DISCUSSION PAPER

Risk Diversification and Tax Competition

The Influence of Risk Correlations and Tax Provisions on Tax Competition

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Preferential Trade Agreements: The Case of EU-Mexico

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Abstract

From standard-portfolio-models the authors derive demand elasticities for risky assets, and combine the results with a simple non-cooperative model of tax competition between capital importing countries. They find that tax rates resulting from tax competition depend heavily on the correlations of capital market indices. If investment alternatives are not correlated, the outcome of both tax competition and a cooperative solution of tax harmonization are identical. The results suggest regional cooperation among capital importing countries. Compared to the exemption method provisions like tax sparing aggravates the harms of tax competition.

Zusammenfassung

Die Autoren leiten aus dem Standard-Portfolio-Modell Nachfrageelastizitäten nach riskanten Anlagealternativen her und bringen diese in ein einfaches nicht-kooperatives spieltheoretisches Modell zum Steuerwettbewerb zwischen kapitalimportierenden Ländern ein. Wie sich zeigt, hängen die vom Steuerwettbewerb hervorgebrachten Steuersätze stark von den Korrelationen der Marktindices ab. Sind diese nicht korreliert, bringt der Steuerwettbewerb das gleiche Ergebnis hervor wie die kooperative Lösung einer Steuerharmonisierung. Die Ergebnisse liefern ferner Argumente für die regionale Kooperation kapitalimportierender Länder.

Zudem wird gezeigt, dass die fiktive Anrechnung ausländischer Quellensteuern den Steuerwettbewerb verschärft.

JEL classification: H 3, G 1

1. INTRODUCTION

Frequently, information concerning increasing international portfolio investment, especially in Emerging Markets, and worries about tax competition come together. The key word is increasing international capital mobility. Since tax policy should pay regard to different degrees of capital mobility, elasticities of substitution measuring the degree of capital mobility, and demand elasticities with respect to taxes determining the magnitude of tax induced capital flows, deserve special attention.

This paper brings together the idea of risk diversification and international tax competition.[1] We focus on two questions: Which parameters determine the degree of demand elasticities with respect to taxes in a framework of risk diversification? And, how do different degrees of elasticity and different methods for the elimination of international taxation influence the outcome of tax competition?

The structure of the paper is as follows: In Section 2 we model international capital flows using the tools of a simple portfolio model and derive elasticities. Section 3 gives an overview of different methods for the elimination of international double taxation. In Section 4, we first consider the interaction between states to be competitive, and compare the outcome with coordinated tax policies, emphasizing capital market correlations.

2. THE DEMAND FOR RISKY ASSETS AND TAXATION

To analyze the impact of taxation on capital flows in a framework of risky assets we introduce a simple model with linear reaction of capital flows to changes in tax rates. In this simple model there are two identical capital importing countries A and B. Their autonomous capital inflows, depending on other factors than taxation, are equal and nominated F. The influence of taxation is introduced through coefficients e and c representing the reaction to the own tax rate, and reactions resulting from the tax rate of the second country, respectively. These interactions are summarized by equations (1)

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1 Literature on international capital income taxation often neglects risk diversification, and assumes that capital is perfectly mobile across countries (see Frenkel, Razin, Sadka [1991], Tanzi [1995], or Devereux [1995] who briefly reviews some of the theoretical literature). Central results are such that a process of competition will leave capital income tax rates too low, compared to an efficient outcome. However, Gordon, Varian (1989) and Werner (1994) and others stress that stochastic structure of returns to investment are important for understanding international spillover effects.

(1a) $F_A^{\,t} = F - e\, t_A^{\,t} + c\, t_B^{\,t}$

(1b) $F_B^{\,t} = F - e\, t_B^{\,t} + c\, t_A^{\,t}$

where F_i^t represents capital flows into country i, and t_i^t total tax burdens on capital income from investment in country i, with $0 \leq t_A^{\,t}, t_B^{\,t} < 1$. We assume that the tax within the country has a greater influence on its capital inflows than taxation of other countries, thus $|e| > |c|$.

To show that our simple model is adequate, we compare it to the Standard Portfolio Model[1] that is used to describe investment decisions in case of risky assets and risk averse investors. While we are interested in capital flows, portfolio models describe portfolio positions. However as long as we consider only one period of time, capital flows result in stocks of identical size. Hence, there is no problem dealing with portfolio positions of a representative investor instead of capital flows. Our investor has the choice between one riskless asset at home and two risky assets, each of them representing the market index one of the capital importing countries A and B.

When returns are taxed, the (absolute) portfolio position F_i^t in (risky assets of) one market (A or B respectively) can be described by the following equation[2]:

(2) $$F_A^{\,t} = \gamma\, r \frac{1-\rho}{\sigma^2 (1-\rho^2)} - \gamma\, r \frac{1}{\sigma^2 (1-\rho^2)}\, t_A^{\,t} + \gamma\, r \frac{\rho}{\sigma^2 (1-\rho^2)}\, t_B^{\,t}$$

with γ being the investor's risk aversion coefficient, r expected returns[3] in both markets, ρ the correlation coefficient of market returns, and σ^2 the variance of returns.

The first term on the right hand side of equation (2) describes the portfolio position of country A that would have been realized without taxation. It is supposed to be proportional to the world capital market share of A. This corresponds to our autonomous capital inflows to country A as described by $F_A^{\,t}$ in equation (1a). The two other terms on the right hand side of equation (2) describe the departure from this particular portfolio

1 This Portfolio Model is the basis for the Capital Asset Pricing Model. See Mathematical Appendix.

2 See Mathematical Appendix. We assumed both countries to be identical in expected returns and return variances, but not in tax rates.

3 E.g. dividends, we assume that the investment of foreigners is small compared to the market size, i.e. foreign investors are price takers.

allocation due to taxation. Hence, according to the portfolio model, coefficients *e* and *c* of our simple model are defined as:

(3) $$e := \gamma\, r \frac{1}{\sigma^2 (1-\rho^2)} \geq 0$$

(4) $$c := \gamma\, r \frac{\rho}{\sigma^2 (1-\rho^2)}$$

While $e \geq 0$ always holds for reasonable variables, one might expect the sign of *c* to be positive as well. However, *c* takes the sign of ρ which is the correlation coefficient of both markets that can be either positive, negative or zero.

For simpler notations, we use *e* in the following equations and substitute *e* by term (3), only when we do the interpretation of our results. Since $c = \rho\, e$ and $F = (1-\rho)\, e$, we can simplify equations (1):

(5a) $$F_A^t = e\,(1-\rho - t_A^t + \rho\, t_B^t)$$[1]

(5b) $$F_B^t = e\,(1-\rho - t_B^t + \rho\, t_A^t)$$

As expected, when taxation of returns of assets in *A* decreases, investment in that country increases:

(6) $$\frac{\delta F_A^t}{\delta t_A^t} = -\,e < 0$$

The further interpretation of equation (2) and (5) is somewhat surprising. We see that for the determination of the cross effect of taxation, the stochastic structure of asset returns in both markets is crucial. The cross effect of taxation can be either zero, positive or negative:

(7) $$\frac{\delta F_A^t}{\delta t_B^t} = \rho\, e$$

1 F_A^t can become negative if ρ is high and t_B is smaller than t_A. Since an investor cannot hold negative stocks in a country, $F_i^t \geq 0$ creates a lower bound.

When both markets are positively correlated, they are considered to be substitutes. A cut in taxation in one country decreases the demand for assets from the other country. This is the expected outcome. When ρ is zero, and one country cuts its taxes there is no reaction in flows of the other asset. However, when ρ is negative - both markets are complements in a sense of diversification - and country B cuts its taxes, assets from country A become more attractive in absolute terms, too.

How can we explain this somewhat surprising result? With a cut in taxation of risky assets in one country, the risky portfolio as such gets more attractive compared to the riskless asset. Consequently, the investor decreases investment in the riskless asset and increases his risky portfolio as such. Risk diversification suggests that it is optimal to hold risky assets in a certain relation, especially when they are complements. To hold on to an optimal relation of risky assets the investor should invest more in the second asset as well. Despite the fact that taxation changes that relation, too, the increase of the risky portfolio as such might be large enough to compensate this opposite effect.

Defining country *A*'s share of portfolio capital as

$$(8) \qquad f_A{}^t := \frac{F_A{}^t}{F_A{}^t + F_B{}^t} \,,$$

relative portfolio positions are

$$(9) \qquad \frac{f_A{}^t}{f_B{}^t} = \frac{F_A{}^t}{F_B{}^t} = \frac{1-\rho - t_A{}^t + \rho t_B{}^t}{1-\rho - t_B{}^t + \rho t_A{}^t}$$

We can determine how the relative allocation within the risky portfolio changes. For the first derivative of (9) with respect to $t_B{}^t$, we get:

$$(10) \qquad \frac{\delta\left(\frac{f_A{}^t}{f_B{}^t}\right)}{\delta t_B{}^t} = \frac{(1-\rho^2)(1-t_A{}^t)}{(1-\rho - t_B + \rho t_A)^2} > 0 \,.$$

We see that an increase of taxation in *B* leads unambiguously to a portfolio reallocation in favor of A. Hence, the relative effect, i.e. the reallocation among the risky assets, is exactly as expected.

The effects of the different signs of ρ are summarized in Table 1.

Table 1

	$\rho < 0$	$\rho = 0$	$\rho > 0$
$\frac{\delta F_i^t}{\delta t_i^t}$	< 0	< 0	< 0
$\frac{\delta F_i^t}{\delta t_j^t}$	< 0	$= 0$	> 0
$\frac{\delta\ (F_i^t / Fj^t)}{\delta t_i^t}$	< 0	< 0	< 0
$\frac{\delta\ (F_i^t / Fj^t)}{\delta t_j^t}$	> 0	> 0	> 0

Capital importing countries are not interested in relative shares of world capital flows, but in information concerning absolute capital inflows to determine tax induced changes in expected revenue or welfare. From (5), (6), and (7) we derive the elasticities of capital flows with respect to total tax burdens:

(11a) $$\frac{\delta F_A^t / \delta t_A^t}{F_A^t / t_A^t} = -\frac{t_A^t}{1-\rho-t_A^t+\rho t_B^t}$$

(11b) $$\frac{\delta F_A^t / \delta t_B^t}{F_A^t / t_B^t} = \frac{\rho\, t_B^t}{1-\rho-t_A^t+\rho t_B^t}$$

Equations (11a) and (11b) show how the stochastic structure determines elasticity[1], and – more crucially – the sign of the cross elasticity.

1 Comparing with (5a), we see that, as expected, this elasticity shows a negative sign for relevant positive values of F_A^t.

3. INTERNATIONAL DOUBLE TAXATION

So far, we concentrated on total tax burdens and portfolio allocation. However, in the context of cross border investment, capital income can be taxed in two countries, and different modi for the elimination of international double taxation apply. While withholding taxes of capital importing countries are crucial for their level of expected tax revenue, they are not necessarily identical with total tax burdens affecting the capital flows. We therefore take a closer look at total tax burdens t_A^t and t_B^t, to find out, to what extent capital importing countries can actually control them. In the following, we analyze the relationship between withholding taxes t_i^s, final tax burdens t_i^t, the allocation of cross border investment, and finally tax revenues.

The effect of withholding taxes t_i^s in country *i* is given by:

$$\frac{\delta F_i^t}{\delta t_i^s} = \frac{\delta F_i^t}{\delta t_i^t}\frac{\delta t_i^t}{\delta t_i^s} \tag{12}$$

The effect of withholding taxes on total tax burdens $\frac{\delta t_i^t}{\delta t_i^s}$ depends on the specific provision of the double taxation treaty (DTA)[1], if applicable, or national tax laws. There are three methods to avoid international double taxation on income from cross border investment: the ordinary credit, tax sparing, and the exemption method. The last method, however, normally does not apply to portfolio investment. Nevertheless we analyze this method, because of two reasons. First, it can also be interpreted as tax evasion by international investors. They pay withholding taxes in the host country and evade taxation in the country of residence. Second, for specific investors that are tax free in the country of residence – like American Pension Funds –, withholding taxes are final taxes.

3.1 Tax Provisions and Capital Flows

3.1.1 Exemption Method (EM) and Tax Evasion

The most generous approach to eliminate international double taxation is the application of the EM to foreign capital income. The country of residence completely exempts

1 For a commentary to model DTAs, see Vogel (1998).

repatriated foreign capital income from taxation.[1] However, in case of tax evasion it does so involuntarily. In this case the host country determines the final tax burden t_i^t. Thus in the case of EM, we have:

(13) $$t_i^t = t_i^s \Rightarrow \frac{\delta t_i^{\ t}}{\delta t_i^{\ s}} = 1$$

Equation (12) specifies as:

(14) $$\text{EM: } \frac{\delta F_i^t}{\delta t_i^{\ s}} = \frac{\delta F_i^t}{\delta t_i^{\ t}} < 0$$

Withholding tax reductions have the full effect on total tax burdens and may therefore influence the international allocation of capital.[2] Furthermore, the treasury of the host country receives all the tax revenue.

3.1.2 Ordinary Credit Method (CM)

Compared to the EM, ordinary tax credits for foreign withholding taxes are considered a less generous approach, because both the host and the residence country may tax cross border capital income. Generally, both countries share tax revenue.

At repatriation the capital owner receives from his home treasury a tax credit t^c for the withholding taxes t^s paid in the source country, $t^c = t^s$. If the tax of the residence country t^r exceeds that of the source country, i.e. $t^r > t^s$, the gap between the two is charged. As a consequence, all capital income – regardless of where it is generated – is taxed at the investor's residence income tax rate, the decision where to invest is not distorted by tax considerations.[3] To avoid exploitation by the source country, there is no reimbursement from the home treasury if the tax paid in the source country exceeds the one of the residence country (tax credit limitation: $t^c \leq t^r$). In this case the withholding tax is the

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1 It is possible to pay regard to the foreign income in the calculation of the progressive rate of the residence income taxation while exempting it from the tax base. To keep the analyses simple we neglect progressive taxation and assume proportional taxation.

2 If all investments taking place in one country are being taxed at the same rate, the application of this method fulfills the source principle and implies capital import neutrality.

3 The conditions of capital export neutrality are fulfilled if the tax base is calculated by the same principles in both countries.

final tax and the tax revenue accrues only to the treasury of the source country. In such a case CM economically acts as EM as analyzed in the previous section. Thus, in the proceedings of the analysis, when we speak about CM, we assume that $t^r > t^s$. The final tax for an investor then is:

(15) $t_i^t = t_i^s + t^r - t_i^c = t^r$

t^r : tax rate in the residence (capital exporting) country

The effect of ordinary credits on tax reductions in the source country is simple to illustrate: As long as $t_i^s \leq t^r$ any reduction in t_i^s by the source country is offset at repatriation of the capital income. The only effects of a tax incentive in the form of a lower t_i^s are an increase of the resident country's tax revenue and a decrease of the host country's tax revenue, while leaving the investor's total tax burden at t^r. The investor does not benefit from any tax reductions in the source country. Therefore, the host country has only a limited influence on the final tax burden of the investor, namely in the case where the withholding taxes exceed the taxes in the residence country and CM acts like EM.

We derive the following specifications of (12) for CM:

(16) CM: $$\frac{\delta t_i^{\,t}}{\delta t_i^{\,s}} = \frac{\delta t^{\,r}}{\delta t_i^{\,s}} = 0 \qquad \Rightarrow \frac{\delta F_i^{\,t}}{\delta t_i^{\,s}} = 0$$

Investors that are not obliged to pay taxes in their residence country, of course, cannot get tax credits for their foreign investment. Thus, these investors always react as if the EM would apply.

3.1.3 Tax Sparing (TS) and Matching Credits (MC)

TS and MC have effects that lie in between the two extremes of EM and CM. The (fictive) credit granted by the residence country t_i^f is fixed by treaty[1] and generally

1 The magnitude of the fictive tax credit t^f can be determined in different ways. The method has changed during the last decades: according to the oldest technique, the fictive tax rate was based on the residence income tax rate and was computed simply as a percentage thereof. According to another method (MC) the credit is a fixed percentage of capital income determined by treaty. With TS the magnitude of the actual tax credit is contingent on the prevailing tax rate in the source country, which would have been imposed if such tax had not been reduced by treaty or incentive program. In the following we do not make any distinction between tax sparing and matching credits. We therefore use the expression tax sparing (TS) for both methods. For details, see Dornelles (1989).

exceeds the withholding taxes t_i^s that have actually been paid by the source country. The credit t_i^f may exceed the maximal withholding tax that is agreed upon in the treaty. In such a case, investment in the capital importing country is subsidized even when this country levies the maximum withholding tax. As a consequence, changes of t_i^s affect t_i^t directly:[1]

$$t_i^t = t_i^s + t^r - t_i^f$$

(17) $$\Rightarrow \frac{\delta t_i^{\,t}}{\delta t_i^{\,s}} = 1 \qquad \text{for all } t_i^s,\ t_i^f \text{ and } t^r$$

This leads to the following specification of (12):

(18) $$\text{TS: } \frac{\delta F_i^{\,t}}{\delta t_i^{\,s}} = \frac{\delta F_i^{\,t}}{\delta t_i^{\,t}} < 0$$

3.2 Tax Provisions and Tax Revenue

While in case of exemption, the treasury of the host country receives all the tax revenue, in most other cases, the revenue is shared between both the capital importing and the capital exporting country. The distribution depends largely on the specific provision of the DTA and the withholding tax set by the capital importing country. However, under all three regimes the expected tax revenue R_A of the capital importing country A is the product of the withholding tax rate t_A^s, the expected return[2] on investment r and foreign capital F_A^t.

(19) $$R_A = t_A^s\, r\, F_A^t\, (t_A^t(t_A^s))$$

To see how withholding taxes t_A^s influence the tax revenue of country A, we take the first derivative of R_A with respect to t_A^s

(20) $$\frac{\delta R_A}{\delta t_A^{\,s}} = rF_A^{\,t}(t_A^{\,t}(t_A^{\,s})) + t_A^{\,s} r \frac{\delta F_A^{\,t}}{\delta t_A^{\,t}} \frac{\delta t_A^{\,t}}{\delta t_A^{\,s}}$$

---

1 As with CM, we assume that $t^r > t^s$.

2 We assume that both governments and representative investors have the same information and expectations concerning the return on investment.

The first term is the direct effect of the reduced rate with a constant tax base. It is always positive. The second term, describing the indirect effect of the reduced tax rate, is the more interesting part of the equation: For the tax revenue to increase with a tax rate reduction this second effect must be strongly negative and outweigh the first. The response of the tax base to changes in the tax rate must be large.

Hence, in the second part of the equation we have to make a distinction between very elastic and less elastic investment, and between different methods for the elimination of international taxation.

After rearranging equation (20), we find the following condition for maximum tax revenue:

(20*) $$\frac{\delta F_A^{\,t} / \delta t_A^{\,t}\ \delta t_A^{\,t} / \delta t_A^{\,s}}{F_A^{\,t} / t_A^{\,s}} = -1$$

To specify the result in (20), we combine our simple model with (5a) and equation (6) to get the following condition for the optimal withholding rate:

$$\frac{\delta R_A}{\delta t_A^{\,s}} = re(1-\rho-t_A^{\,t}\left(t_A^{\,s*}\right)+\rho t_B^{\,t}-t_A^{\,s*}\frac{\delta t_A^{\,t}}{\delta t_A^{\,s}}) \overset{!}{=} 0$$

$$\Rightarrow 1-\rho-t_A^{\,t}\left(t_A^{\,s*}\right)+\rho t_B^{\,t}-t_A^{\,s*}\frac{\delta t_A^{\,t}}{\delta t_A^{\,s}}=0$$

(21a) EM: $t_A^{s*} = \dfrac{1-\rho\left(1-t_B^t\right)}{2}$

(21b) CM: $t_A^{s*} = t^r$

(21c) TS: $t_A^{s*} = \dfrac{1-\rho\left(1-t_B^t\right)-\left(t^r - t^f\right)}{2}$

Only when both markets are completely uncorrelated, conditions in (21) do not depend on the tax rate of the second country. Furthermore, positive and negative correlation by the same magnitude do not lead to the same condition. And we see the difference between EM and TS: At the same given level of taxation in country *B* the optimal withholding tax rate of country *A* is smaller in case of TS than in case of EM.

3.3 Summary and Comparison

Since investment decisions are a function of after-tax returns, they are a function of withholding taxes only if these have an impact on final tax burdens.[1] Under the ordinary credit method capital importing countries often have no possibility to give tax incentives. In contrast to that, EM and TS ensure an impact of the host country's withholding taxes on total tax burdens. However, the distinction between EM and TS is important: in case of exemption a cut in t_i^s reduces final tax burdens by the same percentage and percentage points. Under TS the effect is different: as long as $t^r > t_i^f$, which can be assumed to be the standard case, a reduction of the withholding tax reduces the total tax burden by the same percentage points, but the proportional reduction is smaller.

Since we have $t_i^t = t^r - t_i^f + t_i^s$ elasticity, in this case, is:

$$\frac{\delta t_i^{\,t} / \delta t_i^{\,s}}{t_i^{\,t} / t_i^{\,s}} = \frac{t_i^{\,s}}{t^r - t_i^{\,f} + t_i^{\,s}} < 1$$

The results of this chapter are summarized in Table 2.

1 The actual extend of this theoretical effect will be the subject of a forthcoming empirical research by Reichl, who prepares an empirical study concerning withholding taxes and foreign portfolio investment in Emerging Markets.

Table 2

Impact of With-holding Taxes on	**1. Ordinary Credit**	**2. Matching Credit/ Tax Sparing**	**3. Exemption Method**
Total Tax Burden	$\delta t_i^t / \delta t_i^s = 0$	$\delta t_i^t / \delta t_i^s = 1$	$\delta t_i^t / \delta t_i^s = 1$
(*Elasticity*)	$\frac{\delta t_i^t / \delta t_i^s}{t_i^t / t_i^s} = 0$	$0 < \frac{\delta t_i^t / \delta t_i^s}{t_i^t / t_i^s} < 1$	$\frac{\delta t_i^t / \delta t_i^s}{t_i^t / t_i^s} = 1$
Capital Flows	$\frac{\delta F_i^t}{\delta t_i^s} = 0$	$\frac{\delta F_i^t}{\delta t_i^s} < 0$	$\frac{\delta F_i^t}{\delta t_i^s} < 0$
Tax Revenue in Source Country i	$\frac{\delta R_i}{\delta t_i^s} > 0$	$\frac{\delta R_i}{\delta t_i^s} = ?$	$\frac{\delta R_i}{\delta t_i^s} = ?$

Since under the ordinary credit regime, the capital importing country has no influence on total tax burdens of foreign investors, withholding taxes are not suitable as a variable in competition for capital inflows. If, however, the source country wants to maximize its tax revenue, it can do so by choosing the optimal withholding tax rate $t_i^s = t^r$. In all other cases, capital inflows are maximal, when the source country refrains from taxing foreign capital income. Since this imposes a reverse effect on revenue, the total effect of an increase of withholding taxes is ambiguous – represented by little question marks. Concerning the optimal withholding taxes for the maximized tax revenue, the solution depends largely on the stochastic structure of asset returns.

4. TAX COMPETITION

4.1 Capital Inflows, Revenue and Social Welfare

There are different ways by which capital inflows influence a country's welfare: One is the effect of tax revenue. The justification for regarding tax revenues as welfare increasing comes from the very general assumption that public goods are needed and the state is capable to provide them only by imposing taxes. We also consider other positive external effects of capital inflows on the economy of the host country. One of these could be the reduction of unemployment in an imperfect labor market. In terms of social welfare, positive external effects of an increase in foreign investment may compensate for a lower tax revenue, and vice versa. For an increase in social welfare in the capital importing country, at least one of the following necessary, but not sufficient conditions has to be met by policy measures: inflows or tax revenue have to increase.

Table 3
Welfare Effects of Foreign Investment and Tax Revenue

Foreign Investment / Tax Revenue	↑	0	↓
↑	+	+	?
0	+	0	-
↓	?	-	-

Elasticity requirements for welfare increasing tax cuts are summarized in Table 4.

Table 4
Effects of Tax Rate Reductions on Capital Inflows and Tax Revenue

	$\frac{\delta F_A^{\,t} / \delta t_A^{\,s}}{F_A^{\,t} / t_A^{\,s}} < -1$	$\frac{\delta F_A^{\,t} / \delta t_A^{\,s}}{F_A^{\,t} / t_A^{\,s}} = -1$	$-1 < \frac{\delta F_A^{\,t} / \delta t_A^{\,s}}{F_A^{\,t} / t_A^{\,s}} < 0$	$\frac{\delta F_A^{\,t} / \delta t_A^{\,s}}{F_A^{\,t} / t_A^{\,s}} = 0$
Capital Inflows	↑	↑	↑	**0**
Tax Revenue	↑	**0**	↓	↓
Welfare	+	+	**?**	-

As long as the elasticity of capital inflows with respect to withholding taxes is lower than -1, it is possible to increase both capital inflows and tax revenue by reducing the tax rate. Hence, there is no conflict between maximizing capital inflows and increasing the tax revenue, and vice versa. If the elasticity is between -1 and 0 a cut in taxes still leads to increased capital inflows. However, they are not strong enough to compensate for the lower tax rate. Revenues decline. In this case, a decision on policy measures can not be made without a social welfare function.

In the following model, all external effects of capital inflows on the economy of the host country are assumed to be proportional to these inflows. These effects are represented by the factor g in the following equation. Assuming that both revenue and external effects are separable and additive[1], g is specifying the particular weight that is given to these two single effects, we derive the following social welfare function for each host country i:

(22) $$W_i = t_i^s\, r\, F_i^t + g\, F_i^t = (t_i^s\, r + g)\, F_i^t \qquad i = A, B; \quad r, g > 0$$

By putting (5a) into (22), we derive an equation that exhibits the influence of the two tax rates on the social welfare of country A:

(23) $$W_A = (t_A^s\, r + g)\, F_A^t = \qquad (t_A^s\, r + g)\, e\, (1 - \rho - t_A^t + \rho\, t_B^t)$$

The partial derivative with respect to t_A^s is

(24) $$\frac{\delta W_A}{\delta t_A^{\ s}} = r\, e\, (1 - \rho - t_A^{\ t} + \rho t_B^{\ t}) - e\, (t_A^{\ s}\, r + g)\, \frac{\delta t_A^{\ t}}{\delta t_A^{\ s}}$$
$$= e\, r - e\, r\rho - e\, rt_A^{\ t} + e\, r\rho t_B^{\ t} - ert_A^{\ s}\ \frac{\delta t_A^{\ t}}{\delta t_A^{\ s}} - eg\, \frac{\delta t_A^{\ t}}{\delta t_A^{\ s}}$$

By equating (24) to zero, we derive country A's optimal tax given t_B^t.

Under the EM ($t_A^t = t_A^s$), this gives us:

(25a) $$t_A^{\ s\,*EM} = \frac{1}{2}\left(1 - \rho - \frac{g}{r}\right) + \frac{\rho}{2}\, t_B^{\ t}$$

Under TS ($t_A^t = t^r - t_A^f + t_A^s$), this gives us:

(25b) $$t_A^{\ s\,*\,TS} = \frac{1}{2}\left(1 - \rho - \frac{g}{r}\right) - \frac{(t^r - t_A^{\ f})}{2} + \frac{\rho}{2} t_B^{\ t}$$

The higher the tax rate in the second country the higher is the optimal tax rate of the welfare maximizing country. The other implications of both EM and TS are plausible: The higher the external effects of capital inflows, the smaller the return on investment,

1 Welfare effects form tax revenue from other sources are assumed to be additive and separable and can therefore be neglected in the following.

and finally the higher the correlation between both markets, the lower the optimal tax rate. And again, the difference between TS and EM becomes obvious: Under TS capital importing countries choose lower withholding taxes than under EM (if $t^r > t_A^f$).

4.2 Outcome under Tax Competition

To demonstrate the effects of different degrees of elasticities with respect to taxes in a world with tax competition, we now relax our assumption that country *A* takes the tax rate of country *B* as given. We use a simple non-cooperative game theoretical model, where both countries maximize social welfare by setting their tax rates simultaneously. The reaction curve of *A* to t_B^t under EM can be derived directly from equation (25a) by substituting $t_B^t = t_B^s$:

$$\text{(26)} \qquad \text{EM: } t_A{}^s = \frac{1}{2}\left(1-\rho-\frac{g}{r}\right)+\frac{\rho}{2}t_B{}^s =: r_A{}^{EM}(t_B{}^s)$$

For TS, (25b) combined with $t_B^t = t^r - t_B^f + t_B^s$ and $t_B^f = t_A^f$ gives us:

$$\text{(27)} \qquad \text{TS: } t_A{}^s = \frac{1}{2}\left(1-\rho-\frac{g}{r}\right)-\frac{(1-\rho)\left(t^r - t_A{}^f\right)}{2}+\frac{\rho}{2}t_B{}^s =: r_A{}^{TS}(t_B{}^s)$$

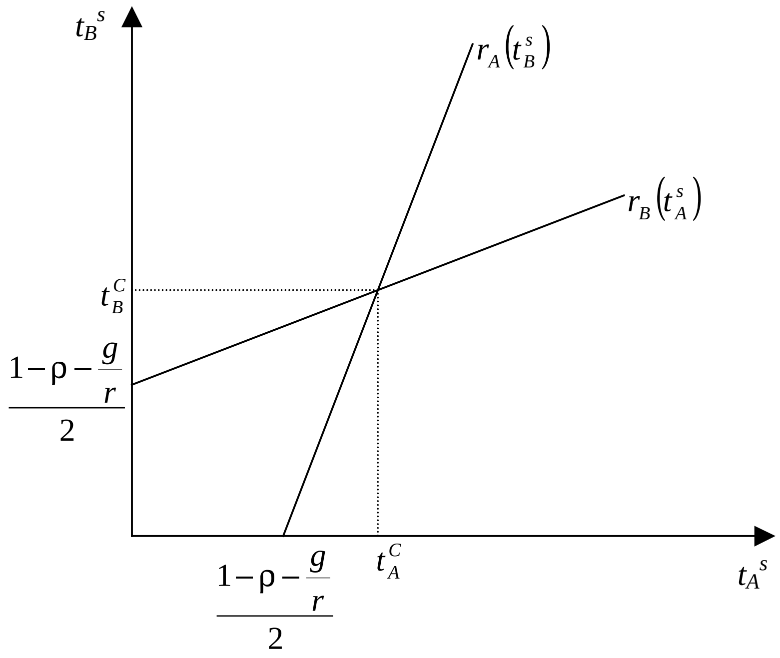
Due to the symmetry of the model the reaction curves of *B* are similar to those of *A*:

$$\text{(28)} \qquad \text{EM: } t_B{}^s = \frac{1}{2}\left(1-\rho-\frac{g}{r}\right)+\frac{\rho}{2}t_A{}^s =: r_B{}^{EM}(t_A{}^s)$$

$$\text{(29)} \qquad \text{TS: } t_B{}^s = \frac{1}{2}\left(1-\rho-\frac{g}{r}\right)-\frac{(1-\rho)\left(t^r - t_B{}^f\right)}{2}+\frac{\rho}{2}t_A{}^s =: r_B{}^{TS}(t_A{}^s)$$

Comparing TS to EM, we see that under TS for a given tax rate in the other country, one's country's desired withholding tax rate is lowered by some proportion of the additional tax due in the residence country of the investor. This effect vanishes if investments in both countries are perfectly correlated. For any other ρ, the introduction of tax sparing shows the same qualitative results as EM with a higher *g*, because all these variables are exogenous in this model. For this reason, in the following analysis we omit the case of TS in the formal analysis to keep notations simple. However, every result applies to TS, as well.

Figure 1



The outcome of this game in continuos strategies is the Cournot-Nash-equilibrium, illustrated in Figure 1 for EM with $\rho > 0$. Analytically, it can be derived by combination of (26) and (28):

$$(30) \qquad t_A{}^{s\,C} = t_B{}^{s\,C} = \frac{1-\rho-g/r}{2-\rho}$$

Note that this equilibrium is stable as long as the absolute slope of the r_A-curve exceeds that of the r_B-curve. Solving (26) for $t_B{}^s$ we get:

$$(26a) \qquad t_B{}^s = -\frac{1-\rho-g/r}{\rho} + \frac{2}{\rho} t_A{}^s$$

Thus, for the equilibrium to be stable it must hold that

$$\left|\frac{2}{\rho}\right| > \left|\frac{\rho}{2}\right|$$

(31) $\Leftrightarrow$ $4 > \rho^2$

This condition is always fulfilled. Since the denominator in equation (30) is always positive, the equilibrium tax rates $t_A^{s\,C}$ and $t_B^{s\,C}$ are positive as long as

(32) $1 - \rho > g/r$

As noted before, if condition (32) does not hold, the tax competition leads to a corner solution with both countries not taxing foreign investment at all. This is more likely with high external effects of capital imports, tax sparing (both represented by a higher g), or low rates of return r.

4.3 Socially Optimal Taxation

Since both countries are identical we maximize total social welfare of both countries by choosing the optimal harmonized tax rate t_H^{s*}. Total capital flows F_T^t into the two countries is

(33) $F_T^t = F_A^t + F_B^t = e\,(1\text{-}\rho - t_H^s + \rho\, t_H^s + 1\text{-}\rho - t_H^s + \rho\, t_H^s) = 2\,e\,(1 - \rho)(1 - t_H^s)$

We define total welfare as $W_T := W_A + W_B$, which leads to:

(34) $W_T = (t_H^s\, r+g)\, F_T^t = (t_H^s\, r+g)\, 2\, e\, (1 - \rho)(1 - t_H^s)$

The optimal harmonized tax rate t_H^s* can be derived by maximizing total welfare

$$\frac{\delta W_T}{\delta t_H{}^s} = 2er(1-\rho)(1-t_H{}^s) - 2e(t_H{}^s r + g)(1-\rho) \overset{!}{=} 0$$

(35) $\Rightarrow$ $t_H^s* = \dfrac{1-g/r}{2}$

It is optimal for the two countries to impose withholding taxes on capital income ($t_H^s* > 0$) as long as

(36) $1 > g/r$

If the external effects are high, tax sparing provisions apply (both high *g*), or returns *r* are low it is optimal to tax capital income at low rates or not at all. Comparing (30) with (35), we find already that, when there is no correlation between both markets, both the competition and the harmonization lead to the same optimal solution because tax collectors of one country do not impose external effects on the other.

4.4 Comparison

To compare the competition and the harmonized solutions closer, we subtract the optimal tax rate of tax competition from the socially optimal taxation:

(37) $$\Delta t = t_H^{s*} - t_i^{sC} = \frac{\rho\,(1+g/r)}{2\,(2-\rho)}$$

We see that for positive correlation ρ, the tax rate, induced by competition, is too low, while it is too high for negatively correlated assets in both countries. As noted before, completely uncorrelated countries are not affected by tax competition.

Equation (37) also shows, how the other parameters influence the deterrence that is induced by tax competition. The deterrence effect of competition is increasing in *g*, while it is decreasing in *r*. Since a higher *g* can also represent TS provisions, we see that TS always aggravates potential harms of competition.

Comparing (33) with (36), we find that the decision of a country, not to levy taxes at all, is also deterred because it neglects the fact that investors diversify and that the correlation between both markets determines the degree of substitutability of both markets and the "cross tax elasticity". Thus, whenever $\rho > 1 - g/r > 0$, each single country decides not to impose taxes on capital earnings while it would be socially desirable to do so. The higher the correlation coefficient ρ, the higher the probability that tax competition leads to zero taxation, while a positive taxation would be socially desirable.

5. IMPLICATIONS

Portfolio capital is supposed to be highly mobile. However, the basic idea behind portfolio investment is risk reduction through diversification. Using a simple portfolio model we have shown that the stochastic structure determines the magnitude of demand elasticities, and the sign of the cross elasticity. Countries are either substitutes or complements in a sense of diversification.

While capital inflows are maximal when countries refrain from taxation regardless of correlation, when it comes to the maximization of tax revenue or social welfare, under conditions of competition tax rates depend largely on the stochastic structure of returns. Our results show that when correlation between markets is zero, the outcome of competition is socially optimal. Then, only the benefits from tax competition, e.g. in terms of more efficient state policies by putting constraints on the budget, remain. In case of negative correlation benefits from diversification are particularly high. Then, risk averse investors are disposed to hold portfolios with assets from both countries simultaneously. Governments can anticipate this by imposing higher tax rates. Therefore, tax rates can be even too high (!) compared to coordination. With positive correlation tax rates tend to be too low.[1] Tax sparing aggravates the harms of tax competition.

We conclude with the empirical relevance of our results. First, our model illustrates, why withholding taxes can still be observed. And, the results emphasize the importance of regional cooperation among states that observe similar capital market developments, e.g. small neighboring countries in Latin America or Asia. On the other hand, there is no particular need for these groups of countries that have little or zero correlation with each other to cooperate. Competition among these groups tends to bring the optimal solution.

1 This is the standard result from literature on tax competition assuming perfect capital mobility, i.e. perfect substitutability.

Mathematical Appendix

According to standard portfolio models, a risk averse investor maximizes his expected utility from holding a portfolio of risky assets and one riskless asset. Having the opportunity to invest in a riskless asset, he first chooses the optimal portfolio allocation of risky assets and then combines it with the riskless asset.

In case of no taxation, the standard result from portfolio optimization[1] is the following:

(A1) $\mathbf{F} = \gamma\, \mathbf{r}\, \Omega^{-1}$

where

F vector of portfolio positions of risky assets

γ risk aversion coefficient

r vector of expected (excess) returns r_i[2]

Ω variance-covariance matrix

Since we assume that both countries are identical, expected returns and return variances σ^2 of both markets are identical: $r := r_A = r_B$ and $\sigma := \sigma_A = \sigma_B$. Therefore, the variance-covariance matrix Ω is of a very simple form:

(A2) $$\Omega = \begin{bmatrix} \sigma^2 & \rho\sigma^2 \\ \rho\sigma^2 & \sigma^2 \end{bmatrix} = \sigma^2 \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$$

with the correlation coefficient $\rho = \dfrac{Cov}{\sigma \cdot \sigma}$. The inverse of Ω is

(A3) $$\Omega^{-1} = \frac{1}{\sigma^2\,(1-\rho^2)} \begin{bmatrix} 1 & -\rho \\ -\rho & 1 \end{bmatrix}$$

Due to the symmetry of our model both countries are identical in terms of expected returns r_i and variances σ_i^2. Hence, portfolio positions of all assets identical as well.

The portfolio position in each single market can be derived by inserting (A3) into (A1):

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1 Elton, Gruber (1995)

2 We assume that the riskless asset yields zero return.

(A4) $F_i = \gamma\, r \dfrac{1-\rho}{\sigma^2(1-\rho^2)}$

If we allow for different taxation in both countries[1], the optimal portfolio allocation of (A1) becomes the following:

(A5) $F^{\,t} = \gamma\, r\, \mathbf{[1\text{-}\boldsymbol{t}]}\, \Omega^{-1}$

with **[1-*t*]** being a matrix of $(1\text{-}t_i)$

(A6) $[\mathbf{1}-\mathbf{t}] := \begin{bmatrix} (1-t_A) & 0 \\ 0 & (1-t_B) \end{bmatrix}$

Hence, the portfolio position of market *A* is

(A7)
$$\begin{aligned} F_A^{\,t} &= \gamma\, r\, (1-t_A) \frac{1}{\sigma^2(1-\rho^2)} - \gamma\, r\, (1-t_B) \frac{\rho}{\sigma^2(1-\rho^2)} \\ &= \gamma\, r \frac{1-\rho}{\sigma^2(1-\rho^2)} - \gamma\, r \frac{1}{\sigma^2(1-\rho^2)} t_A + \gamma\, r \frac{\rho}{\sigma^2(1-\rho^2)} t_B \\ &= \mathrm{F_A} - \gamma\, r \frac{1}{\sigma^2(1-\rho^2)} t_A + \gamma\, r \frac{\rho}{\sigma^2(1-\rho^2)} t_B \end{aligned}$$

with $F_A := \gamma r \dfrac{1-\rho}{\sigma^2\left(1-\rho^2\right)}$

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1 We make the simplifying assumption that taxes only reduce returns, but do not have any effect on risk of assets and portfolios. The sometimes used alternative assumption that taxation reduces risk by decreasing the variance of expected asset returns, implies perfect loss offset, that in reality is not a matter of fact.

Abbreviations and Symbols

EM	Exemption Method
CM	Credit Method
MC	Matching Credit
TS	Tax Sparing

F	autonomous capital inflows
F_i^t	capital inflows into country i, country i's share of the risky portfolio, in case of taxation
R_i	expected tax revenue in country i

γ	risk aversion coefficient
ρ	correlation coefficient of market indices
σ^2	variance of returns

g	external effects of capital inflows on the economy of the host country
r	expected (excess) return

t_i^c	tax credit in the residence country for capital income from country i
t_i^f	fictive tax credit in the residence country for capital income from country i
t^r	tax rate in the residence country
t_i^s	withholding tax rate in country i
t_H^s	harmonized withholding tax rate
t_i^t	total tax burden on capital income from investment in country i

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