

Withholding taxes or information exchange: the taxation of international interest flows

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Abstract

This paper considers withholding taxes and information exchange as alternative means to tax international interest income. For each regime, we consider the maximum level of taxation of foreign-source income that can be sustained as the equilibrium of a repeated game. The best regime is the one that brings the level of taxation in the repeated game closest to the cooperative level of interest taxation. Sustainable levels of taxation in either regime depend on the importance of bank profits and on the marginal cost of public funds, among other things. Simulations with the model illustrate the choice between withholding taxes and information exchange. An explicit possibility is the emergence of a mixed regime, with one country imposing a withholding tax and the other country providing information. The basic model is extended to allow for size differences between the two countries and to incorporate a third, outside country.

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1 Introduction

The introduction of the euro in January 1999 was an important step towards single European banking and capital markets. In euroland, savers who place deposits with foreign banks no longer face any exchange rate risk. The increased attractiveness of foreign deposits will make competition among banks more intense, and at the same time make it increasingly difficult for national tax authorities to tax the overall interest income of their residents. As the difficulties of taxing interest income in Europe become more pressing, possible policy coordination in this area is once more receiving wide attention. As a reflection of the changed mood in favor of policy coordination, the European Commission published a proposal for a directive to improve the taxation of savings income in May 1998. This proposal only deals with the taxation of interest accruing to nonresidents within the European Union, unlike an earlier proposed directive in 1989. Acceptance of the current proposed directive requires unanimity among the 15 EU member states, which has so far proven elusive. The likely abolition of the requirement of unanimity in taxation matters in the future, however, may provide member states with an incentive to come to an agreement relatively soon.

The European Commission proposal of May 1998 envisions two methods to come to a more effective taxation of international interest income: nonresident withholding taxes and the international exchange of information on interest income among national tax authorities. In fact, the proposal offers each member state a choice between a nonresident withholding tax on interest of at least 20 percent or the provision of information about the interest income of residents of other countries to the tax authorities of these other countries. As the choice is exclusive, a cross-border depositor subject to a nonresident withholding tax under the proposal can safely fail to report his foreign interest income to his domestic tax authority.¹ Hence, the nonresident withholding tax will be the one and only level of taxation. In case of information exchange, the cross-border depositor will only be liable for tax in his country of residence. For a given level of taxation, the depositor is unlikely to care whether he pays tax in the foreign-source country or in his country of residence. The countries, however, do care as the method of taxation determines which country gets the tax revenues. Specifically, nonresident withholding taxes effectively introduce source-country taxation of interest income, while information

¹Exclusivity is required by article 2 of European Commission (1998) which states that "each Member State shall apply one and the same system to all interest payments made by a paying agent established within its territory to individuals who are resident for tax purposes in other Member States."

exchange restores a residence-country taxation of such income. Hence, the choice between withholding taxes and information exchange is part of the larger debate regarding the desirability of source- and residence-level taxation, confined to international interest income.

At first glance, it appears that a source country is always better off taxing the interest income of foreign residents rather than supplying information about such income to the country of residence. This begs the question why any country would ever supply information about savings income to a foreign tax authority, and why the European Commission envisions this as a feasible method to repair the taxation of international interest income. In previous work, Bacchetta and Espinosa (1995) have shown that incentives to transmit information may exist in a static framework depending on the tax regime. By providing information to a foreign tax authority, a government allows it to set a higher tax on capital, as the incentive to engage in tax evasion subsides. A higher foreign tax on capital is beneficial to the domestic country, as the incentive for its residents to engage in tax evasion equally subsides. Countries may equally have an incentive to provide information in a repeated game framework, where nonprovision of information is subsequently punished by the partner countries by same treatment. In a framework with repeated interaction, Bacchetta and Espinosa (2000) study the joint determination of taxes on international investment income and information-exchange clauses in double taxation treaties. They find that information exchange may be part of a (sustainable) tax treaty if there is a reciprocity requirement, when there is a high cost of negotiation, or with one-way capital flows.

Following the Commission proposal from 1998 and actual practice in many countries, this paper regards withholding taxes and information exchange as substitutes rather than as complements in a repeated game setting. To do so, we first analyze what level of withholding taxes can be sustained in a game with repeated interaction. Next, we investigate what level of information exchange is feasible in a repeated game. As there is a perceived undertaxation of international interest income, the choice between nonresident withholding taxation and information exchange ideally is determined by which method yields the highest sustainable level of effective cross-border taxation. The 1998 EU proposal, however, explicitly gives EU-members a choice between withholding taxes and information exchange. Then, the noncooperative interaction among EU-member states can be seen to correspond to a two-stage game: first, countries make a regime choice between withholding taxes and information exchange, and second countries select either the withholding

tax rate or the intensity of information exchange depending on the selected regime. In this setting, a real possibility is the selection of a mixed regime, with at least one country selecting the withholding tax regime and at least one the information exchange regime.

These issues are analyzed in a stylized symmetric two-country model where agents from each country have a choice between depositing at domestic or foreign banks. The choice depends on the (heterogeneous) private cost of depositing abroad and on the tax regime. Each country is concerned about the private welfare of its residents, about the profits of national banks (as determined by the volume of deposits with domestic banks), and about national tax revenues. The importance of these three components depends, among other things, on the profitability of banking and on the marginal cost of public funds (from some alternative source of taxation). In the repeated game setting, these factors also turn out to be important determinants of the maximum level of effective taxation under either nonresident withholding taxes or information exchange, and hence of the choice between these two alternatives. If the choice between withholding taxes and information exchange is exclusive, then as indicated we can interpret the selection of the tax regime and the subsequent policies within these regimes as a two stage game. This two-stage game turns out to be too complicated to be analyzed analytically in a meaningful way. However, we present some illustrative simulations of the symmetric two-country model later in the paper.

The basic model is extended in several ways. First, we consider the possibility that depositors can place their funds in a third country that falls outside any withholding tax or information exchange regime. A third country threat importantly affects the cooperative as well as the noncooperative levels of taxation of interest flows between the original two countries, and consequently also the merits of withholding taxes vs. information exchange. A key consideration is the private cost of placing deposits in the third country relative to the second or partner country. Also, we extend the original two-country model to allow for differences in country size. Within the European Union, member states differ vastly in size, and these size differences may well drive some of the differences of opinion on international tax coordination. Asymmetries in size will also give rise to asymmetries in the maximum sustainable withholding taxes or information exchange between the two countries. In fact, as one country becomes infinitely large (relative to the other country), we find that this country can maintain policies that prevent any cross-border deposits from the small to the large country, while policy in the small country in the repeated game collapses to the policy outcome in a one-shot noncooperative game. Finally, we

consider how the intensity of information gathering and reporting in the information exchange regime varies with the costs of collecting this information.

The paper first derives the maximum sustainable tax rates (as well as the one-shot Nash and cooperative tax rates) for the two pure regimes with both countries selecting either a withholding tax or information exchange. We also characterize the mixed regime (with one country choosing a withholding tax and the other information exchange) to be able to address the issue of regime choice later. For this mixed regime, we cannot derive the maximum sustainable tax rates analytically. This is why we turn to simulations.

The simulations address both regime selection and subsequent tax policies. For the symmetric two-country model, we find that both countries selecting withholding taxes or information exchange may be equilibria. Where there exist two pure equilibria like this, either equilibrium may be preferable in the sense of yielding higher welfare depending on the common discount factor. For the case where countries differ in size, a mixed regime may emerge. The larger country then opts for information exchange, while the smaller country imposes a withholding tax. This interesting result is consistent with the view that the Commission's proposal from 1998, if adopted, would prompt the UK to select information exchange, while Luxembourg likely would levy a withholding tax.

This outcome is indeed becoming increasingly likely, at least for the intermediate term, after the European Council meeting of June 19-20 at Santa Maria de Feira in Portugal. After a stalemate of almost two years, EU member states agreed that "exchange of information, on as wide a basis as possible, shall be the ultimate objective of the EU."² This is to be laid down in a directive to be adopted no later than December 31, 2002. Until the end of 2009, however, Austria and Luxembourg are allowed to operate a withholding tax. Belgium, Greece, and Portugal will inform the Council of their regime choice for the period till 2009 by the end of the year 2000. Other EU member states maintain that information exchange should be introduced by 2007. Thus it is fair to say that the European Union intends to adopt a mixed regime until 2009, before ultimately switching to a common system of information exchange.

The remainder of this paper is organized as follows. Section 2 outlines the basic model. Section 3 extends the model to include a third country. Section 4 introduces size differences in the two-country model, while section 5 considers varying costs of information exchange in the two-country model. Section 6 briefly considers the case of a mixed

²See Annex IV of the 'Presidency Conclusions' as summarized by the Portuguese presidency after the Council meeting.

regime, while section 7 illustrates the regime-selection game with simulations based on varying values of key model parameters. Finally, section 8 concludes.

2 The model

The basic model has two symmetric countries, with stars denoting foreign variables.³ In each country, there are households that have funds of unit size that they wish to deposit at either domestic or foreign banks. Depositors receive the same pre-tax interest rate at domestic and foreign banks. Specifically, the deposit interest rate equals $i^* - \delta$, where i^* is an (exogenous) return on bank assets, and δ is the interest spread or profit rate per unit of deposits. As all banks pay the same deposit rate, the deposit location will be determined by tax and non-tax costs, if any. Starting with the non-tax costs, we assume that depositing at a domestic bank is costless, while the costs of depositing at a foreign bank vary across households. As in Gros (1990), the costs of depositing abroad are equal to βh for household h , where h is uniformly distributed on the interval $[0, 1]$. These heterogeneous costs may reflect differences in travel or communication costs.⁴

The taxation of interest generally also varies with the bank location. Domestic deposits are assumed to be subject to a specific tax t in either country. Cross-border deposits are subject to taxation by the source country only under a regime of nonresident withholding taxes, while they are taxed by the country where the depositor resides in case of international information exchange. Specifically, in the withholding tax regime the foreign country taxes cross-border deposits by domestic residents at a withholding tax rate τ_w^* .⁵ In the information exchange regime, the foreign country is required to report interest income accruing to domestic residents to the domestic country tax authority. In practice, the foreign country will be able to choose the intensity with which it tracks down international deposits, and hence the probability p^* that deposits by domestic residents are indeed reported. If reported, cross-border deposits by domestic residents are subject to a domestic tax equal to $t(1 + f)$, where $f \geq 0$ is a fine rate. The expected tax

³A somewhat more complicated, three-country version of the model is used in Huizinga and Nielsen (2000) to study the implications of a minimum withholding tax on interest in a European context. We show in our earlier work that a minimum withholding tax can be Pareto improving for two EU members of different size, even if there is a third, outside country that acts as a tax haven.

⁴For simplicity, yet without implications for our basic insights, our model has some stark features. There is no non-tax motive (such as diversification) for depositing funds abroad. On the contrary, cross-hauling of funds will be socially inefficient and will only occur for tax reasons. Depositors will be dishonest and evade taxation, if that pays. Finally, none of the countries has a comparative advantage in banking.

⁵The present paper takes for granted that (positive) tax discrimination of foreign deposits is possible. The welfare implications of such discrimination are examined by Janeba and Peters (1999).

imposed on cross-border deposits by domestic residents now equals $\tau_i^* = p^*t(1 + f)$. The residence-based tax t is taken to be exogenous, as it might be determined by the need to tax other income (such as labor income) in a comprehensive income tax system. Likewise, the fine rate f is taken to be exogenous, in that it would be determined by the severity of tax evasion relative to other forms of crime. As p^* therefore is more readily adjusted than t or f , the cross-border tax τ_i^* is de facto chosen by the foreign country. The effective cross-border tax is thus determined by the source country under both withholding taxes and information exchange. The two systems differ, however, in which country receives the tax revenues: withholding taxes are source-level taxes, while information exchange to some extent repairs the taxation of cross-border deposits by the residence country.

A domestic household h prefers to deposit at home under the withholding tax regime if

$$i^* - \delta - t \geq i^* - \delta - \tau_w^* - \beta h \quad (1)$$

Let the value of h at which domestic households are indifferent as to the deposit location under the withholding tax regime be denoted \hat{h}_w which implies that

$$\hat{h}_w = \frac{t - \tau_w^*}{\beta} \quad (2)$$

The domestic depositor who is indifferent as to the country of deposit under the information exchange regime is found analogously.

For the case of withholding taxes, aggregate private net-of-all-cost income, I_w , is given by

$$\begin{aligned} I_w &= (1 - \hat{h}_w)(i^* - t - \delta) + \int_0^{\hat{h}_w} (i^* - \delta - \tau_w^* - \beta h_w) dh_w \\ &= i^* - t - \delta + \hat{h}_w(t - \tau_w^*) - \frac{\beta \hat{h}_w^2}{2} \end{aligned} \quad (3)$$

Domestic banks receive deposits from domestic and foreign residents yielding bank profits, P_w , given by

$$P_w = [(1 - \hat{h}_w) + \hat{h}_w^*] \delta \quad (4)$$

while domestic tax revenues, T_w , are given by

$$T_w = (1 - \hat{h}_w)t + \hat{h}_w^* \tau_w \quad (5)$$

The domestic government is interested in maximizing a social surplus, S_w , consisting of private income, bank profits, and tax revenues as follows

$$S_w = I_w + P_w + \rho T_w \quad (6)$$

where $\rho \geq 1$ is the marginal cost of public funds from an alternative source of government revenue. In case of information exchange, expressions for private income, I_i , and bank profits, P_i , are found after replacing τ_w^* by τ_i^* and \hat{h}_w by \hat{h}_i in (3) and (4), while domestic tax revenues T_i are given by $t(1 - \hat{h}_i) + \hat{h}_i \tau_i^*$. Before considering noncooperative tax policies, it is useful to see what policies materialize under full cooperation between the two countries. It is readily seen that under cooperation the choice between withholding taxes and information exchange is immaterial, as the two regimes provide the two countries with fully equivalent possible (symmetric) outcomes. Further note that cooperation in the present model will yield tax levels high enough to preclude any cross-border deposits. We next consider noncooperative tax policy for the cases of withholding taxes and information exchange in turn.

2.1 Withholding taxes

For the case of withholding taxes, we can evaluate the social surplus, S_w , using (3), (4), and (5) as follows

$$S_w = i + (\rho - 1)t + \delta(\hat{h}_w^* - \hat{h}_w) - \rho(t\hat{h}_w - \tau_w \hat{h}_w^*) + \beta(\hat{h}_w)^2/2 \quad (7)$$

As a benchmark, we first consider the withholding tax policy by the domestic country in a one-shot Nash equilibrium. The optimality condition for the domestic country regarding τ_w is given by

$$\frac{dS_w}{d\tau_w} = \frac{1}{\beta}[t\rho - \delta - 2\tau_w\rho] = 0 \quad (8)$$

which is solved for the equilibrium tax rate τ_w^n as follows⁶

$$\tau_w^n = \frac{t\rho - \delta}{2\rho} \quad (9)$$

⁶Throughout, we shall realistically assume that $\delta < t\rho$, i.e. that the social value of the statutory tax exceeds the contribution to bank profit. Hence, the one-shot Nash withholding tax will be positive.

A higher domestic withholding tax rate prevents some foreign residents from depositing in the home country and thus increases the foreign surplus, S_w^* , as seen by

$$\frac{dS_w^*}{d\tau_w} = \frac{1}{\beta}[(\rho - 1)t + \delta + \tau_w] > 0 \quad (10)$$

which implies that the noncooperative tax rate, τ_w^n , is too low to maximize joint surplus $S_w + S_w^*$.

In the repeated game setting, countries are able to sustain withholding taxes higher than τ_w^n in (9) in the noncooperative equilibrium. A withholding tax which is higher than τ_w^n clearly introduces an incentive to deviate and revert back to τ_w^n to attain higher instantaneous government surplus. Such a reversal by, say, the domestic country is assumed to be punished by the foreign country imposing the same tax rate τ_w^n in all subsequent periods. In the usual way, the maximum sustainable withholding tax rate in the repeated game, $\tau_w^m \leq t$, is such that the instantaneous gain from reverting to τ_w^n balances the (discounted) loss from the subsequent punishment by the foreign country. To proceed, let S^m be defined as the instantaneous surplus achieved by both countries if they set τ_w^m . Also, let S^d be the welfare for the domestic country if this country chooses τ_w^n , while the other country maintains τ_w^m . Finally, S^n is the surplus level for both countries if they jointly choose τ_w^n . The home country indeed has no incentive to set τ_w below τ_w^m if

$$(S_w^m - S_w^n) \frac{\Delta}{1 - \Delta} \geq (S_w^d - S_w^m) \quad (11)$$

where Δ is the common discount factor, with $0 < \Delta < 1$. Note that the criterion (11) also involves the foreign country taxes τ_w^{*m} and τ_w^{*n} . Further, there is also a parallel no-cheating condition for the foreign country.

To find τ_w^m we have to evaluate $(S_w^m - S_w^n)$ and $(S_w^d - S_w^m)$ in (11). Specifically, utilizing the symmetry between the two countries, $(S_w^m - S_w^n)$ and $(S_w^d - S_w^m)$ can be expressed as functions of τ_w^n and τ_w^m making use of (7). An interior value of τ_w^m (less than t) can now be found to equal

$$\tau_w^m = \tau_w^n + \frac{\Delta(2\rho - 1)}{\rho - \Delta/2}(t - \tau_w^n) \quad (12)$$

which immediately implies that $\tau_w^m > \tau_w^n$.

An interesting way to see how τ_w^m depends on model parameters is to see when in the repeated game the cooperative outcome $\tau_w^m = t$ can be sustained. Using (12), we find the following result

PROPOSITION 1. In the repeated game with withholding taxes, the fully cooperative outcome can be sustained in equilibrium if

$$\Delta \geq \frac{\rho}{2\rho - 1/2}.$$

Not surprisingly, a high discount factor Δ and high marginal cost of public funds ρ make it more likely that the first-best outcome can be achieved. Also note that the criterion is independent of the bank profit parameter δ .

2.2 Information exchange

With information exchange, the social surplus, S_i , can be evaluated as follows

$$S_i = i + (\rho - 1)t + \delta(\hat{h}_i^* - \hat{h}_i) - \rho(t - \tau_i^*)\hat{h}_i + \beta(\hat{h}_i)^2/2 \quad (13)$$

Again, we first consider the determination of the level of information exchange in a one-shot Nash equilibrium. It is immediately seen that the domestic country faces no incentive to supply any information to the foreign country as

$$\frac{dS_i}{d\tau_i} = -\frac{\delta}{\beta} < 0 \quad (14)$$

Hence, in a one-shot Nash equilibrium we have $\tau_i = 0$. The foreign country stands to benefit from information provided by the domestic country as

$$\frac{dS_i^*}{d\tau_i} = \frac{1}{\beta}[\delta + (2\rho - 1)(t - \tau_i)] > 0 \quad (15)$$

for $\tau_i < t$.

Again, it is easily seen that the maximization of joint welfare $S_i + S_i^*$ requires $\tau_i \geq t$.

Next, we consider whether some information exchange can be maintained in a repeated game. Now let $\tau_i^m \leq t$ be the maximum level of taxation of foreign-source income implicit in the information supplied by the domestic country. The welfare levels S_i^m , S_i^d and S_i^n

are defined analogously to the earlier discussion for the withholding taxation regime. Analogously to (11), we now have

$$(S_i^m - S_i^n) \frac{\Delta}{1 - \Delta} \geq (S_i^d - S_i^m) \quad (16)$$

Again, we have to evaluate $(S_i^m - S_i^n)$ and $(S_i^d - S_i^m)$ while using (13) to find τ_i^m . Noting that $\tau_i^n = 0$, we can solve for τ_i^m if less than t from an equality in (16) as follows⁷

$$\tau_i^m = 2t - \frac{1 - \Delta}{\Delta} \frac{\delta}{(\rho - 1/2)} \quad (17)$$

In a repeated game, there will be some international exchange of information, if $\tau_i^m > 0$ in (17). This is more likely, the larger are t , Δ and ρ , and the smaller is δ . It is also interesting to see when information exchange in the repeated game mimicks the full-cooperation outcome, i.e. $\tau_i^m = t$. Here we find

PROPOSITION 2. In the repeated game with information exchange, the fully cooperative outcome can be sustained in equilibrium if

$$\Delta \geq \frac{\delta}{\delta + (\rho - 1/2)t}.$$

Thus the fully cooperative equilibrium is more likely to be sustainable through information exchange the higher is the domestic tax rate t , the government's discount factor Δ , the cost of public funds ρ , and the lower is the banking profit rate δ . With a low banking profit rate δ , fully cooperative levels of information exchange can easily be maintained, as then countries have nothing to lose by informing other countries about their deposits with their domestic banking systems.

Comparing proposition 1 and 2, it seems that the first best may in principle be attained only through withholding taxes (with $t_w^m = t > \tau_i^m$), only through information exchange (with $t_i^m = t > \tau_w^m$), through both (with $t_w^m = \tau_i^m = t$) or through neither ($t_w^m, \tau_i^m < t$). To illustrate, Figure 1 relates the maximum sustainable tax rates under withholding tax and information exchange to the discount rate (Δ) for given other parameters.⁸ With the discount factor equal to zero, the maximum sustainable tax rates

⁷Once more we utilize symmetry between the two countries

⁸Specifically, $a = 1, t = 0.03, \beta = 0.04, \delta = 0.005$, and $\rho = 1.4$.

are the one-shot Nash values (of τ_w^n in (9) and zero for the withholding tax and information exchange regimes, respectively). As the discount factor increases, the maximum sustainable withholding tax rises relatively slowly until reaching the residence-based tax of t for a discount factor below unity (specifically a discount factor of $\rho/[2\rho - 1/2]$, cfr. Proposition 1). The maximum sustainable implicit tax rate with information exchange, instead, stays zero until the discount factor reaches $[1 + (\rho - 1/2)2t/\delta]^{-1}$ [see (17)], after which it quickly rises to the level t . This tax level is reached for a discount factor of $[1 + (\rho - 1/2)t/\delta]^{-1}$.

For low values of the discount factor, neither tax regime thus brings about the first-best level of taxation. For intermediate discount values, only the information exchange regime accomplishes this, whereas for high discount values both regimes achieve this outcome. Since higher maximum sustainable tax rates are preferable in any symmetric two-country setting, we see that the withholding tax regime is better for small rather than intermediate discount factors, and vice versa. For even higher discount values, the regime choice is immaterial, as both tax regimes deliver a full taxation of savings. A pattern as in Figure 1 arises, if in fact the sustainable tax rate under the information exchange regime reaches the level t at a relatively low discount factor. This is the case if $\rho/[2\rho - 1/2] > [1 + (\rho - 1/2)t/\delta]^{-1}$, which holds as long as $\delta < t\rho$.⁹ Hence we have established

COROLLARY Given that $\delta < t\rho$, first best taxation is attained in the repeated game for a bigger set of discount factors under information exchange than under withholding tax.

3 A third country threat

So far, we have ignored that savers may deposit their funds outside the two countries under consideration. There will always be outside financial centers and tax havens with low or no taxes and no information provision where depositors can take refuge. The presence of such third countries poses severe limits on the taxation policies that can be determined by any group of countries, such as the European Union, if it decides to jointly beef up the taxation of intragroup interest flows. Clearly, a main determinant of tax policies within a group of countries attempting to raise effective taxation levels will be the costs that savers face in investing in the third country.

⁹Above, we have assumed this inequality to hold.

Here we assume that depositing in the third country carries a cost of γh for household h , with $\gamma > \beta$. The third country does not levy a withholding tax or provide information to outsiders. When depositing in the third country, a household thus get a net return $i^* - \delta - \gamma h$. Below, we focus on the case where also some households' deposit in the second 'partner' country, while some other households deposit in the domestic country. We start out considering withholding taxes and subsequently turn to information exchange.

3.1 Withholding taxes

As before \hat{h}_w in (2) is the index of the household that is indifferent between depositing in the domestic and foreign countries in the withholding tax regime. In addition, let \tilde{h}_w be the index of the household indifferent between depositing in the third and foreign countries. From the equality $i^* - \delta - \gamma \tilde{h}_w = i^* - \delta - \beta \tilde{h}_w$, we can solve

$$\tilde{h}_w = \frac{\tau_w^*}{\gamma - \beta} \quad (18)$$

The fact that we assume that some deposits go to all three countries implies that $\tilde{h}_w < \hat{h}_w$. For the extended model, we again consider policies under the withholding tax and information exchange regimes in turn. With withholding taxes, domestic social surplus, S_w , in (7) is now replaced by

$$S_w = i + (\rho - 1)t + \delta(\hat{h}_w^* - \tilde{h}_w^* - \hat{h}_w) - \rho(t\hat{h}_w - \tau_w(\hat{h}_w^* - \tilde{h}_w^*)) + [\beta(\hat{h}_w)^2 + (\gamma - \beta)(\tilde{h}_w)^2]/2 \quad (19)$$

Compared to (7) it now has to be taken into account that the domestic country loses both some bank profits and some withholding tax revenue as foreigners turn to the third country to deposit funds.

In a one-shot game, the home country simply chooses τ_w to maximize S_w in (19). This yields

$$\tau_w^n = \frac{\gamma - \beta}{2\gamma}t - \frac{\delta}{2\rho} \quad (20)$$

Note that τ_w^n in (20) is lower than τ_w^n in (9). Thus, the third country threat causes each country to lower its tax rate in the one-shot equilibrium. Also note that τ_w^n in (20) approaches τ_w^n in (9) as γ approaches infinity, as then depositing in the third country is prohibitively expensive, and the third country threat loses significance.

Remember that in the previous two-country model the cooperative withholding tax level equals t . To find the cooperative tax level denoted τ_w^c in the present case, we set $d(S_w + S_w^*)/d\tau_w = 0$ and solve for τ_w^c as follows

$$\tau_w^c = \frac{\gamma - \beta}{\gamma}t - \frac{\beta\delta}{\gamma(2\rho - 1)} \quad (21)$$

It is immediately seen that $\tau_w^c < t$. The reason is that with $\tau_w^c = t$ too many depositors go to the third country. However, even with $\tau_w = \tau_w^c$, some depositors will transact in the third country. Also, note that τ_w^c approaches t as γ approaches infinity. Again, with infinitely high costs of depositing in the third country, the third country threat loses significance, and cooperative policy corresponds to what it is in the absence of a third country.

Using (19) and following steps similar to those in section 2, we find that the maximum sustainable withholding tax, if below t , can be written as

$$\tau_w^m = \tau_w^n + \frac{(\gamma - \beta)\Delta}{\gamma(\rho - \Delta/2)} \left[\left(\left(2 - \frac{\beta}{\gamma} \right) \rho - 1 \right) t - \left(2\rho - \frac{\gamma}{\gamma - \beta} \right) \tau_w^n \right] \quad (22)$$

which obviously is a generalization of (12) to a three-country setting. It is also easily seen that the presence of a third country lowers the maximum sustainable withholding tax in the repeated game, *ceteris paribus*.

With a third country present, the benchmark for the maximum sustainable withholding tax in the repeated game no longer is the residence-based tax t , but rather the cooperative tax τ_w^c in ((21)). A natural question to ask now is whether the set of discount rates supporting the cooperative tax level with a third country present is bigger or smaller than the set of discount factors supporting first-best taxation absent a third country. Unfortunately, this question is too complex to yield an analytical answer.

3.2 Information exchange

Turning to the information exchange regime, we see that S_i in (13) is replaced by

$$\begin{aligned} S_i = & i + (\rho - 1)t + \delta(\hat{h}_i^* - \tilde{h}_i^* - \hat{h}_i) - \rho(t\hat{h}_i - \tau_i^*(\hat{h}_i - \tilde{h}_i)) \\ & + [\beta(\hat{h}_i^2) + (\gamma - \beta)(\tilde{h}_i^2)]/2 \end{aligned} \quad (23)$$

Compared to (13), the domestic country registers a loss of bank profits from some foreigners and of tax revenue from some domestic citizens as these groups of depositors turn to the third country.

It remains the case that supplying more information to the foreign country is not in the home country's interest as

$$\frac{dS_i}{d\tau_i} = -\frac{\delta}{\beta} \frac{\gamma}{\gamma - \beta} < 0 \quad (24)$$

Thus, in the one-shot Nash equilibrium the domestic and foreign countries again exchange no information. As before, starting from no information, the foreign country benefits from receiving some information. The cooperative level of information exchange is now found to be

$$\tau_i^c = \frac{\gamma - \beta}{\gamma} t - \frac{\beta \delta}{\gamma(2\rho - 1)} \quad (25)$$

Not surprisingly, τ_w^c in (25) and τ_i^c in (21) are identical. In the end, it does not matter whether a particular level of taxation of foreign source income is effected by way of withholding taxes or by way of information exchange. Interestingly, as $\tau_i^c < t$, it is clear that information exchange is optimally not complete. Equivalently, the probability p of information on taxable income being exchanged is optimally less than $1/(1+f)$.

In the repeated game, let τ_i^m again be the maximum level of taxation that is sustainable by information exchange, where we now only consider $\tau_i^m \leq \tau_i^c$ with τ_i^c in (25). For $\tau_i^m \leq \tau_i^c$, we get

$$\tau_i^m = 2t \frac{\gamma - \beta}{\gamma} - \left[\frac{\beta}{\gamma} + \frac{1 - \Delta}{\Delta} \right] \frac{\delta}{(\rho - 1/2)} \quad (26)$$

First note that τ_i^m in (26) is less than τ_i^m in (17). The third country threat thus reduces the maximum sustainable level of taxation in the repeated game. In the repeated game, the cooperative tax level τ_i^c can be sustained, i.e. $\tau_i^m = \tau_i^c$, if

$$t \geq \left[\frac{\beta + 2\gamma \frac{1-\Delta}{\Delta}}{2(\gamma - \beta)} \right] \frac{\delta}{(\rho - 1/2)}. \quad (27)$$

Note that (27) will be satisfied for a smaller range of values of the domestic tax t than the condition in proposition 2, as the right-hand-side of (27) is greater than the term subtracted from t in proposition 2. Also note that condition (27) collapses to the result

in proposition 2 if γ approaches infinity. The results of this section are summarized as follows

PROPOSITION 3. The threat of a third country reduces the noncooperative withholding tax in a one-shot game. It also gives rise to a cooperative tax level below the domestic tax level as well as lower maximum sustainable tax rates in the repeated game under either withholding taxes or information exchange. All these tax levels are lower, the lower the costs associated with investing in the third country.

4 Countries of different sizes

In this section we return to a two-country model, but now we allow the two countries to have different sizes. Specifically, we assume that the domestic country is $a \geq 1$ times larger than the foreign country. Starting with the use of withholding taxes, we now have two different expressions for domestic and foreign surpluses. Domestic and foreign surpluses can be expressed as

$$S_w = a(i + (\rho - 1)t) + \delta(\hat{h}_w^* - a\hat{h}_w) - \rho(at\hat{h}_w - \tau_w\hat{h}_w^*) + a\beta(\hat{h}_w)^2/2 \quad (28a)$$

and

$$S_w^* = i + (\rho - 1)t + \delta(a\hat{h}_w - \hat{h}_w^*) - \rho(t\hat{h}_w^* - a\tau_w^*\hat{h}_w) + \beta(\hat{h}_w^*)^2/2 \quad (28b)$$

The size difference does not affect the Nash withholding tax rates. Specifically, we maintain $\tau_w^n = \tau_w^{n*} = [t\rho - \delta]/(2\rho)$.

With information exchange, the domestic and foreign surplus levels are given by

$$S_i = a(i + (\rho - 1)t) + \delta(\hat{h}_i^* - a\hat{h}_i) - \rho(t - \tau_i^*)a\hat{h}_i + a\beta(\hat{h}_i)^2/2 \quad (29a)$$

and

$$S_i^* = i + (\rho - 1)t + \delta(a\hat{h}_i - \hat{h}_i^*) - \rho(t - \tau_i)\hat{h}_i^* + \beta(\hat{h}_i^*)^2/2 \quad (29b)$$

The Nash equilibrium a fortiori implies no information exchange.

In the repeated game with withholding taxes, the maximum sustainable withholding taxes for the two countries generally differ as the incentive compatibility constraints in (11) differ if the two countries differ in size. Similarly, in the repeated game the maximum information exchange differs for the two countries as the constraints in (16) differ.¹⁰ One

¹⁰The incentive compatibility constraints for either regime can be derived from the general versions listed in the appendix which cover all imaginable pure and mixed regimes, as well as any size asymmetry and the possible existence of a third country. They can be used to find the maximum sustainable tax rates in the repeated game in all regimes, once values of the various parameters have been selected.

would expect that the larger of the two countries would be able to sustain the higher level of withholding taxes or information exchange. This intuition is confirmed, if we let the domestic country be infinitely large relative to the foreign country, i.e. we let the size parameter a go to infinity. For this case we find

PROPOSITION 4. For the case where the domestic country's relative size goes to infinity, the domestic country imposes withholding taxes or provides information corresponding to the cooperative level with the effective taxation of cross-border deposits equal to the domestic tax rate, while the foreign country imposes either a withholding tax or provides information exchange as in the one-shot static game.

For a proof, see the Appendix.

In general, the following insight will hold: When the domestic country becomes very large relative to the foreign one, it is ready to ensure a high level of tax on deposits from the partner country in exchange for a modest increase, relative to one-shot Nash, in the tax on its own depositors when they invest in abroad. Conversely, the very small foreign country would not worry much about its own citizens investing in the domestic country but instead about holding on to the (relatively many) depositors from the domestic country via a low level of tax on their investments.

5 Introducing costs of inspection

So far we have assumed that information exchange is costless. Specifically, we have ignored the probably considerable costs of gathering and processing information about the interest earnings of foreign residents from domestic banks. In this section, we introduce such costs within the benchmark symmetric, two-country model of section 2.2. Only the deposit-receiving country is assumed to incur such costs in the information exchange regime. Specifically, the inspection of a unit of foreign-owned deposits is assumed to carry a cost c . As before, a domestic country's choice variable is the probability of inspecting a foreign deposit, p , given the symmetric domestic tax rate t and fine rate f . By choosing p , the domestic country thus chooses the effective tax rate $\tau_i = pt(1 + f)$ on foreign-owned deposits in the home country. Similarly, the foreign country chooses its inspection probability p^* .

The home country selects p so as to maximize its surplus S_i given by

$$S_i = i + (\rho - 1)t + \delta(\hat{h}_i^* - \hat{h}_i) - pt(1 - (1 + f)p^*)\hat{h}_i + \beta(\hat{h}_i)^2/2 - \hat{h}_i^*pc \quad (30)$$

where

$$\hat{h}_i^* = \frac{t}{\beta}(1 - (1 + f)p)$$

In a static, one-shot game the home country still has no incentive to collect and provide information about foreign-owned deposits as

$$\frac{dS_i}{dp} = \frac{t}{\beta}[-(1 + f)\delta - c + 2p(1 + f)c] \quad (31)$$

At $p = 0$, the derivative is zero indicating the absence of any incentive to exchange information. Moreover, it can be seen that for all the relevant values of $p > 0$ (such that $\tau_i \leq t$), social surplus S_i will be smaller than with $p = 0$. As before, the foreign country benefits from any information provided by the domestic country; in fact, equation (15) – suitably rewritten with the inspection probability p as the choice variable – still holds. If the two countries jointly maximize their welfare, it is easily seen that they will choose p to equal or exceed the minimal value of p that eliminates all costly cross-border banking i.e. $p = 1/(1 + f)$ for any value of c . If p is chosen high enough to eliminate all cross-border banking, then there will be no need to carry out any inspections, and hence the tax authorities in fact incur no inspection costs. As before, in the fully cooperative case, the residence-based tax on bank deposits is fully restored.

Next, we consider how the cost of inspection affects the inspection intensity in the repeated game. Let p^m now be the maximum value of the inspection rate that can be sustained in the equilibrium of the repeated game. To find p^m , we have to evaluate eq. (16), but now for the case where $c > 0$. Assuming that p^m takes an interior value less than $1/(1 + f)$ so that not all cross-border banking is eliminated, we can express p^m as follows

$$p^m = \frac{1}{1 + f} - \frac{(1 - \Delta)\delta - \Delta(\rho - 1/2)t}{\Delta(\rho - 1/2)t(1 + f) - c} \quad (32)$$

From (32), we see that in fact p^m takes an interior value less than $1/(1 + f)$, if the inequality in proposition 2 is reversed. Thus the condition for an interior value of p^m is independent of c . At the same time, (32) shows that with an interior value of p^m , this value will be smaller, the greater is the cost of information exchange c . We state this finding as

PROPOSITION 5. The existence of linear costs of information collection (and exchange) in the host country *ceteris paribus* reduces the effective tax on foreign deposits (if this tax is lower than the first best level).

6 Mixed regimes

So far we have assumed that both countries are committed to either a regime of withholding taxes, or a regime of information exchange. The Commission proposal of 1998, however, gives countries a choice between either withholding taxes or information exchange. If the proposal is enacted, then the noncooperative game among the European nations can be seen to have two stages. At the first stage, the countries choose between withholding taxes or information exchange. At the second stage, countries either choose the withholding tax rate, if they have opted for the withholding tax regime, or the inspection intensity, if they have selected a regime of information exchange. In principle, the outcome of the first stage can be symmetric (i.e. all countries choosing either withholding taxes or information exchange), or the outcome can be asymmetric or mixed (with at least one country choosing withholding taxes, and at least one country choosing information exchange). If the 1998 proposal were to be enacted, the presumption is that Luxembourg will be among the countries imposing withholding taxes, while Britain will opt for information exchange. Hence, a mixed regime appears to be a real possibility.¹¹

This section briefly considers the case of mixed regimes. To do so, we would like to be able to derive analytically the selected tax levels under a mixed regime. Despite the simplicity of the underlying economic model, however, this problem and hence also the prior problem of regime selection is too complex to be analyzed analytically. Instead, in the next section we consider the issue of regime choice by simulation, after selecting numerical values for the parameters of our model. By varying model parameters, we present several illustrative examples of regime selection. Before doing so, however, we have to see how the welfares of the two countries depend on the chosen tax policies in a mixed regime (with one country setting the withholding tax, and the other country choosing its inspection intensity). This characterization of mixed regimes only goes so far as to enable subsequent simulations of the model.

¹¹As pointed out in the Introduction, the agreement at the European Council meeting in Portugal in June 2000 would also result in a mixed regime (at least for a time), if it is implemented.

As a convention, let the domestic country select the regime of withholding taxes, while the foreign country selects information exchange. In terms of the tax rates, the domestic choice variable thus is τ_w , while the foreign choice variable is τ_i^* . The social surpluses achieved by the two countries can be written as

$$S_w = i + (\rho - 1)t + \delta(\hat{h}_w^* - \hat{h}_i) - \rho(t - \tau_i^*)\hat{h}_i + \rho\tau_w\hat{h}_w^* + \beta(\hat{h}_i)^2/2 \quad (33a)$$

$$S_i^* = i + (\rho - 1)t + \delta(\hat{h}_i - \hat{h}_w^*) - \rho t\hat{h}_w^* + \beta(\hat{h}_w^*)^2/2 \quad (33b)$$

Some work goes to show that the no-cheating conditions facing the domestic and foreign country in this case can be written as follows

$$\rho(\tau_w^m - \tau_w^n)^2 \leq \Delta\tau_i^{*m}[(2\rho - 1)t + \delta - (\rho - 1/2)\tau_i^{*m}] \quad (34a)$$

$$\delta\tau_i^{*m} \leq \Delta\left[\frac{\tau_w^m - \tau_w^n}{2} + (t - \tau_w^n)(2\rho - 1)\right](\tau_w^m - \tau_w^n) \quad (34b)$$

The values of the tax rates τ_w^m and τ_i^{*m} which jointly satisfy the two no-cheating conditions with equality are the maximum sustainable tax rates for the mixed regime. The no-cheating conditions in (34a-b) are, by the way, special cases of the more general incentive compatibility constraints stated in the appendix.

This completes our description of the mixed regime with the domestic country selecting a withholding tax and the foreign country opting for information exchange. The other mixed regime with mirrored regime choices can be described analogously.

7 Simulations of regime selection

The simulation model, as the theoretical model, encompasses a three-stage decision process. Initially, each of the two countries selects either the withholding tax regime or information exchange. Each country chooses its regime, given the regime choice by the other country. With two countries, there are three possible outcomes: 2 pure regimes with both countries selecting either withholding taxes or information exchange, or the mixed regime. Next, countries choose their tax rates - an explicit withholding tax rates or an implicit tax rate in case of information exchange. Finally, private depositors choose the country of destination for their deposits - the home country or the foreign country (later we will introduce a third country into the simulations). In the symmetric two-country world, we are particularly interested in how regime selection and the subsequent

tax outcomes depend on (a) the common discount factor Δ , and (b) the relative size of the countries a .

Within each simulation round, we first compute the two countries' resulting taxes, international deposit pattern, and national welfare levels for the three possible regime outcomes (two pure regimes and the mixed regime). We then have countries choose their tax regimes. The simulations below demonstrate that all three regime outcomes are possible for varying parameter constellations.

Two-country simulations

The benchmark simulation is based on the following values of key model parameters: $\Delta = .1$, $a = 1$, $t = 0.03$, $\beta = 0.04$, $\delta = 0.005$, and $\rho = 1.4$ (see fn. 8 above). The first row of Table 1 now shows the common tax rates, deposit pattern, and national welfare levels with both countries opting for a withholding tax. The maximum sustainable withholding tax is shown to lie between the one-shot Nash tax and the residence-based tax so that some citizens deposit abroad. The second row of Table 1 instead gives the (implicit) tax rates, the deposit pattern, and welfare levels with both countries selecting information exchange. Finally, the third row presents variable values, if the home country chooses a withholding tax and the foreign country information exchange. A second mixed regime, with countries choosing alternative regimes, is completely analogous.

Table 2 summarizes, in game form, the welfare levels and tax rates in the two countries for the four possible regimes. Clearly, for the benchmark parameter values, the pure withholding tax regime and the pure information exchange regime are equilibria. Note, however, that the pure withholding tax regime yields higher welfare for both countries, and hence will be preferred.

Next, we consider how tax rates and welfare levels in the two pure regimes depend on (a) the discount factor, and (b) the relative size of the home country. From Table 3, we see that for somewhat higher discount rates than the benchmark value, the pure information regime implies higher taxes and higher welfare levels than the pure withholding tax regime. To see why, remember that a deviation from the sustainable tax level by one country in the information exchange regime is followed by the subsequent withholding of all information by the other country. This is a rather harsh punishment causing a sharp decline in welfare levels. The threat of this severe punishment works well with a relatively high discount factor. The pure information exchange regime, therefore, is preferred for a relatively high discount factor. To illustrate, Table 4 represents the two countries'

welfare levels, in game form, for a discount factor of $\Delta = 0.15$.¹² As in Table 2, the pure regimes (of withholding taxes and information exchange) are both equilibria. Now the pure information exchange regime, however, yields higher welfare, and is preferred.

Next, we examine how relative country size matters. Table 3 now shows that the larger of two countries selects the higher tax rate. Moreover, the large country's tax rate increases with its relative size, and vice versa. How does relative size affect the regime choice? To see this, we take the particular example where the domestic country is 10 times as large as the foreign country, i.e. $a = 10$ (keeping other parameters as in the benchmark simulation). Table 5 gives the relevant welfare levels and tax rates in game form, immediately yielding that the larger (smaller) country chooses information exchange (a withholding tax). This mixed regime corresponds to actual international practice where countries rely on withholding taxes and information exchange to different extents. Also, it is consistent with the view that the Commission proposal, if adopted, would cause Britain and Luxembourg to opt for information exchange and a withholding tax, respectively.

Why do the two countries of different size end up with this particular mixed regime? The easy part is to understand that the smaller country, with large incoming financial flows, adopts a withholding tax yielding significant tax revenues. But why does the large country opt for information exchange? The key insight here is that the large country's main interest is to ensure that the small country levies a relatively high withholding tax. To enforce this, the large country needs to be able to punish the small country severely, if the small country deviates from an 'agreed' high withholding tax. By selecting the information exchange regime, the large country can mete out the largest punishment possible, i.e. to withhold all information from the small country. By selecting the information exchange regime, the large country, of course, foregoes some withholding tax revenues. These foregone tax revenues, however, are relatively minor, as deposit flows from the small country to the large country are only modest.

Simulations with the three-country model

How are the simulations affected by the existence of a third-country threat? To investigate this, we assume a benchmark transaction cost of $\gamma = 0.1$ associated with deposits in the third country. Further, in the benchmark model we raise the value of the

¹²The level of this and other discount factors should not be taken too seriously. Despite the selection of sensible values of other model parameters, model specifics have the effect of rendering the relevant values of discount factors quite small.

discount factor, Δ , from 0.1 to 0.15 to ensure that there will be meaningful maximum sustainable tax rates.¹³ Otherwise, benchmark parameters are as before.

Table 6 presents the computed tax rates, portfolio allocations, and welfare levels for benchmark parameter values for the different regimes (analogously to Table 2). In this benchmark simulation, maximum sustainable tax rates are shown to be relatively high under the withholding tax regime. Next, Table 7 represents simulation results for varying levels of the discount rate Δ , the size parameter a , and the transaction cost parameter γ . In the first three rows, we see that the maximum sustainable tax rate in the information exchange regime is zero with $\Delta = 0.1$, while it has reached the cooperative level with $\Delta = 0.3$. In the next three rows, a larger relative size of the domestic country is shown to raise (lower) the domestic (foreign) country's effective tax rate in either regime. Finally, the last three rows illustrate that a higher transaction cost parameter γ occasions higher taxes and surplus levels in both partner countries. Analogously, we showed in section 3 that the presence of a third country tends to lower all tax rates (i.e. one-shot Nash rates, cooperative rates, as well as the maximum sustainable tax rates).

Turning to regime choice, we see that similar possibilities as in the two-country model emerge. Specifically, in the benchmark simulation the two countries will select the withholding tax regime (see Table 8). Raising the discount factor to 0.20, we find instead that the two pure regimes both are possible equilibria, with the information regime generating higher taxes and surpluses (see Table 9). Finally, we make the domestic country ten times as large as the foreign country, i.e. ($a = 10$). Then the mixed regime with the domestic (foreign) country opting for information exchange (a withholding tax) is shown to be the equilibrium regime (see Table 10). Hence, with a third country threat, the two partner countries may still select either pure regime or the mixed regime as the actual regime.

8 Conclusions

With increasing ease, residents of any EU country can deposit funds in the banking system of any other EU country, or alternatively acquire financial assets issued in another EU country. As the returns to these placements are difficult to monitor by domestic authorities, EU countries find it increasingly difficult to tax cross-border interest flows.

¹³Note that eq. (26) implies that higher discount factors are needed to generate non-zero maximum sustainable tax rates under information exchange with γ being finite (as opposed to γ being infinite as in the two-country model).

Worried about this state of affairs, the European Commission has put forth a proposal requiring each EU member state to either levy a withholding tax (of at least 20 percent) on intra-European interest flows or provide information on these flows to other tax authorities.

This proposal has rekindled a debate that was put on hold after a previous Commission proposal (in 1989) on the taxation of interest in Europe failed to gain the required approval of all member states. The previous proposal called for a minimum withholding tax of 15 percent on cross-border interest flows, while countries had a choice between such a withholding tax or requiring the (internal) provision of information by paying agents (such as banks) on intra-national interest flows. At this point, it is too early to say whether the current proposal will be acceptable to member states. Regardless, sooner or later Europe is likely to coordinate its approach to taxing cross-border interest flows, and as mentioned in the Introduction the first step may well have been taken in the European Council meeting in Portugal in June 2000.

This paper focuses on the distinguishing feature of the Commission proposal of 1998, i.e. each country's choice between a nonresident withholding tax and information exchange. Following this regime choice, countries are engaged in a repeated game as to the tax policies within the chosen regimes. Interestingly, each country choosing either a withholding tax or information exchange, or countries choosing different regimes can all be equilibrium outcomes. Both countries choosing information exchange is preferred to both countries choosing withholding taxes, if there is relatively little discounting of the future. In that instance, information exchange performs relatively well, as the threat of not supplying any information at all then works to enforce a tax equilibrium with a relatively high taxation of interest. Thus this paper demonstrates that information exchange may be a desired feature of the taxation of international interest flows. Information exchange, to some extent, repairs a residence-based taxation of interest. Such residence-based taxation, for low enough discounting, is superior to source-based interest taxation through nonresident withholding taxes.¹⁴

A mixed regime with (at least) one country choosing a withholding tax and (at least) one country choosing information exchanges can materialize, if countries differ significantly in size. Specifically, the smaller country chooses a withholding tax, while the larger country selects information exchange. Coordination of the taxation of international interest

¹⁴Moreover, unlike withholding taxes information exchange allows for progressive taxation of foreign-source interest income.

flows thus does not have to lead to an international harmonization of regimes. The menu approach, implicit in the current European Commission proposal, may indeed provide gains from cooperation with relatively small constraints on national tax policy.

The basic symmetric, two-country model of this paper is highly simplified. To add realism, several complicating factors have to be considered. Some of these, such as the presence of third countries and costs of exchanging information, are analyzed as extensions to the basic model. Outside countries and information costs both make it more difficult to maintain high levels of interest taxation for the inside countries.

In addition, there are other, more practical, difficulties to taxing interest that require attention.¹⁵ The evasion of interest taxation on essentially intra-European interest by channeling the interest through third countries, for instance, has to be counteracted. Information exchange, if adopted, further requires considerable investments in information technology. Declining costs of computing and communication, however, now make comprehensive information exchange a more realistic option than, say, ten years ago. Finally, there remain conceptual issues as to the definition of interest. Financial innovations, for instance in the area of derivatives, pose new definitional problems. Such challenges, of course, are not particular to the taxation of international interest flows. The roadblocks to an effective taxation of international interest flows, clearly, are manifold. International cooperation, either explicit or implicit, can have a place in overcoming these roadblocks.

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Appendix

Proof of proposition 4:

We start with the case of withholding taxes. We are interested in the constraints on τ_w^m and τ_w^{*m} implied by (11) for the two countries, as suitably adjusted for the size parameter a . As we take the case where a goes to infinity, we can ignore terms that are not proportional to a . Then we find the incentive compatibility constraints of the domestic and countries after dividing by a to be equivalent to

$$\Delta(\tau_w^{*m} - \tau_w^{*n})[\delta + \rho t + \frac{\tau_w^{*m} + \tau_w^{*n}}{2\beta}] \geq 0 \quad (A1)$$

$$\Delta(\tau_w^{*m} - \tau_w^{*n})[t\rho - \delta - \rho(\tau_w^{*m} + \tau_w^{*n})] \geq (1 - \Delta)\rho(\tau_w^{*m} - \tau_w^{*n})^2 \quad (A2)$$

It is immediately clear that there is no constraint on τ_w^m . Assuming $\tau_w^{*m} - \tau_w^{*n} > 0$, the foreign-country constraint (A2) becomes

$$\Delta[t\rho - \delta - \rho(\tau_w^{*m} + \tau_w^{*n})] \geq (1 - \Delta)\rho(\tau_w^{*m} - \tau_w^{*n}) \quad (A3)$$

Note that $\tau_w^{*m} > \tau_w^{*n}$ implies $\tau_w^{*m} + \tau_w^{*n} > 2\tau_w^{*n} = t - \delta/\rho$ which would be a violation of (A3). Therefore, (A2) can only meet if $\tau_w^{*m} = \tau_w^{*n}$. To summarize, we get $\tau_m = t$ and $\tau_w^{*m} = \tau_w^{*n}$.

Turning to the case of information exchange, the two constraints as in (16) for a going to infinity are equivalent to

$$\Delta\tau_i^{*n} + (\rho - 1/2)\tau_i^{*m}(2t - \tau_i^{*m}) \geq 0 \quad (A4)$$

$$-\Delta\delta\tau_i^{*m} \geq (1 - \Delta)\delta\tau_i^{*m} \quad (A5)$$

Both equations can only be satisfied jointly if $\tau_i^{*m} = 0$, while there is no constraint on τ_i^{*n} . The foreign country thus provides no information, while the domestic country provides a level of information corresponding to the cooperative outcome.

General formulation of no-cheating constraints

In the following, we list the general representations of the no-cheating (or incentive compatibility, i.e. IC) constraints associated with implicit coordination in the repeated game setting. The relevant taxes τ^m and τ^{*m} (withholding tax or implicit tax corresponding to information exchange) have to fulfill the two IC constraints applicable to the relevant regime in question. We consider all four regimes in turn: IE-IE, WT-WT, WT-IE, IE-WT (WT for withholding tax, IE for information exchange). The specification of the IC constraints takes into account possible differences in size – the parameter a may be greater than one – as well as a possible third-country threat – the parameter γ may be finite. Selecting $a = 1$ and/or γ approaching infinity will deliver simpler symmetric and/or two-country variants of the general model.

1. The pure IE-IE regime

$$\Delta a\tau^{*m}[\delta + (\rho - 1/2)(2t - \frac{\gamma}{\gamma - \beta}\tau^{*m})] \geq \frac{\gamma}{\gamma - \beta}\delta\tau^m \quad (1IC)$$

$$\Delta\tau^m[\delta + (\rho - 1/2)(2t - \frac{\gamma}{\gamma - \beta}\tau^m)] \geq \frac{a\gamma}{\gamma - \beta}\delta\tau^{*m} \quad (1IC^*)$$

2. The pure WT-WT regime

$$\Delta a(\tau^{*m} - \tau^{*n})\left[\left(2 - \frac{\beta}{\gamma}\right)\rho - 1\right)t - \left(2\rho - \frac{\gamma}{\gamma - \beta}\right)\tau^{*n} + \frac{\gamma}{\gamma - \beta} \frac{\tau^{*m} - \tau^{*n}}{2}\right] \geq (\tau^m - \tau^n)^2 \frac{\rho\gamma}{\gamma - \beta} \quad (2IC)$$

$$\Delta(\tau^m - \tau^n)\left[\left(2 - \frac{\beta}{\gamma}\right)\rho - 1\right)t - \left(2\rho - \frac{\gamma}{\gamma - \beta}\right)\tau^n + \frac{\gamma}{\gamma - \beta} \frac{\tau^m - \tau^n}{2}\right] \geq a(\tau^{*m} - \tau^{*n})^2 \frac{\rho\gamma}{\gamma - \beta} \quad (2IC^*)$$

3. The mixed WT-IE regime

$$\Delta a\tau^{*m}\left[\delta + (\rho - 1/2)(2t - \frac{\gamma}{\gamma - \beta}\tau^{*m})\right] \geq (\tau^m - \tau^n)^2 \frac{\rho\gamma}{\gamma - \beta} \quad (3IC)$$

$$\Delta(\tau^m - \tau^n)\left[\left(2 - \frac{\beta}{\gamma}\right)\rho - 1\right)t - \left(2\rho - \frac{\gamma}{\gamma - \beta}\right)\tau^n + \frac{\gamma}{\gamma - \beta} \frac{\tau^m - \tau^n}{2}\right] \geq \frac{a\gamma}{\gamma - \beta} \delta\tau^{*m} \quad (3IC^*)$$

4. The mixed IE-WT regime

$$\Delta a(\tau^{*m} - \tau^{*n})\left[\left(2 - \frac{\beta}{\gamma}\right)\rho - 1\right)t - \left(2\rho - \frac{\gamma}{\gamma - \beta}\right)\tau^{*n} + \frac{\gamma}{\gamma - \beta} \frac{\tau^{*m} - \tau^{*n}}{2}\right] \geq \frac{\gamma}{\gamma - \beta} \delta\tau^m \quad (4IC)$$

$$\Delta\tau^m\left[\delta + (\rho - 1/2)(2t - \frac{\gamma}{\gamma - \beta}\tau^m)\right] \geq a(\tau^{*m} - \tau^{*n})^2 \frac{\rho\gamma}{\gamma - \beta} \quad (4IC^*)$$

It is interesting to note that the above formulation of IC conditions implies that the IC conditions of the mixed regimes themselves are mixtures of elements of the IC conditions pertaining to the two pure regimes.

Figure 1: Tax rates as functions of the common discount factor

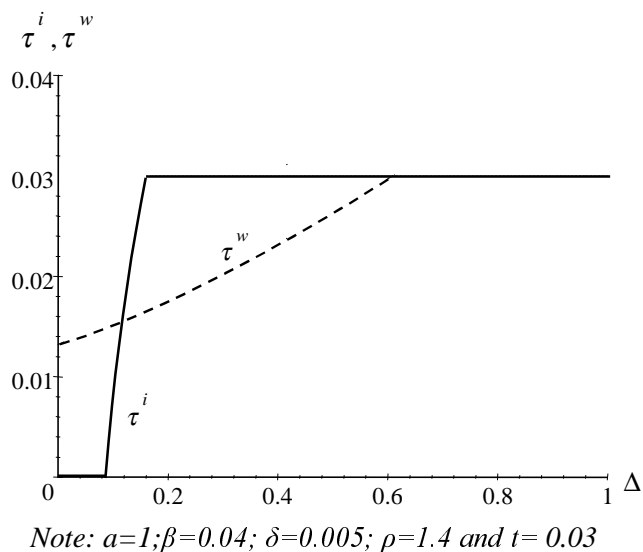


Table 1: Comparisons of alternative regimes

Tax regime	One-shot Nash		Max. sust. tax rate		Foreign placements		Welfare	
	τ^n	τ^{*n}	τ^m	τ^{*m}	\hat{h}	\hat{h}^*	S	S^*
WT - WT	0.01321	0.01321	0.01545	0.01545	0.36369	0.36369	0.06724	0.06724
IE - IE	0	0	0.01	0.01	0.05000	0.05000	0.06300	0.06300
WT - IE	0.01321	0	0.01580	0.00163	0.70920	0.35490	0.05998	0.06138

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, \Delta = 0.1$.

Table 2: Simulation with symmetric countries

		Foreign	
		WT	IE
Domestic	WT	0.06724 [0.01545]	0.06138 [0.00163]
	IE	0.05998 [0.01580]	0.06300 [0.0100]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 1, \Delta = 0.1$.
Numbers indicate social surplus, obtained using the tax in brackets.

Table 3: Selected further simulation results

WT-WT Regime								IE-IE Regime					
<i>Rel. size</i>	<i>Discount factor</i>	<i>One-shot Nash</i>		<i>Max. sust. tax rate</i>		<i>Welfare</i>		<i>One-shot Nash</i>		<i>Max. sust. tax rate</i>		<i>Welfare</i>	
<i>a</i>	<i>S*</i>	τ^n	τ^{*n}	τ^m	τ^{*m}	<i>S</i>	<i>S*</i>	τ^n	τ^{*n}	τ^m	τ^{*m}	<i>S</i>	<i>S*</i>
1	0.05	0.01321	0.01321	0.01431	0.01431	0.06605	0.06605	0	0	0.0	0.0	0.05175	0.05175
1	0.10	0.01321	0.01321	0.01545	0.01545	0.06724	0.06724	0	0	0.01	0.01	0.06300	0.06300
1	0.15	0.01321	0.01321	0.01663	0.01663	0.06798	0.06798	0	0	0.02852	0.02852	0.07195	0.07195
.	0.20*	0.01321	0.01321	0.01786	0.01786	0.06869	0.06869	0	0	0.03	0.03	0.07200	0.07200
.	0.30*	0.01321	0.01321	0.02047	0.02047	0.06995	0.06995	0	0	0.03	0.03	0.07200	0.07200
.	0.40*	0.01321	0.01321	0.02329	0.02329	0.07099	0.07099	0	0	0.03	0.03	0.07200	0.07200
.	0.50*	0.01321	0.01321	0.02635	0.02635	0.07170	0.07170	0	0	0.03	0.03	0.07200	0.07200
.	0.60*	0.01321	0.01321	0.02969	0.02969	0.07199	0.07199	0	0	0.03	0.03	0.07200	0.07200
.	0.70*	0.01321	0.01321	0.03	0.03	0.07200	0.07200	0	0	0.03	0.03	0.07200	0.07200
2	0.10	0.01321	0.01321	0.01603	0.01500	0.12395	0.07861	0	0	0.01346	0.00631	0.11489	0.06970
5	0.10	0.01321	0.01321	0.01704	0.01454	0.29346	0.11463	0	0	0.01630	0.00289	0.26209	0.08301
10	0.10	0.01321	0.01321	0.01804	0.01427	0.57519	0.17868	0	0	0.01736	0.00151	0.50328	0.10245
20	0.10	0.01321	0.01321	0.01932	0.01407	1.13758	0.31620	0	0	0.01792	0.00076	0.98391	0.14028

Note: * Indicates that for these values of the discount factor, the maximum sustainable tax rate corresponds to the residence-based tax, $t=0.03$, in the *IE-IE* regime. Parameter values: $\beta = 0.04$, $\delta = 0.005$, $i = 0.06$, $\rho = 1.4$.

Table 4: Simulation with symmetric countries: higher discount factor

		Foreign	
		<i>WT</i>	<i>IE</i>
Domestic	<i>WT</i>	0.06798 [0.01663]	0.06358 [0.00569]
	<i>IE</i>	0.06437 [0.01894]	0.07195 [0.02852]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 1, \Delta = 0.15$.
Numbers indicate social surplus, obtained using the tax in brackets.

Table 5: Simulation with asymmetric countries:

		Foreign	
		<i>WT</i>	<i>IE</i>
Domestic	<i>WT</i>	0.17868 [0.01427]	0.09518 [0.00017]
	<i>IE</i>	0.57519 [0.01804]	0.49208 [0.01587]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 10, \Delta = 0.1$.
Numbers indicate social surplus, obtained using the tax in brackets.

Table 6: Comparisons of alternative regimes: three countries

Tax regime	One-shot Nash		Max. sust. tax		Foreign placements				Welfare	
	τ^n	τ^{*n}	τ^m	τ^{*m}	\tilde{h}	\hat{h}	\tilde{h}^*	\hat{h}^*	S	S^*
WT - WT	0.00721	0.00721	0.00919	0.00919	0.15310	0.52036	0.15310	0.52036	0.06022	0.06022
IE - IE	0	0	0.00230	0.00230	0.03827	0.69259	0.03827	0.69259	0.05446	0.05446
WT - IE	0.00721	0	0.00925	0.00113	0.01878	0.72183	0.15419	0.51871	0.05616	0.05723

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, \Delta = 0.15$, and $\gamma = 0.1$. The cooperative tax rate is, in all regimes, $\tau^c = 0.01689$.

Table 7: Selected simulations: three countries

				<i>WT-WT Regime</i>						<i>IE-IE Regime</i>					
<i>Rel. size</i>	<i>Discount factor</i>	<i>Tr. c. to third ctr.</i>	<i>Cooperative tax</i>	<i>One-shot Nash</i>		<i>Max. sust. tax rate</i>		<i>Welfare</i>		<i>One-shot Nash</i>		<i>Max. sust. tax rate</i>		<i>Welfare</i>	
<i>a</i>	Δ	γ	τ^c	τ^n	τ^{*n}	τ^m	τ^{*m}	S	S^*	τ^n	τ^{*n}	τ^m	τ^{*m}	S	S^*
1	0.10	0.1	0.01689	0.00721	0.00721	0.00850	0.00850	0.05981	0.05981	0	0	0	0	0.05175	0.05175
1	0.15	0.1	0.01689	0.00721	0.00721	0.00919	0.00919	0.06022	0.06022	0	0	0.00230	0.00230	0.05446	0.05446
1	0.30	0.1	0.01689	0.00721	0.00721	0.01139	0.01139	0.06131	0.06131	0	0	0.01689*	0.01689*	0.06245	0.06245
1	0.15	0.1	0.01689	0.00721	0.00721	0.00919	0.00919	0.06022	0.06022	0	0	0.00230	0.00230	0.05446	0.05446
5	0.15	0.1	0.01689	0.00721	0.00721	0.01058	0.00839	0.27128	0.08836	0	0	0.00380	0.00073	0.24824	0.07105
10	0.15	0.1	0.01689	0.00721	0.00721	0.01147	0.00816	0.53427	0.12295	0	0	0.00411	0.00039	0.48860	0.09011
1	0.15	0.07	0.01127	0.00464	0.00464	0.00599	0.00599	0.05696	0.05696	0	0	0	0	0.05175	0.05175
1	0.15	0.15	0.02126	0.00921	0.00921	0.01167	0.01167	0.06280	0.06280	0	0	0.01104	0.01104	0.06241	0.06241

Note: Parameter values: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4$. The cooperative tax is a function of γ .

* At this level of the discount factor, countries choose the cooperative tax level in the information exchange regime.

Table 8: Simulation with 3 symmetric countries:

		Foreign	
		<i>WT</i>	<i>IE</i>
Domestic	<i>WT</i>	0.06022 [0.00919]	0.05723 [0.00113]
	<i>IE</i>	0.05616 [0.00925]	0.05446 [0.00230]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 1, \Delta = 0.15,$
and $\gamma = 0.1$. Numbers indicate social surplus, obtained using the tax in
brackets.

Table 9: Simulation with 3 symmetric countries: higher
discount factor

		Foreign	
		<i>WT</i>	<i>IE</i>
Domestic	<i>WT</i>	0.06061 [0.00989]	0.05822 [0.00278]
	<i>IE</i>	0.05783 [0.01083]	0.06138 [0.01156]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 1, \Delta = 0.2,$
and $\gamma = 0.1$. Numbers indicate social surplus, obtained using the tax in
brackets.

Table 10: Simulation with 3 asymmetric countries:
different sizes

		Foreign	
		<i>WT</i>	<i>IE</i>
Domestic	<i>WT</i>	0.12295 [0.00816]	0.09102 [0.00012]
	<i>IE</i>	0.12442 [0.00882]	0.09011 [0.00039]

Note: $\beta = 0.04, \delta = 0.005, i = 0.06, \rho = 1.4, t = 0.03, a = 10, \Delta = 0.15,$
and $\gamma = 0.1$. Numbers indicate social surplus, obtained using the tax in
brackets.