Tax Competition With Two Tax Instruments –and Tax Evasion

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Abstract

We consider a world in which countries apply optimal taxes on mobile capital and savings (like in Bucovetsky & Wilson, 1991). Firms and savers may evade taxation by underreporting their tax base. We show that, even in the presence of tax evasion, the equilibrium under tax competition may still be constrainedly efficient (in the sense that there is scope for welfare enhancing tax coordination). This is the case if the marginal social losses due to evasion of savings taxes and investment taxes are equal. Generally, the efficiency properties of the tax competition equilibrium crucially depend on how elastically evasion activity reacts to tax rates. Perhaps surprisingly, investment tax rates are inefficiently high relative to savings tax rates if investment tax avoidance is more important than avoidance of savings taxes. We also state sufficient conditions under which tax coordination effectively increases public good levels.

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1 Introduction

Efficient taxation of capital suffers from the asymmetry between boundless capital markets and national tax policies that are constrained by national borders. An abundant literature deals with the inefficiencies resulting from this asymmetry. Bucovetsky & Wilson (1991) have shown that, if both savings and investment can be taxed, tax competition may be efficient in the sense that the net externality of tax policy is zero. This theoretical finding is often dismissed by pointing to the large degree of evasion of taxes on savings income. As a consequence, many theoretical studies of source-based tax competition ignore the role of savings taxes.

Recent developments may warrant revisiting this argument. First, there is, by now, a huge literature that demonstrates the empirical importance of avoidance of source-based taxes (surveyed by, among others, Heckemeyer & Overesch 2017, Riedel 2018, Beer et al. 2018). Empirical studies show that firms shift profits via transfer pricing (Cristea & Nguyen 2016, Davies et al. 2018) and thin capitalization, and they shift intangible assets like patents (Karkinsky & Riedel 2012, Griffith et al. 2014) and trademarks (Dudar & Voget 2018) in order to profit from low taxes. The overall effect on the allocation of tax bases is huge; e.g. Torslov et al. (2018) estimate that up to $600bn are shifted to tax havens. Second, while evasion of savings taxes is still a substantial problem, some progress has been made in the international enforcement of residence-based taxes on saving returns: e.g. the (automatic) international exchange of information (Bilicka & Fuest 2014), FATCA (Johannesen et al. 2018), reductions in bank secrecy (Johannesen & Zucman 2014), though their level of effectiveness is subject to debate (Shep-

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2 Overesch/Heckemeyer (2017) provide a meta-study of 27 profit shifting studies and report a semi-elasticity of subsidiary profits with respect to tax rate of -0.8. Beer et al. (2018) present another meta-study of 37 profit shifting studies and find a semi-elasticity of -1 and for more recent years even close to -1.5.

3 Heckemeyer/Overesch (2017) estimate that one third of all profits shifted are moved via financing schemes and two thirds via manipulated transfer prices.

4 There is extensive evidence that taxes affect the location of intangibles as e.g. patents. Dischinger/Riedel 2011 report that a one percentage point increase in the corporate tax rate (or, more precisely, in the rate differential across the MNE’s affiliates) decreases intangible property investment by 1.7 percent (i.e. a semi-elasticity of -1.7).

5 Johannesen and Zucman (2014) provide evidence that tax evaders shift deposits to tax havens not covered by a treaty with their home country, thereby benefiting the least compliant havens. They discuss several policy options, including the the use of comprehensive multilateral agreements that prevent tax evaders from transferring funds from one haven to another.
The literature thus seems to suggest that both kinds of taxes are subject to extensive avoidance and evasion activities. Therefore, instead of just assuming that one tax instrument is unavailable due to excessive evasion, the question arises how optimal policy and tax competition looks like if both instruments are only imperfectly enforced.

In this paper, we therefore reconsider optimal tax policy with two tax instruments, i.e. savings and investment taxes, when both taxes can be avoided or evaded. Following Chetty (2009), we differentiate between tax avoidance activities, which incur a social cost (by using valuable resources), and tax evasion activities, which have only a private cost (e.g. expected fines) but no social cost (as fines are revenue from the government’s perspective). First, we find that even with underreporting of both tax bases, the tax competition equilibrium can be efficient. To be precise, if underreporting of both types of income have the same marginal social cost in equilibrium, the net externality is zero and the classical Bucovetsky-Wilson (1991) result is restored. Second, if, as we argue, the social marginal cost of investment tax underreporting is larger than that of underreporting of savings taxes, source-based investment taxes are inefficiently high. In other words, there may be overtaxation of corporate profits in the sense that a coordinated decrease of corporate taxes and an associated increase of savings taxes would increase welfare. Generally, the model shows that, ironically, if source-based taxes on capital are inefficiently low, this is only because residence-based taxes are evaded more than source-taxes are evaded. Third, we show that, with underreporting, one of the two taxes will usually be too high while the other is too low. This finding is informative for the debate on tax coordination, which sometimes seems to assume that both taxes should be increased in coordination. Fourth, we show that, while the optimum tax structure under coordination is undetermined (only the total tax wedge matters) in the absence of underreporting, it is unique if at least one of the two tax bases can be underreported. Finally, we outline sufficient conditions for the coordinated tax policy to increase public goods provision. Our results allow a better assessment of the prospects for business tax coordination in times when the enforcement of savings taxes is better enforced (e.g. through

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6 The empirical evidence shows that there is still an enormous amount of wealth located in tax havens (Zucman 2013, 2014, Alstadsæter et al. 2017a, 2017b). Hanlon et al. (2015) is a rare example of a study that allows for measuring tax effects on evasion of taxes on interest income. Using data on US investors, these authors find that “a 1% increase in the top U.S. ordinary tax rate results in an approximate 2.1% to 2.8% increase in inbound [foreign portfolio investment] from tax havens relative to nonhavens” (p. 259). The resulting revenue loss is in the range between $8 to $27 billion.
abolishment of bank secrecy, shut-down of tax havens etc.).

The next section describes the model, Section 3 investigates the equilibrium tax policy, and Section 4 analyses its welfare properties and optimal government intervention. Section 5 extends the analysis to include labor taxation, and Section 6 concludes.

2 The model

The model augments the framework used in Bucovetsky and Wilson (1991) by introducing tax avoidance and evasion opportunities.

2.1 Setup

Consider a two-period model with \( n \) identical countries. The index on countries is suppressed unless misunderstandings arise. For simplicity, we assume that \( n \) is large, so each country is a price-taker in international capital markets. The basic insights, however, carry over to the case where \( n \) is small.

In each country, there is a representative household who receives utility from private consumption in the first period, \( x_1 \), and the second period, \( x_2 \), and from a local public good, \( g \), which is consumed in period 2. Utility is given by

\[
  u = u(x_1, x_2, g)
\]

with \( u_{x_1} > 0 > u_{x_1 x_1} \), \( u_{x_2} > 0 = u_{x_2 x_2} \) and \( u_{g} > 0 > u_{gg} \). To simplify, we assume that utility is linear in \( x_2 \), so that savings depend only on its after-tax return (i.e., no income effects).

The household is endowed with income \( e \), which, in period 1, may be consumed or saved. Thus, the first-period budget constraint is given by

\[
x^1 = e - S
\]

where \( S \) denotes savings.

In period 2, the household receives savings plus interest and dividends \( \Pi \) from firm ownership. Gross interest income is given by \( \rho S \) where \( \rho \) denotes the world market interest rate. The government levies taxes on savings at the rate \( m \).

The household may engage in activities that reduce the tax base for \( m \) below \( S \). We refer to this reduction as “underreporting”, though it may involve not only illegal tax evasion, but also legal tax avoidance activities. Letting \( a \) denote the amount of underreporting on a dollar of savings, the tax
base is given by $S(1 - a)$. Following Chetty (2009), we distinguish between two types of underreporting costs. Let $c^a (a)$ denote the real resource cost of underreporting per dollar of savings, which is both a private and social cost. Next, let $z^a (a, m)$ denote the cost that is only a private cost, e.g. fines that are paid by evaders and received by the government. We assume that $c^a (0) = z^a (0, m) = 0$; $c^a (a) > 0$ and $z^a (a, m) > 0 > c^a (a), z^a (a, m) < 0$ for $a > 0$; and $a > z^a (a, m) > 0$. The last assumption makes sure that the government cannot increase its tax base by levying a higher tax rate.

The household’s second-period budget constraint is

$$x^2 = \Pi + S(\rho - m(1 - a) - c^a (a) - z^a (a, m))$$  \hspace{1cm} (3)$$

In each country, there is a representative firm, which is fully owned by the domestic household. The firm has a production technology $F(K)$, which uses only capital $K$ as the variable input. We have $F'(K) > 0$ and $F''(K) < 0$. Capital can be rented in the world capital market at an interest rate of $\rho$. The government levies a unit tax on capital use $K$. However, the firm may underreport capital use such that the tax revenue is given by $(\tau - b)K$. The underreporting amount $b$ is chosen by the firm, and again requires a social cost and a private cost, $c^b (b)$ and $z^b (b, \tau)$, respectively. For instance, with regard to foreign direct investment (FDI), the main function of tax havens is to engage in legal tax avoidance; in this case, we may expect $z^b (b, \tau)$ to be relatively low compared to $c^b (b)$. We assume that $c^b (0) = z^b (0, \tau) = 0$; $c^b (0) = z^b (0, \tau) = 0$; $c^b (b)$ and $z^b (b, \tau) > 0 > c^b (b), z^b (b, \tau) < 0$ for $a > 0$; and $b > z^b (a, \tau) > 0$.

Firm profits are given by

$$\Pi = F(K) - (\rho + \tau(1 - b) + c^b (b) + z^b (b, \tau))K$$  \hspace{1cm} (4)$$

While real world tax systems set taxes on interest income and profit income (allowing for debt cost deductions, etc.), our model features unit taxes on savings $S$ and investment $K$. We do so for simplicity reasons and to allow for comparison with the standard tax competition literature, starting with Zodrow and Mieszkowski (1986) and Wilson (1986). Note also that a tax on profits would either be perfectly neutral (provided that the tax base is $\Pi$) or a combination of a tax on pure profit and a tax on investment. If a neutral tax is available, there is no point in levying distorting taxes on

\footnote{Chetty (2009) interprets $z^a (a, m)$ as an expected fine but ignores risk aversion by assuming risk neutral taxpayers. We similarly ignore issues involving risk aversion.}
savings and capital and a country could immunize itself from tax competition (Sinn 1990).

The government’s budget constraint is given by
\[ g = (m(1-a) + z^a(a,m))S + (\tau(1-b) + z^b(b,\tau))K \] (5)
The presence of \( z^a(a,m) \) and \( z^b(b,\tau) \) in the government budget constraint reflects our assumption that these are private costs but not social costs, as they just represent a redistribution of funds from the private sector to the public sector.

2.2 Utility and profit maximization

Each household takes the government’s policy choices of \( m, \tau \) and \( g \) as given and chooses \( x^1, x^2, K, a \) as well as \( b \) in order to maximize utility. The household’s maximization problem is
\[ \max_{x^1,x^2,a,K,b} u(x^1,x^2,g) \] (6)
subject to (2), (3) and (5).

The first-order conditions are:
\[ \frac{u_{x^2}}{u_{x^1}}(.) = \frac{1}{\rho - m(1-a) - c^a(a) - z^a(a,m)}; \] (7)
\[ c^a_a(a) + z^a_a(a,m) = m; \] (8)
\[ F^g(K) = \rho + \tau(1-b) + c^b(b) + z^b(b,\tau); \] (9)
\[ c^b_b(b) + z^a_b(b,\tau) = \tau. \] (10)

Conditions (8) and (10) imply that \( a \) can be expressed as a function \( a(m) \) and \( b \) as \( b(\tau) \). Going forward, it is convenient to work with the following effective unit tax rates, inclusive of evasion and avoidance costs:
\[ M(m) = m(1-a(m)) + z^a(a(m),m) + c^a(a(m)); \] (11)
\[ T(\tau) = \tau(1-b(\tau)) + z^b(b(\tau),\tau) + c^b(b(\tau)). \] (12)

In what follows, we treat \( M \) and \( T \) as control variables. Accordingly, we consider the savings and investment functions, \( S(\rho-M) \) and \( K(\rho+T) \), defined by the solution to the above utility maximization problem. Since \( a(m) \) monotonously increases in \( m \) and \( M \) monotonously increases in both \( m \) and \( a(m) \), we may also express \( a(m) \) as \( a(M) \) and \( b(\tau) \) as \( b(T) \). Similarly, the cost function \( c^a(a(m)) \) may be written as \( c^a(M) \) and \( c^b(b(\tau)) \) as \( c^b(T) \). Then, the government budget constraint is given by
\[ g = (M-c^a(M))S(\rho-M) + (T-c^b(T))K(\rho+T). \] (13)
2.3 Capital market

In capital market equilibrium, aggregate capital demand for all of the $n$ identical countries has to be equal to aggregate savings supply. Under symmetry, this implies that in each individual country savings equal capital demand:

$$S(\rho - M) = K(\rho + T). \quad (14)$$

This requirement implicitly defines the interest rate as a function of the common equilibrium effective tax rates: $\rho(M, T)$. A coordinated tax change (with identical rate changes in each country) would affect the interest rate as follows:

$$\frac{\partial \rho}{\partial M} = \frac{\epsilon_S}{\epsilon_S + \epsilon_K} > 0; \quad (15)$$

$$\frac{\partial \rho}{\partial T} = -\frac{\epsilon_K}{\epsilon_S + \epsilon_K} < 0; \quad (16)$$

where $\epsilon_S$ and $\epsilon_K$ are semi-elasticities for savings and capital, measured positively: $\epsilon_S = S'/S$ and $\epsilon_K = -K'/K$.

3 Equilibrium tax policy

Each government’s optimization\(^8\) problem may be written as follows:

$$\max_{M, T} u(x^1, x^2, g) \quad (17)$$

subject to $x^1 = e - S(\rho - M)$ as well as\(^9\)

$$x^2 = F(K) - (\rho + T)K(\rho + T) + (\rho - M)S(\rho - M) \quad (19)$$

$$g = (M - c^a(a))S(\rho - M) + (T - c^b(b))K(\rho + T) \quad (20)$$

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\(^8\)Note that evasion costs $z^a$ and $z^b$ do not directly enter this optimization problem because they are not social costs. However, more tax evasion requires a higher statutory tax rate to achieve a given effective tax rate, and a higher statutory tax rate implies higher tax avoidance costs. In this way, tax evasion does have a social cost, albeit indirectly.

\(^9\)The intertemporal budget constraint can thus be expressed as

$$e + \frac{\Pi}{\rho - M} = x^1 + \frac{x^2}{\rho - M} \quad (18)$$
Recall that each country is a price-taker: it treats \( \rho \) as fixed. The first-order conditions are:

\[
\begin{align*}
(u_g - u_{x_2}) S - u_g \left( c_M^a S + (M - c^a (M)) S' \right) &= 0; \quad (21) \\
(u_g - u_{x_2}) K - u_g \left( c_T^b K - \left( T - c^b (T) \right) K' \right) &= 0; \quad (22)
\end{align*}
\]

which may be rewritten in a form that equates the marginal benefit of the public good to the marginal cost:

\[
\begin{align*}
\frac{u_g}{u_{x_2}} &= \frac{1}{1 - c_M^a - (M - c^a (M)) \epsilon_S}; \quad (23) \\
\frac{u_g}{u_{x_2}} &= \frac{1}{1 - c_T^b - (T - c^b (T)) \epsilon_K}. \quad (24)
\end{align*}
\]

As usual, an optimum is achieved only when the marginal cost of the public good does not depend on the method of financing. This invariance condition may be written as follows:

\[
(M - c^a (M)) \epsilon_S - \left( T - c^b (T) \right) \epsilon_K = c_T^b - c_M^a. \quad (25)
\]

The above condition characterizes the optimal tax mix under tax competition. For purpose of comparison, consider the case where there is no avoidance or evasion. Then, the above rule boils down to \( M \epsilon_S = T \epsilon_K \) or \( M/T = \epsilon_K/\epsilon_S \) which is a kind of inverse elasticity rule.

**Lemma 1** (Bucovetsky/Wilson 1991) Both tax rates are positive, \( m > 0 \) and \( t > 0 \).

**Proof.** With \( M = 0 \) if \( m = 0 \) and \( c^a \left( 0 \right), c_M^a \left( 0 \right) = 0 \), the above equation (25) cannot hold. The same argument can be made for \( t = 0 \).

Thus, in the tax competition equilibrium, countries levy both taxes at non-zero rates.

### 4 Welfare properties

Before we discuss the welfare properties of the tax competition equilibrium, we define the notion of efficiency as a benchmark measure. Unconstrained efficiency would have the households save according to \( u_{x_2}/u_{x_1} = \frac{1}{\rho} \) and reduce evasion activities to zero. Firms would need to invest according to \( F' (K) = \rho \) and, again, set underreporting to zero. Public goods would be financed by lump-sum taxes.
In this paper, we assume that lump-sum taxes and other more sophisticated tax instruments are unavailable. Instead, governments have only the taxes $m$ and $\tau$, as defined above, at their disposal. Under these circumstances, we can define constrained efficiency as follows:

**Definition 2** An equilibrium under tax competition is characterized by constrained efficiency if no household’s utility can be improved by changing the individual countries’ choices of tax rates without making another household’s utility decrease.

Assume now that there is a symmetric equilibrium in which all countries set their tax rates according to (23) and (24). In line with the above definition of constrained efficiency, we ask whether the equilibrium is constrainedly efficient. In the uncoordinated equilibrium, each country sets its tax rate such that its own household’s utility cannot be made better off. Therefore, inefficiencies of uncoordinated tax rate setting can be measured by the effect of changes in other countries’ tax rates, i.e. the size of the cross-border externalities. These externalities only occur through changes in $\rho$ since there are, by assumption, no other cross-border linkages between countries.

Under symmetry, each country’s gross interest income equals its interest cost, $\rho S = \rho K$. Therefore, a rise in $\rho$ increases interest income by the same amount that it reduces profits. However, a change in $\rho$ may affect tax revenue and, therefore, $g$, depending on the relative tax rates on savings and investment. In other words, a change in $\rho$ may create a fiscal externality.

**Proposition 3** Assume that there is a symmetric Nash equilibrium in tax competition. With respect to the notion of constrained efficiency (as defined above), the following holds:

(i) If $c_T^b - c_M^a < 0$, savings taxes are inefficiently high and investment taxes are inefficiently low.

(ii) If $c_T^b - c_M^a = 0$, the tax competition equilibrium is efficient (as in Bucovetsky & Wilson, 1991).

(iii) If $c_T^b - c_M^a > 0$, savings taxes are inefficiently low and investment taxes are inefficiently high.

**Proof.** Starting from the Nash equilibrium, consider a small increase in $M (T)$ in all countries. Having optimized over its own tax rates, an individual country is only affected through the change in the world market interest rate. The resulting change in utility is given by

$$\frac{du}{d\rho} = u_g \left[ (M - c^a (M)) \epsilon_S - (T - c^b (T)) \epsilon_K \right] S = u_g (c_T^b - c_M^a) S.$$

(26)
where we used (21) and (22). This implies that the sign of the welfare effect of change in the interest rate is the sign of $c^b_T - c^a_M$, that is the difference in marginal real cost of avoidance/evasion. Since a rise in every country’s savings tax $M$ (investment tax $T$) increases (lowers) $\rho$, (26) shows that an increase in $M$ ($T$) increases (lowers) welfare if $c^b_T > c^a_M$.

The efficiency of the mix of taxes when $c^b_T = c^a_M$ can be explained intuitively. Eq. (25) tells us that, in the uncoordinated equilibrium, the tax rates are set such that

$$(M - c^a(M)) = \frac{e_K}{e_S} \cdot \left(T - c^b(T)\right) \text{ if } c^b_T = c^a_M$$

Thus, the effective savings tax rate equals $\frac{e_K}{e_S}$ times the effective investment tax rate, which is basically an inverse elasticity rule. In other words, if $\rho$ is raised while holding taxes fixed, this rule implies that $S$ rises and $K$ falls by amounts that keep total tax payments unchanged. So whereas changes in all countries taxes still affect $\rho$, there is no fiscal externality from a change in $\rho$.

In the case of $c^a_M \neq c^b_T$, each individual country deviates from the inverse elasticity rule in (27) and adjusts its choices of $m$ and $\tau$ for the differing social costs of underreporting. The fiscal externalities are entirely channelled through the interest rate, and they are now non-zero. It follows from the above proposition that there is simultaneous over- and undertaxation (in the constrained efficiency sense).

**Corollary 4** There is no simultaneous undertaxation of savings and investment. If both taxes, $m$ and $t$, are chosen optimally (taking into account the social cost of underreporting), the resulting equilibrium is either constrainedly efficient or one of the two tax instruments is chosen at an inefficiently high rate.

This corollary suggests a need to re-evaluate the intuitive argument that, because savings cannot be properly taxed (and are, thus, undertaxed), we need source-based taxes that are, due to tax competition, inefficiently low.

How does optimal (i.e. second-best) tax policy look like? To investigate properties of the second-best levels of public goods provision and the total effective tax rate, $M + T$, consider a central planner’s optimization problem, which may be written:

$$\max_{M,T} u(x^1, x^2, g)$$

(28)
subject to $x^1 = e - S$, $x^2 = F(S) - (M + T)S$, $g = (M - c^a(M) + T - c^b(T))S$ and $S(\rho - M) = K(\rho + T)$. The latter condition implies that the planner takes into account that, due to symmetry, each country’s savings must equal its capital demand.

The first order conditions w.r.t. $M$ and $T$ are:

$$
(u_g - u_{x_2}) - u_g \left[ c^a_M + \frac{M - c^a(M) + T - c^b(T)}{\varepsilon_K + \frac{1}{\varepsilon_S}} \right] = 0 \quad (29)
$$

$$
(u_g - u_{x_2}) - u_g \left[ c^b_T + \frac{M - c^a(M) + T - c^b(T)}{\varepsilon_K + \frac{1}{\varepsilon_S}} \right] = 0 \quad (30)
$$

where we used $1 - \frac{\partial \rho}{\partial M} = \frac{\varepsilon_K}{\varepsilon_S + \varepsilon_K}$ and $\frac{\partial \rho}{\partial T} = -\frac{\varepsilon_K}{\varepsilon_S + \varepsilon_K}$, and thus, $\frac{dS}{dM} = \frac{dK}{dT} = \frac{1}{\varepsilon_K + \frac{1}{\varepsilon_S}}$. The two equations above only differ in the first term in squared brackets, the marginal real cost of underreporting, $c^a_M$ and $c^b_T$. All other terms are affected equally by changes in $M$ and $T$, since both tax instruments have the same marginal impacts on saving and investment – only the total tax wedge $M + T$ matters. Thus, the central planner optimizes by choosing the individual values of $M$ and $T$ to minimize $c^a(M) + c^b(T)$. Let $c'(M + T)$ denote the minimized cost level where $c^b_T = c^a_M$ for a given level of $M + T$.

**Proposition 5** Under coordination, the optimal choices of $M$ and $T$ satisfy (29) and (30) and minimize the real cost of underreporting, $c^a(M) + c^b(T)$. This is achieved when the marginal real cost of underreporting is equalized, $c^a_M = c^b_T$.

**Proof.** Omitted. ■

This implies that, when $c^a_M > c^b_T$ in equilibrium, i.e. the marginal real underreporting cost is higher for the savings tax, a coordinated move from savings taxation towards source-based taxation of capital use, would reduce the welfare loss due to underreporting, and increase welfare.

Note that, in the absence of underreporting opportunities, (29) and (30) are identical which reflects the irrelevance of the tax structure (i.e. the tax wedge division) for a given level of $M + T$. This is a special case of the “irrelevance proposition”, under which the incidence of a tax does not depend on whether the tax is collected from suppliers or demanders. But as emphasized by Slemrod (2008), the irrelevance proposition does not apply in general to cases where there are evasion and avoidance activities, since these activities may differ between the two sides of the market. In the current case of saving and investment taxes, Prop. 1 shows that decentralized government
decision-making will not produce the efficient mix of taxes: there will be too much reliance of the tax for which the marginal social cost of tax evasion and evasion is higher.

**Corollary 6** If only one type of income tax can be evaded, the coordinated tax setting implies a zero tax on this kind of income.

**Proof.** As shown above, in the absence of tax evasion, the coordinated tax is not unique, only the sum of $M + T$ is determined. Therefore, efficient tax setting allows for setting the tax on income which can be evaded equal to zero.

Under tax competition, there is simultaneous over- and undertaxation as long as $c_T^b \neq c_M^a$. Under these circumstances, it is no longer clear whether public goods are underprovided. Public goods provision cannot be efficient in a first-best sense, because distortionary taxes on saving and investment are being used to finance it. However, given the available tax instruments, tax policy may achieve second-best efficiency. In other words, the question is whether tax coordination aimed at maximizing the representative household’s utility increase revenue or decrease it?

Second-best public goods provision is implied by

$$\frac{u_g}{u_{x_2}} = \frac{1}{1 - c^a (M + T) - \frac{M - c^a (M) + T - c^b (T)}{c_S + c_K}}$$

(31)

Does this condition imply higher or lower public goods provision. To answer this question, we split the tax rate adjustments in order to get to the constrained efficiency optimum into two steps. First, we adjust the structure of $M$ and $T$ while holding $M + T$ constant in order to minimize $c^a (M) + c^b (T)$; second, we adjust the level of $M + T$ such that the above optimality condition holds.

We start by considering the first step. Starting from the uncoordinated tax competition equilibrium a small coordinated increase in $M$ in all countries affects welfare by $u_g (c_T^b - c_M^a) \frac{c_S}{c_S + c_K} S$. Similarly, a small increase in $T$ changes welfare by $-u_g (c_T^b - c_M^a) \frac{c_K}{c_S + c_K} S$. For instance, if $c_T^b > c_M^a$, an increase in $M$ and a decrease in $T$ of the same amount increases welfare by $u_g (c_T^b - c_M^a) S$. Such a reform that does not alter the effective tax burden on capital, $M + T$, does not change the private budget since $S$ and $K$ remain unaffected. However, by making taxation more efficient (via reducing the sum of $c^a (M) + c^b (T)$), such a reform increases tax revenue. Thus, there is room for a welfare-enhancing change in the tax structure which increases tax revenue by making taxation more efficient.
Now, consider the second step, the adjustment in the level of $M + T$. With more efficient effective taxation, it is plausible to assume that the welfare optimum implies increased revenue as well. In this case, the Nash equilibrium with $c^c_T \neq c^c_M$ would involve inefficiently low tax revenue and public goods provision (seen from a second-best efficiency perspective). A coordinated tax reform would therefore increase revenue. This does not mean, however, that this necessarily involves a higher tax burden $M + T$ or even a higher effective tax burden $M - c^a(M) + T - c^b(T)$. The reason is that, by reducing $M + T$, savings are increased that allow for higher revenue even if the effective tax burden is lower. To be more precise, the Nash equilibrium under tax competition is characterized by the following equation\(^\text{10}\):

$$u_g - u_{x_2} - \frac{M^N - c^a(M^N) + T^N - c^b(T^N)}{\frac{1}{\epsilon_K} + \frac{1}{\epsilon_S}} = c^c_T(T^N) \frac{\epsilon S}{\epsilon S + \epsilon_K} + c^c_M(M^N) \frac{\epsilon K}{\epsilon S + \epsilon K}$$

where the subscript $N$ denotes the Nash equilibrium levels.

In comparison, after adjusting $M$ and $T$ in order to minimize $c^a(M) + c^b(T)$, a small increase in $M + T$ has the following effect on welfare:

$$\frac{\tilde{u}_g - u_{x_2}}{\tilde{u}_g} - \frac{(M + T)^N - c^a(M^N) - c^b(T^N)}{\frac{1}{\epsilon_K} + \frac{1}{\epsilon_S}} \geq c'(M + T)^N$$

where the tilde denotes the levels after adjusting tax rates. Note that $\tilde{M} + \tilde{T} = (M + T)^N$, i.e. has the same level as in the Nash equilibrium. By adjusting $M$ and $T$ while holding $M + T$ constant (step 1), $S$ and $K$ stay constant, as do $\epsilon_S$ and $\epsilon_K$. However, by increasing tax revenue, $u_g$ is reduced and, thus, $\frac{u_g - u_{x_2}}{u_g}$. At the same time, $M + T - c^a(M) + T - c^b(T)$ is increased. These effects make it, at first glance, difficult to determine whether $M + T$ is optimally increased or decreased and whether this results in larger revenue.

The following Proposition outlines sufficient conditions for the coordinated optimum being characterized by higher revenue.

**Proposition 7** Starting from a Nash equilibrium where $c^c_T \neq c^c_M$, a coordinated tax reform unambiguously increases welfare. Sufficient conditions for the optimum to have higher tax revenue and public goods provision are that

(i) $c^c_T \frac{\epsilon S}{\epsilon S + \epsilon_K} + c^c_M \frac{\epsilon K}{\epsilon S + \epsilon_K} \geq c'(M + T)$ for a given level of $M + T$ and

(ii) $\epsilon_S$ and $\epsilon_K$ are non-increasing in $S$ and $K$.

---

\(^{10}\)The equation is attained as follows: Eq. (21) is plugged into (29). The same equation results if (22) is plugged into (30).
Proof. Assume that the planner adjusts $M$ and $T$ while holding $M + T$ constant to minimize total real cost $c^a (M) + c^b (T)$. If at this point, $\frac{u_g - u_{x_2}}{u_g} - c' (M + T) - \frac{M - c^a (M) + T - c^b (T)}{\frac{c^a}{M} + \frac{c^b}{T}} \geq 0$, the second best optimum implies higher revenue as $S$ and $K$ are unchanged but $(M - c^a (M) + T - c^b (T))$ has increased (due to more efficient tax structure). If it is negative, though, e.g. because $u_g - u_{x_2}$ is reduced due to higher revenue, assume that $M + T$ is reduced (in a cost efficient way) such that revenue is the same as in the Nash equilibrium. Then, if $\epsilon_S$ and $\epsilon_K$ are non-increasing in $S$ and $K$, and $c' (M + T) < c^b_T \epsilon_S + c^a_M \epsilon_K$, it must be that $\frac{u_g - u_{x_2}}{u_g} - c' (M + T) - \frac{M - c^a (M) + T - c^b (T)}{\frac{c^a}{M} + \frac{c^b}{T}} > 0$ (since $\frac{u_g - u_{x_2}}{u_g}$ is the same as in the Nash equilibrium, $c' (M + T)$ is lower, and $M - c^a (M) + T - c^b (T)$ is lower). Accordingly, starting from this benchmark of equal revenue, an increase in taxation and, thus, revenue is welfare-increasing.

5 Integrating labor taxes

In the above model, there is untaxed income. To be specific, $F (K) - (\rho + T) K$ is residual income that remains untaxed. Do the above results depend on the assumption that this income is actually untaxed and that there are no supplementary tax instruments? As we outlined above, the availability of lump-sum taxation implies that both taxes on investment and savings are zero – with and without evasion. However, what is the consequence of introducing another tax on an immobile factor that may still be adjusted by the household, though?

In the following, we assume that there is a second production input, labor. Production now exhibits constant returns to scale in capital $K$, and labor $L$, and is represented by the production function, $F (K, L)$. Labor income is taxed at the household level. Households now have a utility function that includes disutility from work:

$$u (x_1, x_2, L, g), \text{ with } u_L < 0.$$  

The household receives labor income of $wL$, with $w$ denoting the wage rate. The government levies a proportional tax $\theta$ on labor income. In parallel to the taxes on investment and savings, the household may evade a fraction $h$ of her labor income at a social cost of $c^h (h)$ and a private cost of $z^h (h, \theta)$. We define $\Theta \equiv \theta (1 - h) + c^h (h) + z^h (h, \theta)$.

Evasion of payroll income is usually assumed to close to zero. However, the labor input here may also include self-employment work.
The budget constraints are now given by

\[ x_1 = e - S \]
\[ x_2 = \Pi + (w - \Theta) L + (\rho - M) S \]
\[ \Pi = F(K, L) - wL - (\rho + T)K \]

and the first order conditions are \( \frac{u_2}{u_1} = \frac{1}{\rho - M}, \) \( c^a_h (a) + z^a (a, m) = m, \)
\( -u_L = w - \Theta, \) \( c^h_h (h) + z^h (h, \theta) = \theta, \)
\( F_K (K, L) = \rho + T, \) \( F_L (K, L) = w, \)
and \( c^b_b (b) + z^b (b, \tau) = \tau. \)

Here and in what follows, the interest rate \( \rho \) is taken as given from an individual country’s point of view (i.e., the small open economy assumption). Then the above first-order conditions imply a savings function \( S(\rho - M), \) a labour supply function \( L^s (w - \Theta), \) a labor demand function \( L^d (w, \rho + T), \)
and a capital demand function \( K(w, \rho + T). \)

In the labor market equilibrium, labor supply equals labor demand:

\[ L^s (w - \Theta) = L^d (w, \rho + T). \]

It follows that

\[ \frac{dw}{d\Theta} = \frac{\epsilon_{L^s}}{\epsilon_{L^s} + \epsilon_{L^d, w}} > 0; \]
\[ \frac{dw}{d(\rho + T)} = -\frac{\epsilon_{L^d, \rho + T}}{\epsilon_{L^s} + \epsilon_{L^d, w}} < 0; \]

where \( \epsilon_{L^s} \) is the semi-elasticity of labor supply with respect to the net wage, and \( \epsilon_{L^d, w} = \frac{L^d_{\rho + T}(w, \rho + T)}{L^d(w, \rho + T)} \) and \( \epsilon_{L^d, \rho + T} = \frac{L^d_{\rho + T}(w, \rho + T)}{L^d(w, \rho + T)} \) are the semi-elasticities of labor demand with respect to labor cost and capital cost, respectively, both defined as a positive measure.

From the country’s viewpoint, the wage rate is just an accounting number that ensures full employment – and an unambiguous function of the policy parameters \( \Theta, T \) and the interest rate \( \rho. \) Therefore, we have now a savings function \( S(\rho - M), \) a labour input function \( L(\Theta, \rho + T), \) and capital demand function \( K(\Theta, \rho + T). \)

We can now proceed and consider optimal tax policy choices. The individual government maximizes utility subject to the constraints, \( x_1 = e - S, \)

\[ x_2 = F(K, L) - (\rho + T)K(\Theta, \rho + T) - \Theta L(\Theta, \rho + T) + (\rho - M) S(\rho - M), \]
and
\[ g = \left( \Theta - c^h (\Theta) \right) L(\Theta, \rho + T) + (T - c^b (T)) K(\Theta, \rho + T) + (M - c^a (M)) S(\rho - M). \] (34)

The first-order conditions can be expressed as
\[ u_g - u_x - u_g (c_M^a + (M - c^a (M)) \epsilon_s) \leq 0; \]
\[ u_g - u_x + u_g \left( c^h (\Theta) + (\Theta - c^h (\Theta)) \epsilon_{L,\Theta} + (T - c^b (T)) \epsilon_{K,\Theta} \frac{K}{L} \right) \leq 0; \]
\[ u_g - u_x + u_g \left( \frac{c^h (\Theta) + (\Theta - c^h (\Theta)) \epsilon_{L,\rho T} \frac{L}{K}}{K} \right) \leq 0; \]

where \( \epsilon_{L,\Theta}, \epsilon_{K,\Theta}, \epsilon_{K,\rho T}, \epsilon_{L,\rho T} \) are positively defined semi-elasticities. From this, we can derive the following results.

**Lemma 8** (Gordon 1986, Bucovetsky/Wilson 1991) In the absence of labor tax evasion, the optimal source tax on investment is zero. The savings tax and the labor income tax are strictly positive.

**Proof.** See the Appendix. ■

**Proposition 9** With evasion of labor taxes, all three taxes are used in equilibrium.

**Proof.** To start, note that \( u_g > u_x \) since the available tax instruments are distortionary. It follows from the first condition that \( m > 0 \). It follows from both the second and third condition, that the equilibrium values of \( \tau \) and \( \theta \) cannot both equal zero. Can \( \tau = 0, \theta > 0 \) be an equilibrium? In this case, the second and third conditions read
\[ u_g - u_x - u_g \left( c^h (\Theta) + (\Theta - c^h (\Theta)) \epsilon_{L,\theta} \right) = 0; \] (35)
\[ u_g - u_x + u_g \left( \frac{(\Theta - c^h (\Theta)) \epsilon_{L,\rho T} \frac{L}{K}}{K} \right) \leq 0. \] (36)

With \( \frac{dL}{d\Theta} = \frac{F_{KK}(K,L)}{F_{KL}(K,L)} \frac{dP}{dT} \) and, due to constant returns to scale, \( \frac{F_{KK}(K,L)}{F_{KL}(K,L)} = \frac{L}{K} \), the two equations read
\[ u_g - u_x + u_g \left( -c^h (\Theta) + (\Theta - c^h (\Theta)) \epsilon_{L,\rho T} \frac{L}{K} \right) = 0; \] (37)
\[ u_g - u_x + u_g \left( (\Theta - c^h (\Theta)) \epsilon_{L,\rho T} \frac{L}{K} \right) \leq 0; \] (38)
which, due to $- \frac{c}{\Theta}(\Theta) < 0$, cannot be simultaneously true. The proof that $\tau > 0, \theta = 0$ cannot be optimal follows similar lines. ■

**Corollary 10** In the uncoordinated Nash equilibrium, the marginal cost of labor tax evasion is higher than the marginal cost of investment tax evasion.

It follows from the optimal conditions for labor and investment taxes that

$$c^b(\Theta) - c_T^b = \left( T - c^b(T) \right) \left( \epsilon_{K,\rho+T} - \epsilon_{K,\Theta} \frac{K}{L} \right) + \left( \Theta - c^b(\Theta) \right) \left( \epsilon_{L,\rho+T} \frac{L}{K} - \epsilon_{L,\Theta} \right).$$

With $\frac{dL}{d\rho} = -\frac{F_{KK}(K,L)}{F_{KL}(K,L)} \frac{dL}{dT}$ and $\frac{dK}{d\rho} = -\frac{F_{LL}(K,L)}{F_{KL}(K,L)} \frac{dK}{dT}$, as well as $\frac{dL}{d\Theta} = \frac{F_{LL}(K,L)}{F_{KL}(K,L)} \frac{dL}{d\Theta} + \frac{F_{KL}(K,L)}{F_{KL}(K,L)} \frac{dK}{d\Theta}$, and $F_{LL}(K,L) = -\frac{K}{L}$, it follows that

$$c^b(\Theta) - c_T^b = \left( T - c^b(T) \right) \left( \epsilon_{K,\rho+T} - \epsilon_{K,\Theta} \frac{K}{T} \right) > 0$$

This condition implies that, if the evasion cost functions are of similar shape, a larger part of labor taxes are evaded than of investment taxes.

Before we turn to coordinated tax changes, we briefly describe the world market for capital. In capital market equilibrium, aggregate capital demand for all of the $n$ identical countries has to be equal to aggregate savings supply. Under symmetry, this implies that in each individual country savings equal capital demand:

$$S(\rho - M) = K(\Theta, \rho + T).$$

This requirement implicitly defines the interest rate as a function of the common equilibrium effective tax rates: $\rho(\Theta, M, T)$. A coordinated tax change (with identical rate changes in each country) would affect the interest rate as follows:

$$\frac{\partial \rho}{\partial M} = \frac{\epsilon_S}{\epsilon_S + \epsilon_{K,\rho+T}} > 0;$$

$$\frac{\partial \rho}{\partial T} = -\frac{\epsilon_{K,\rho+T}}{\epsilon_S + \epsilon_{K,\rho+T}} < 0;$$

$$\frac{\partial \rho}{\partial \Theta} = -\frac{\epsilon_{K,\Theta}}{\epsilon_S + \epsilon_{K,\rho+T}} < 0.$$

Starting from the uncoordinated Nash equilibrium, coordinated changes of taxes $\tau, m$ or $\theta$ affect an individual country only via the interest rate:

$$\frac{du}{d\rho} = u_g \left[ (M - c^a(M)) \epsilon_S - (\Theta - c^b(\Theta)) \epsilon_{L,\rho+T} \frac{L}{S} - \left( T - c^b(T) \right) \epsilon_{K,\rho+T} \right] S.$$
It follows from the optimality conditions for individual policy-making that

\[ \frac{du}{d\rho} = u_g \left[ c_T^b - c_M^g \right] S. \]  

(43)

**Proposition 11**  
(i) In the absence of labor tax evasion, the opportunity to evade savings taxes implies that savings taxes are too high.  
(ii) In the presence of labor tax evasion, Prop. 3 applies.

**Proof.** (i) Without labor tax evasion, the optimal source tax on investment, \( \tau \), is zero, as shown above. Therefore, \( \frac{du}{d\rho} = u_g \left[ -c_M^g \right] S < 0 \). A coordinated decrease in savings taxes reduces the world market interest rate and, therefore increases welfare. Part (ii) follows from inspection of eq. (43).

We may further state the following.

**Corollary 12**  
Whenever investment taxes are too high, labor taxes are too high as well, and vice versa.

**Proof.** The Corollary follows from the fact that the sign of the interest rate effect of a coordinated increase in \( \tau \) is the same as a coordinated increase in \( \theta \).

6 Discussion and concluding remarks

The above analysis shows that, even in the presence of tax avoidance and evasion, uncoordinated tax setting under competition may be constrainedly efficient. This, however, will rather be an exception than the rule. In general, the tax competition equilibrium with two tax instruments and evasion will be characterized by an inefficient tax structure, with one tax being inefficiently low and the other one inefficiently high.

Our analysis puts into question the implicit assumption of many contributions in the tax competition literature that the analysis may be restricted to source taxes because residence-based capital taxes are subject to evasion. We consider both avoidance and evasion in residence taxation and source taxation. Except for extreme cases, both taxes will be used with strictly positive rates. And, as mentioned above, our analysis qualifies the intuitive claim that both residence-based and source-based capital taxes are too low. We demonstrate that the equilibrium is either constrained efficient or one of the tax rates will be unambiguously too high. So ironically, if source taxes are supposed to be inefficiently low, as is commonly held in the tax competition literature, this can only be true if residence taxes are too high.
Actually, a case can be made for investment taxes being inefficiently high and saving taxes being inefficiently low. An important method of underreporting by savers involves the use of tax havens to conceal income; that is, there is illegal tax evasion. In contrast, multinationals typically use tax havens to engage in tax avoidance activities. The latter may involve substantial resource costs, used to design and execute complicated tax planning strategies. These resources represent a social cost, whereas the concealment of income by savers involves the risk of substantial fines, which are only a private cost. Thus, the different mixes of evasion and avoidance activities involved in underreporting saving and investment income provides an argument for assuming that the marginal real cost of underreporting investment taxes is larger than the equivalent in savings taxes. In this case Proposition 1 says that savings taxes are inefficiently low and investment taxes are inefficiently high.

7 Appendix

This Appendix supplements the part on labor tax evasion. Recall that the first order conditions are \( \frac{u_x}{ux_1} = \frac{1}{\rho - M} \), \( c^o_a(a) + z^o_a(a, m) = m \), \( -\frac{u_L}{u_{x_L}} = w - \Theta \), \( c^o_h(b) + z^o_h(h, \theta) = \theta \), \( F_K(K, L) = \rho + T \), \( F_L(K, L) = w \), and \( c^o_b(b) + z^o_b(b, \tau) = \tau \). It follows from the optimal labor supply condition that \( \frac{dL}{dw} = -\frac{dL}{d\theta} = -\frac{u}{\Psi} \) where \( \Psi < 0 \) is the second derivative with respect to labor supply. From the optimal capital and labor demand condition follow

\[
\begin{align*}
\frac{\partial L}{\partial w} &= \frac{F_{KK}(K, L)}{F_{LL}(K, L)F_{KK}(K, L) - F_{LK}(K, L)F_{KL}(K, L)} \\
\frac{\partial K}{\partial w} &= \frac{F_{KL}(K, L)}{F_{LL}(K, L)F_{KK}(K, L) - F_{LK}(K, L)F_{KL}(K, L)} \\
\frac{\partial L}{\partial (\rho + T)} &= \frac{-F_{LL}(K, L)F_{KK}(K, L) - F_{LK}(K, L)F_{KL}(K, L)}{F_{LL}(K, L)} \\
\frac{\partial K}{\partial (\rho + T)} &= \frac{-F_{LL}(K, L)F_{KK}(K, L) - F_{LK}(K, L)F_{KL}(K, L)}{F_{LL}(K, L)}
\end{align*}
\]
We can now use the labor market equilibrium equation, \( L^s (w - \Theta) = L^d (w, \rho + T) \), to derive effects on wages.

\[
\frac{dw}{d\Theta} = \frac{u_x}{F_{KK}(K,L)} - \frac{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi} \\
\frac{dw}{d(\rho + T)} = \frac{F_{KK}(K,L)}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi}
\]

Using \( \frac{-dL^s}{d\Theta} = -\frac{u_x}{\Psi} \), total effects of a change in \( \Theta \) are:

\[
\frac{dL}{d\Theta} = L^s \frac{dw}{d\Theta} - L'^s = \frac{u_x}{\Psi} \frac{F_{KK}(K,L)}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi} < 0
\]

\[
\frac{dK}{d\Theta} = -\frac{u_x}{\Psi} \frac{F_{KK}(K,L)}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi}
\]

from which follows \( \frac{dK}{d\Theta} = -\frac{F_{KL}(K,L)}{F_{KK}(K,L)} \frac{dL}{F_{KK}(K,L)} \frac{d\Theta}{\Psi} \). Total effects of a change in \( T \) are:

\[
\frac{dL^s}{dT} = L^s \frac{dw}{dT} = \frac{u_x}{\Psi} \frac{F_{KL}(K,L)}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi}
\]

\[
\frac{dK}{dT} = \frac{1+F_{LL}(K,L)\frac{u_x}{\Psi}}{F_{LL}(K,L)F_{KK}(K,L) - F_{LK}(K,L)L_{F_{KL}(K,L)}} + \frac{u_x}{\Psi}
\]

from which follows \( \frac{dK}{dT} = -\frac{F_{LL}(K,L)}{F_{KL}(K,L)} \frac{dL}{F_{KL}(K,L)} \frac{1}{\Psi} \).

It follows further that \( \frac{dL}{d\Theta} = -\frac{F_{KK}(K,L)}{F_{KL}(K,L)} \frac{dL}{\Psi} \) and \( \frac{dK}{d\Theta} = -\frac{F_{KL}(K,L)}{F_{KK}(K,L)} \frac{dK}{\Psi} \).

**References**


