple in this model. The two countries need only harmonize their tax policy. That is, they must agree to have a uniform tax rate. Of course, the harmonized tax rate must be set at its optimal value (corresponding to the equilibrium when the economies were closed) to restore efficiency. But since it is to the advantage of both countries to choose this rate, they will do so.

A model of tax evasion

This section introduces tax evasion into our previous set-up. We continue to assume the same preferences and cost structure, with competitive markets. However, we now recognize the fact that when tax administrations cannot observe revenues of the firms costlessly, the firms will have an incentive to evade a part of their taxes. The model of tax evasion we consider below is based on Cremer and Gahvari (1992, 1993).

A particular firm's taxes depend on its reported sales. The firm may thus attempt to evade taxes by reporting only a proportion, α, of its sales, x. The firms cannot hide any part of their sales unless they spend real resources to conceal their activity. Each unit of output concealed from the tax administration entails a resource cost of $G(1-\alpha)$, which is an increasing and convex function of the proportion $(1-\alpha)$ of sales not reported. The tax administration audits a fraction of firms, β $(0 \leq \beta \leq 1)$, selected randomly. The audits are costly and reveal the firms' sales accurately. Firms that are caught cheating, are taxed on the true amount of their sales and, in addition, have to pay a fine proportional to the amount of tax evaded. The penalty rate is $(\tau-1)$.

The firm's profit is

$$\pi_g = px - cx - (\alpha x)t - [(1-\alpha)x]G$$

if not audited, and

$$\pi_b = \pi_g - [(1-\alpha)x]t - [(1-\alpha)xt](\tau-1)$$

if audited. The first event occurs with a probability of $(1-\beta)$, and the second with β. The firm's expected profit, π, is thus equal to

$$\pi=(p-c-g(1-\alpha)-(\alpha+(1-\alpha)\beta\tau)t]x \quad (10)$$

where $g(1-\alpha)\equiv(1-\alpha)G(1-\alpha)$.

Introducing

$$z\equiv g(1-\alpha)+(\alpha+(1-\alpha)\beta\tau)t \quad (11)$$

one can rewrite equation (10) as

$$\pi=(p-z)x$$

It is clear from the above equation, if $x>0$, maximization of π implies that the firm chooses α such that z is minimized. Note that z is independent of x. The proportion of sales reported will thus be independent of the firm's output (provided that $x>0$). This

separability between output and evasion decisions arises because the evasion cost has been assumed proportional to output. A necessary condition to have an interior solution for α is that[7]

$$\beta\tau < 1$$

Otherwise, the firms report honestly as they will find the expected cost of evading to be prohibitively high. If this condition is violated, the tax evasion problem does not arise. We will thus assume that the condition is satisfied.

Let

$$\theta \equiv (\alpha + (1-\alpha)\beta\tau)t \qquad (12)$$

denote the firm's expected tax payment per unit of output. The market equilibrium occurs at

$$p = c + g + \theta \qquad (13)$$

where both g and θ are evaluated at the firm's optimal value of α. This is because at any other price the firms would want to supply either $x = 0$ or $x = \infty$ and an equilibrium cannot be achieved. This result is the analogue of $p = c + t$ of equation (2) in Section 3. In both cases, it reflects the "zero-profit" condition of competitive markets.

In the next section, we will discuss how in the presence of tax evasion the two countries will set their tax and audit rates (and public good levels) with closed and open borders. As a building block for that problem, we must first determine how changes in the legislated tax rate and the audit probability impact the proportion of reported sales, expected per unit tax and the consumer price. Cremer and Gahvari (1993) prove that:

$$\frac{\partial \alpha}{\partial t} < 0 \qquad (14a)$$

$$\frac{\partial \theta}{\partial t} \gtrless 0 \qquad (14b)$$

$$\frac{\partial p}{\partial t} > 0, \qquad (14c)$$

$$\frac{\partial \alpha}{\partial \beta} > 0 \qquad (14d)$$

$$\frac{\partial \theta}{\partial \beta} > 0 \qquad (14e)$$

$$\frac{\partial p}{\partial \beta} > 0 \qquad (14f)$$

The signs of (14a) and (14c) indicate that as the legislated tax increases, the reported proportion of sales decreases and the consumer price increases. Similarly, the signs of (14d)–(14f) indicate that as the audit probability increases, the reported proportion of sales, the expected per unit tax and the price increase. These results are all quite intuitive. The only ambiguous sign is that of (14b). It shows that an increase in the legislated tax rate may increase, as well as decrease, the expected per unit tax. This is

7. The first-order condition for this problem is

$$g'(1-\alpha) = (1-\beta\tau)t$$

This results in the necessary condition of $\beta\tau < 1$. The second-order condition is:

$$g''(1-\alpha) > 0.$$

This is satisfied because the assumption that G is an increasing and convex function of $(1-\alpha)$ implies that the same properties hold for g.

due to the fact that the reduction in the reported proportion of sales, induced by the increase in the legislated tax rate, has a negative impact on the expected per unit tax.

Tax competition with tax evasion

Consider again two similar countries. The objective of national governments continues to be the maximization of the utility of their residents. The crucial difference that tax evasion makes is that the government in each country now has an additional instrument, the audit probability, to effect its optimal policy. Below, we will discuss the government's optimization problem first for closed and then for open borders.

(i) **Closed borders:** The problem of country i, $(i=h,f)$ is, as before, to maximize the welfare of its residents subject to the government's budget constraint. In the presence of tax evasion, with $p=c+g+\theta$, welfare is represented by[8]

$$v-(c+g+\theta)+\ln y \qquad (15)$$

where θ is given by (12). The government's budget constraint will now be equal to:

$$\theta-d(\beta)-y=0 \qquad (16)$$

where $d(\beta)$ denotes the audit cost, and is assumed to be increasing in β.

To derive the equilibrium values of y, t and β, we need to specify particular functional forms for concealment cost technology, $g(1-\alpha)$, and audit cost, $d(\beta)$, coupled with specific parameter values. For the concealment cost, we postulate the following functional form

$$g=(1-\alpha)^2+.1(1-\alpha) \qquad (17)$$

where g is an increasing and convex function of $(1-\alpha)$. Turning to the audit cost, we assume it also to be an increasing and convex function of its argument; it is given by

$$d=20\beta^2 \qquad (18)$$

Based on these, one can easily solve the optimization problem of country i (see the Appendix for analytic solutions). We report the equilibrium values for t, β, θ, y and u in the first column of Table 2.

(ii) **Open borders:** As previously, we model the interaction between the two countries using the Nash equilibrium concept. The government of each country chooses its own tax and audit rates, treating as given the tax and audit rates set by the other country (while taking into account the impact on cross-border shopping). This is done in order to maximize the sum of the utilities of the country's residents. For the purpose of derivations, assume h is the "higher-price" country. Its aim will be to choose t_h, β_h and y_h in order to maximize

$$v-(c+g_h+\theta_h)+\frac{(g_h+\theta_h-g_f-\theta_f)^2}{2\delta}+\ln y_h \qquad (19)$$

subject to

$$\theta_h\left(1-\frac{g_h+\theta_h-g_f-\theta_f}{\delta}\right)-d(\beta_h)-y_h=0 \qquad (20)$$

The problem of the government of f may also be formulated in a similar fashion. The difference with country h's problem is that the maximand will not include the term

8. For ease in notation, we drop the subscript i in the discussion below.

Table 2.

	Closed borders	Economic integration	Integration plus tax harmonization (I)	Integration plus tax harmonization (II)
t	1.0476	0.4768	1.0476	0.9465
β	0.0595	0.0240	0.0362	0.0370
θ	0.9788	0.4293	0.8578	0.7988
y	0.9080	0.4178	0.8315	0.7713
u	0.8822	0.6675	0.8486	0.8553

$(g_h+\theta_h-g_f-\theta_f)^2/2\delta$, and that in the revenue constraint, the term $(g_h+\theta_h-g_f-\theta_f)/\delta$ will appear with a positive rather than a negative sign.

To determine the impact of integration, we resort to the specific functional forms for g and d given by (17) and (18). This allows us to calculate the equilibrium values of all the variables of our model (see the Appendix for analytic solutions). These are reported in column 2 of Table 2. The numbers suggest that tax rate and audit probability both decline as a result of integration. Note that with a lowering of both fiscal instruments, the effective tax rate, θ, the public good supply and welfare also decline.[9]

That β decreases is very interesting. It shows that fiscal competition is fought in two fronts. The competing countries lower their effective taxes not just through cutting their legislated tax rates but also by lowering the number of people they audit. This aspect of fiscal competition has thus far escaped the attention of all researchers and policy makers. This is a crucial omission. It suggests that to avert the inefficiency, the countries must harmonize *both* their tax policies as well as their audit strategies. In the symmetric case we are considering, the inefficiency of tax competition will be totally wiped out if the two countries set their tax and audit rates at their equilibrium values under closed borders.

At first blush, it may seem reasonable to assume that the countries may just do this and coordinate all their fiscal instruments. After all, harmonization of tax and audit rates will help them both. On further reflection, one realizes this may not be that easy. Legislated tax rates are publicly observable; all member countries can check if everyone else is adhering to a harmonized tax policy. This is clearly not the case for audit strategies. These are by nature "confidential". The government of one country can hardly observe, and can never verify, the audit strategies of the other country.

Next, we investigate the implications of a harmonization policy on tax rates alone. In our present context, this changes the problem we have discussed in this section as follows. The government of country i $(i=h,f)$

9. Cremer and Gahvari (1996b) prove, for a more general specification of preferences, audit cost and concealment costs, that the values of t and β, will *always* be less than optimal.

continues to maximize the welfare of its residents. But in so doing, it chooses *only* the values of β_i and y_i (subject to its budget constraint while taking the other country's choice of β as fixed). It no longer optimizes over t_i. Setting the problem this way, one can easily derive the new Nash equilibrium *conditional* on the harmonized tax rate. As in the case without evasion, let us assume that the countries decide to harmonize their tax rates at its closed-border value. We report the results for this policy in the third column of Table 2. Interestingly, observe that tax harmonization alone, while welfare improving, does not restore the welfare level under closed borders. This is in sharp contrast to tax harmonization for symmetric countries in the absence of tax evasion. There, we saw that harmonizing taxes at the closed-border rate enabled the two countries to arrive back at the efficient equilibrium. Comparing the outcome under tax harmonization with the initial closed-border one reveals that fiscal competition has not been averted. The countries respond to the fixing of their legislated tax rates by cutting the number of people they audit, thus reducing their effective tax rate. The audit rate (β) is now .0362 as opposed to .0595 under closed borders.[10] The consequence is a lower public good supply and a lower level of welfare. This tells us that tax harmonization policies alone are not sufficient to restore efficiency. The countries will continue to engage in fiscal competition by auditing a smaller number of people. In other words, they will tacitly encourage tax evasion in their countries! Another interesting aspect of the tax harmonization policy is its impact on enforcement. As the countries' tax rates are pushed up (from .4768 without tax harmonization to 1.0476 with), the equilibrium value of β increases from .0240 to .0362. It is true that .0362 is still less than optimal (in the sense that if the countries coordinate their audit policies they will both benefit by increasing the audit rate to .0595), but that the value of β has increased at all appears rather paradoxical. It suggests that increasing the countries' tax rates may encourage them to increase their enforcement too!

The intuition for this result is best understood in the context of a closed economy. There, the optimal audit rate balances the benefits of an audit at the margin (the increased tax revenue) against its cost (resource cost of the audit). A higher tax rate implies a higher marginal benefit (the audit recoups more in tax revenues) but the same marginal cost. It is thus not surprising that the audit rate should increase with the tax rate. In an open economy, the situation is more complicated. There is an additional cost to higher audits; they discourage sales to residents of the other country thus reducing the potential tax base. It is difficult to predict the final outcome of these conflicting forces in all circumstances. Nevertheless, our result here is suggestive of the possibility of a positive correlation between tax and audit rates.

Finally, we examine the consequences of tax harmonization at some other rate. The closed-border solution would be the efficient tax rate *if* the countries also choose their audit probability cooperatively. With the noncooperative choice of β, the "optimal"

10. This is a general result. See Cremer and Gahvari (1996b) who prove, for a more general specification of preferences, audit cost and concealment cost, that given *any* harmonized tax rate, the corresponding Nash equilibrium value for the audit probability is less than optimal.

level of t will change. In this revised problem, the Nash equilibrium values of the variables have been found conditional on t. Consequently, the utility levels in both countries are also conditioned on t. It is then easy to determine the value of t that maximizes the utility levels. Setting t at this rate yields the equilibrium values of the other variables. We report these calculations in the fourth column of Table 2.

The first interesting observation here concerns the optimal value of t; it differs from its closed-border level (0.9465 versus 1.0476). This makes quite a bit of sense. Since β is chosen non-cooperatively, its value reflects a "distortion". The general theory of the second-best has taught us that two distortions may be better than one. This is precisely why the optimal value of t differs from its closed-border (first-best) value. The final outcome is characterized by a lower effective tax rate and a lower level of public good provision (than when borders are closed). Welfare continues to be lower than what it was when the borders were closed; although there is improvement over cases of not harmonizing the tax or harmonizing it at the closed-border rate. Note also that, this time, the decline in the harmonized tax rate (from 1.0476 to 0.9465) is associated with increased enforcement (β increases from .0362 to .0370). As discussed earlier, the relationship between tax and audit rates is a complicated one.

This result has an important policy implication: Tax evasion affects the optimal design of tax coordination policies. Coordination is generally possible if the participants find a way to commit to a particular policy. In the case of tax policies, it is likely that this may be feasible; e.g., through EU directives. However, with audit strategies, as we argued above, observability and enforcement problems make it rather impossible for national governments to credibly commit to a coordinated policy (unless they adopt a centralized tax administration). This has two consequences. First, it undermines the value of fiscal cooperation. Second, to the extent that a coordinated tax policy alone is still desired, it must be designed taking the potential for fiscal competition through audit strategies into account. In particular, this implies that the countries will have to adopt a tax which is different from its first-best value (closed-border solution).

Conclusion

This paper has introduced tax evasion into a specific model of tax competition. In has derived closed-form solutions for the equilibrium values of the variables of the model both in the absence and in the presence of tax evasion. Tracing these values the paper has shown that, when national governments in an economic union engage in tax competition and there is no tax evasion, the result is less than optimal tax rates and public good supplies. However, the countries are able to correct this problem and restore efficiency by harmonizing their tax policy.

Tax evasion complicates this picture drastically. Again tracing the equilibrium values of the variables, the paper has shown that as a result of fiscal competition, public good supplies will continue to be less than optimal. However, fiscal competition can now be waged not just through tax instruments but also through audit strategies. The outcome is less than optimal tax rates *and* audit probabilities.

While the above result is quite general, it clearly rests on our Nash behavioral assumption. Whether or not the countries do in fact engage in fiscal competition, is of course an empirical question. Moreover, the

question applies equally to the existing results in the literature regarding competition in tax rates, as it does to our result here concerning competition in audit strategies. These empirical questions have not been the concern of our paper. They are nevertheless very important questions that must be addressed by the literature.

Finally, the paper has shown that, contrary to the case without evasion, one can no longer rely on tax harmonization alone to achieve efficiency. Banned from competing in tax rates, the countries continue to engage in tax competition by cutting their audit rates. That is, they implicitly encourage tax evasion! In turn, this implies that the optimal design of tax coordination policies must take tax evasion into account. This calls for a harmonized tax rate which is different from its first-best value. These are serious policy questions which must further be investigated.

References

Allinghham, M.G. and A. Sandmo (1972) "Income tax evasion: A theoretical analysis", *Journal of Public Economics*, 1:323-338.

Border, K. and J. Sobel (1987) "Samurai accountant: A theory of auditing and plunder", *Review of Economic Studies*, 54:525-540.

Cowell, F. (1990) *Cheating the Government: The Economics of Evasion*, The MIT Press. Cambrige, Massachusetts

Cremer, H. and F. Gahvari (1992) "Tax evasion and the stucture of indirect taxes and audit probabilities", *Public Finance/Finances Publiques*, supplement, 47:351-365.

Cremer, H. and F. Gahvari (1993) "Tax evasion and optimal commodity taxation", *Journal of Public Economics*, 50:261-275.

Cremer, H. and F. Gahvari (1994) "Tax evasion, concealment and the optimal linear income tax", *Scandinavian Journal of Economics*, 96:219-239.

Cremer, H. and F. Gahvari (1996a) "Tax evasion and the optimum general income tax", *Journal of Public Economics*, 60:235-249.

Cremer, H. and F. Gahvari (1996b) "Tax evasion, fiscal competition and economic integration", mimeo.

Cremer, H., M. Marchand and P. Pestieau (1990) "Evading, auditing and taxing: The equity-compliance tradeoff", *Journal of Public Economics*, 43: 67-92.

Edwards, J. and M. Keen (1996) "Tax competition and the Leviathan", *European Economic Review*, 40: 113-134.

Kanbur, R. and M. Keen (1993) "Jeux sans frontières: Tax competition and tax coordination when countries differ in size", *American Economic Review*, 83:877-892.

Keen, M.J. (1989) "Pareto-improving indirect tax harmonisation", *European Economic Review*, 33: 1-12.

Marrelli, M. (1984) "On indirect tax evasion," *Journal of Public Economics*, 25:181-196.

Mintz, J. and H. Tulkens (1986) "Commodity tax competition between member states of a federation: equilibrium and efficiency", *Journal of Public Economics*, 29:133-172.

Oates, W. E. (1972) *Fiscal Federalism*. Harcourt Brace Jovanovich, New York.

Reinganum, J. and L. Wilde (1985) "Income tax compliance in a principal-agent framework", *Journal of Public Economics*, 26:1-18.

Sinn, H. W. (1990) "Tax competition and harmonization in Europe", *European Economic Review*, 34:489-504.

Sinn, H. W. (1994) "How much Europe? subsidiarity, centralization and fiscal competition", *Scottish Journal of Political Economy*, 41:85-107.

Virmani, A. (1989) "Indirect tax evasion and production efficiency", *Journal of Public Economics*, 50:223-237.

Wildasin, D. E. (1989) "Interjurisdictional capital mobility: fiscal externality and a corrective subsidy," *Journal of Urban Economics*, 25:193-212.

Wilson, J. (1986) "A theory of inter-regional tax competition", *Journal of Urban Economics*, 19:296-315.

Zodrow, G. R. and P. M. Mieszkowski (1986) "Pigou, property taxation and the under-provision of local public goods," *Journal of Urban Economics*, 19:356-370.

Appendix

Honest firms in a closed economy: The Lagrangian expression, Λ, for the problem of country i is

$$\Lambda = v - (c+t_i) + \ln y_i + \lambda (t_i - y_i) \qquad \text{(A1)}$$

where λ is the Lagrangian multiplier. Differentiating Λ partially with respect to t_i and y_i and setting the resulting derivatives equal to zero yields

$$-1 + \lambda = 0 \qquad \text{(A2)}$$

$$\frac{1}{y_i} - \lambda = 0 \qquad \text{(A3)}$$

Solving equations (A2) – (A3) and (3) result in $t_i = y_i = 1$.

Honest firms in an open economy: The Lagrangian expression for the problem of country h (the higher-price country) is

$$\Lambda_h = v - (c+t_h) + \frac{(t_h - t_f)^2}{2\delta} + \ln y_h + \lambda_h \left[t_h\left(1 - \frac{t_h - t_f}{\delta}\right) - y_h\right] \qquad \text{(A4)}$$

Setting the partial derivatives of Λ_h with respect to t_h and y_h equal to zero yields:

$$-1 + \frac{t_h - t_f}{\delta} + \lambda_h \left(1 - \frac{t_h - t_f}{\delta} - \frac{t_h}{\delta}\right) = 0 \qquad \text{(A5)}$$

$$\frac{1}{y_h} - \lambda_h = 0 \qquad \text{(A6)}$$

Similarly, one can write the Lagrangian expression for the problem of country f as

$$\Lambda_f = v - (c+t_f) + \ln y_f + \lambda_f \left[t_f\left(1 + \frac{t_h - t_f}{\delta}\right) - y_f\right] \qquad \text{(A7)}$$

The first-order conditions for country f are:

$$-1 + \lambda_f \left(1 + \frac{t_h - t_f}{\delta} - \frac{t_h}{\delta}\right) = 0 \qquad \text{(A8)}$$

$$\frac{1}{y_f} - \lambda_f = 0 \qquad \text{(A9)}$$

Solving equations (A5)–(A6), (A8)–(A9), and the governments' budget constraints (6) and (8) result in the equilibrium values reported in (9) in the text.

Comparative statics for evasive firms: The following formulas are used to calculate the first-order conditions that are given below for evasive firms (both in closed and in open economies). They may be proved by differentiating the firstorder condition given in footnote 7, (12), (13) with respect to t and β, and simplifying; see Cremer and Gahvari (1993).

$$\frac{\partial \alpha}{\partial t} = \frac{-(1-\beta\tau)}{g''} \qquad \text{(A10)}$$

$$\frac{\partial \theta}{\partial t} = (\alpha + (1-\alpha)\beta\tau) - \frac{(1-\beta\tau)^2 t}{g''} \qquad \text{(A11)}$$

$$\frac{\partial p}{\partial t} = \alpha + (1-\alpha)\beta\tau \qquad \text{(A12)}$$

$$\frac{\partial \alpha}{\partial \beta} = \frac{t\tau}{g''} \qquad \text{(A13)}$$

$$\frac{\partial \theta}{\partial \beta} = (1-\alpha)t\tau + \frac{(1-\beta\tau)t^2\tau}{g''} \qquad \text{(A14)}$$

$$\frac{\partial p}{\partial \beta} = (1-\alpha)t\tau \qquad \text{(A15)}$$

Evasive firms in a closed economy: The Lagrangian expression for the problem of country i, $(i = h, f)$ is[11]

11. For ease in notation, we drop the subscript.

$$\Omega = v - (c+g+\theta) + \ln y + \mu[\theta - d(\beta) - y] \quad \text{(A16)}$$

The first-order conditions associated with this problem, after a bit of manipulations, are written as:

$$\frac{1}{\mu} = 1 - \frac{(1-\beta\tau)^2 t}{(\alpha+(1-\alpha)\beta\tau)g''} \quad \text{(A17)}$$

$$\frac{1}{\mu} = 1 + \frac{(1-\beta\tau)t}{(1-\alpha)g''} - \frac{d'(\beta)}{(1-\alpha)t\tau} \quad \text{(A18)}$$

$$\frac{1}{\mu} = y \quad \text{(A19)}$$

Solving equations (A17)–(A19) and (16), along with (12), yield the equilibrium values for t, β, θ and y. From (15) one can then determine the utility level also.

Evasive firms in an open economy: The Lagrangian expressions for the problem of country h (the higher price country) and country f (the lower price country) are:

$$\Omega_h = v - (c+g_h+\theta_h) + \frac{(g_h+\theta_h-g_f-\theta_f)^2}{2\delta} + \ln y_h$$

$$+\mu_h[\theta_h(1 - \frac{(g_h+\theta_h-g_f-\theta_f)}{\delta}) - d(\beta_h) - y_h], \quad \text{(A20)}$$

$$\Omega_f = v - (c+g_f+\theta_f) + \ln y_f$$

$$+\mu_f[\theta_f(1 + \frac{(g_h+\theta_h-g_f-\theta_f)}{\delta}) - d(\beta_f) - y_f] \quad \text{(A21)}$$

The first-order conditions for the two countries will be derived by differentiating Ω_h with respect to t_h, β_h and y_h, and Ω_f with respect to t_f, β_f and y_f, and setting the resulting expressions equal to zero.

Concentrating on the resulting *symmetric* equilibrium, the first-order conditions for both countries can be simplified to

$$\frac{1}{\mu} = 1 - \frac{(1-\beta\tau)^2 t}{(\alpha+(1-\alpha)\beta\tau)g''} - \frac{\theta}{\delta} \quad \text{(A22)}$$

$$\frac{1}{\mu} = 1 + \frac{(1-\beta\tau)t}{(1-\alpha)g''} - \frac{d'(\beta)}{(1-\alpha)t\tau} - \frac{\theta}{\delta} \quad \text{(A23)}$$

$$\frac{1}{\mu} = y \quad \text{(A24)}$$

$$y = \theta - d(\beta) \quad \text{(A25)}$$

where we have dropped the subscripts h and f due to symmetry. Equations (A22)–(A25) determine the equilibrium values of policy instruments t, β as well as the level of public good provision, y.