Public Goods Provision, Redistribution and Capital Mobility

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Abstract

Two results follow from the standard workhorse model of tax competition. One is that tax competition between countries leads to underprovision of public consumption goods (see Zodrow and Mieszkowski 1986). The other that tax competition lowers capital taxes and may lead to less redistribution due to higher efficiency costs of capital taxation. This paper embeds both public goods provision and redistribution in a single model framework, and shows that preferences for income redistribution may alter the standard result of under-provision of public goods under tax competition.

JEL classification: H2, F6, H4

Keywords: public goods, redistribution, tax competition
1 Introduction

Two results follow from the standard workhorse model of tax competition. One is that tax competition between countries leads to underprovision of public consumption goods (see Zodrow and Mieszkowski 1986). The other that tax competition lowers capital taxes and may lead to less redistribution due to higher efficiency costs of capital taxation. This paper embeds both public goods provision and redistribution in a single model framework, and shows that preferences for income redistribution may alter the standard result of under-provision of public goods under tax competition.

A simultaneous analysis of public goods provision and redistribution is important because public goods affect households differently. In this paper I differentiate between two types of public goods: The first pertains to public goods that benefit high-income earners more than low-income earners. Police services and highways are examples of public goods that benefit rich people more. The second relates to public goods that benefit low-income earners more than high-income earners. This type of public goods can include public provision of vaccination, public parks and public schools. Obviously, taxes to finance public goods have distributional effects as well. A third factor that has implication for income redistribution is that there may be a positive correlation of capital income and labor income, which has been largely ignored in the tax competition literature.\(^1\) The correlation of earnings and wealth in the U.S., for example, is found to be 0.51 when retirees are excluded (Rodriguez et al., 2002).

This paper contributes to the literature by analyzing the interactions of redistribution and public goods provision under capital mobility. I use a standard two-country symmetric tax competition model, whereby benevolent governments tax labor income and capital to finance public goods. Public goods can benefit low-income people more or less than high-income ones. Furthermore, capital income and labor income are positively correlated. I derive the optimal redistribution of labor income and capital income as well as the optimal level of public goods provision. Capital mobility constraints the taxation

\(^1\)Huber (1999) considered this aspect and shows that capital taxation has a negative externality by reducing the income inequality of foreign country if labor income and capital income are positively correlated.
of capital, leading to under-redistribution of capital income relative to labor income. The extent to which capital income is less redistributed relative to labor income is equal to the net welfare costs of capital mobility. The higher the capital mobility, the lower the optimal capital tax rate will be and the more unequal the net capital income is relative to net labor income. Consequently, the optimal level of income redistribution is lower.

The optimal level of public goods is determined by the marginal benefit of providing them and the marginal costs of public funds. Sandmo (1998) shows that if public goods benefit high-income earners more (less) than low-income ones, a lower (higher) level of public goods should be provided in order to achieve a better redistribution. Thus, public goods can be used as an instrument to counteract the negative effect of capital mobility on redistribution. If capital mobility increases, the direct distributional effect of public goods calls for a higher (lower) level of public goods, if public goods benefit low-income earners more (less). On the other hand, due to the positive correlation of capital income and labor income, a less strong redistribution of capital income can be partly compensated by a stronger redistribution of labor income. As a result, taxing labor income becomes more beneficial from a distributional viewpoint and the marginal costs of public funds decrease, which calls for a higher level of public goods. This is the opposite to the result in literature that capital mobility increases the costs of public goods provision. Combing two effects, the optimal level of public goods is unambiguously increased by higher capital mobility, if public goods benefit low-income earners more. For the case that public goods benefit low-income earners less, the effect of higher capital mobility depends on which of the two effects dominates.

The rest of the paper is organized as follows: Section 2 gives an overview of the literature. The model setup is introduced in Section 3 and the optimal policy of the government is analyzed in Section 4. I derive in the fifth section the comparative statics of optimal policy w.r.t. capital mobility and discuss the results in Section 6. The last section concludes.
2 Literature review

There are two strands of literature on the welfare effects of capital mobility. One strand focuses on the effects of capital mobility on the provision of public goods and the other analyzes how capital mobility affects income redistribution.

The literature on public goods provision normally applies a representative agent model and thus ignores the distributional aspect. By restricting tax instruments to capital tax, a lower level of public goods provision results when capital mobility increases the efficiency costs of capital taxation (see Zodrow and Mieszkowski, 1986; Wilson, 1986 and Hoyt, 1991). One wonders, however, whether public goods are still under-provided in the presence of other tax instruments. Using a representative agent model too, Bucovetsky and Wilson (1991) analyze the optimal capital tax and labor tax to finance public goods. They show that both capital income and labor income are inefficiently low taxed and public goods are under-provided when capital is mobile. The under-taxation of labor income results from its negative externality because of labor supply distortion and the interaction between labor market and capital market.

Most papers that analyze income redistribution use either models with individuals who differ only in capital income or workers vs. capitalists models. In Persson and Tabellini (1992) individuals differ in their capital income and the government is chosen by the median voter. Increasing tax competition reduces redistribution because capital taxation becomes more distortionary. However, anticipating this change, the median voter chooses a "further left" policy maker, who prefers more redistribution. Reduction in redistribution by capital mobility is therefore mitigated by a political effect. Papers like Lopez, Marchand and Pestieau (1998) and Gabszewicz and van Ypersele (1996) use workers vs. capitalists models, showing that capital mobility reduces redistribution from capitalists to workers. Lejour and Verbon (1997) considers capital taxation to finance public goods that only benefit workers. Therefore, public goods can be interpreted as a transfer to workers. They show that over-provision of public goods can result, but due to the negative externality of capital taxation in growth. A stronger capital taxation reduces domestic saving and thus capital invested in foreign country, which lowers its growth rate.
Other studies analyze the optimal mix of capital tax and labor tax to finance exogenous revenue requirement. When the effects of factor income are considered, capital tax rate can be either increased or decreased by capital mobility. (see e.g. Haufler, 1997 and Grazzini and van Ypersele, 2001).

In workers vs. capitalists model labor income and capital income are per definition negatively correlated\(^2\). However, income data show that they are positively correlated. This fact is considered in Huber (1999), which uses Mirrlees’ approach to study the effects of capital mobility on optimal redistribution from high-skilled to low-skilled individuals. The paper shows that if high-skilled individuals own more capital than low-skilled, capital taxation has a positive externality by reducing income inequality in the foreign country.

The paper closest to ours is Ihori and Yang (2008), which analyzes both redistribution and public goods provision under tax competition. They show that tax competition does not affect the optimal level of public goods provision, but only reduces capital income redistribution. They assume that a lump-sum transfer (tax) is available to finance public goods and they did not consider the possibility that public goods have distributional effect. Consequently, providing public goods and redistribution can be separated.

3 The model

A two-country capital tax competition model is considered. The two countries, denoted by subscript \(i \in (A, B)\), are identical. Each country is populated by a continuum of individuals, whose mass is normalized to 1. The individuals in each country differ in their human capital \(h\) as well as in their physical capital endowment \(k\), which have a joint distribution with the density function \(f(k, h)\) and the supports \(k \in [0, \bar{k}]\) and \(h \in [0, \bar{h}]\). The covariance between human capital and physical capital endowment is positive, i.e. \(\text{cov}(h, k) > 0\). This assumption is based on the finding in data that capital income and labor income are positively correlated. The aggregate capital endowment and human capital are both normalized to 1, \(\bar{K}_i = \int_0^{\bar{k}} \int_0^{\bar{h}} k f(k, h) dk dh = 1\) and \(\bar{H}_i = \)

\(^2\)In the setting of Gabszewicz and van Ypersele (1996) the two kinds of income are uncorrelated, since all individuals have the same labor income.
whereby $\kappa_i \equiv \frac{K_i}{\pi_i}$ is the capital intensity, i.e., capital investment per efficiency unit of labor, in country $i$ and $K_i$ denotes the total capital investment in country $i$, $i \in (A, B)$. Factor market and product market are perfectly competitive, which implies that factor prices, i.e., wage rate $w_i$ and gross interest rate $r_i$, are determined by capital intensity: $w_i = g(\kappa_i) - g'(\kappa_i) \kappa_i = b \kappa_i^2$; $r_i = g'(\kappa_i) = a - 2b \kappa_i$.

Capital is mobile between two countries, but labor is immobile. Investing in foreign country causes transaction costs of $\frac{1}{2} \beta K_i$ (1 - $K_i$), where 1 - $K_i$ is the total amount of capital invested by residents of country $i$ in country $j$, $i, j \in (A, B)$ and $i \neq j$. Capital tax is source-based and flat at a rate of $\tau_i$ per unit. Equilibrium on the capital market implies that the difference between the net return to capital in both countries is equal to the marginal costs of transaction: $r_i - \tau_i = r_j - \tau_j - \beta (1 - K_i)$. Using the additional condition that $K_A + K_B = K_A + K_B = 2$, the equilibrium capital intensity can be derived as

$$\kappa_i = 1 + \frac{\tau_j - \tau_i}{4b + \beta}, i \neq j; i, j \in (A, B).$$

For later references I derive the following derivatives:
Capital intensity in one country depends negatively on its own tax rate and positively on the other country’s tax rate. A higher capital tax rate reduces the wage rate and increases the gross return to capital in its own country, and its effects on the factor prices in the other country are exactly the opposite. The parameter $\beta$ determines the degree of capital mobility and thus the intensity of tax competition. The larger the $\beta$, the higher the transaction costs and the smaller the negative effect of capital tax increase on its own capital intensity.

Individuals derive utility from the consumption of the numeraire private goods $c$ and public goods $z$:

$$u_{kh} = u(c_{kh}, z).$$

The subscript $kh$ denotes individuals with human capital $h$ and capital endowment $k$. The utility function is increasing and concave in both arguments, i.e. the first derivatives $u_c$ and $u_z$ are positive and the second derivatives $u_{cc}$ and $u_{zz}$ are negative. The cross derivative $u_{cz}$ can be either positive or negative. A positive derivative implies that private goods and public goods are complementary in consumption. They are substitutes if $u_{cz}$ is negative. The marginal rate of transformation between private goods and public goods is given by $p$.

To finance public goods $z$, the government levies a flat rate tax $t$ on labor income and a source-based unit tax $\tau$ on capital. For computational simplicity, it is assumed that only one individual in the export country invests in the foreign country\(^3\). The private

\(^3\)Since we look at the symmetric equilibrium where both countries choose the same capital tax rate and there is no capital flow, this assumption is not essential to our results.
consumption of all other individuals in country \( i \) are\(^4\)

\[
c_{kh} = (1 - t_i) w_i h + (r_i - \tau_i) k, \quad i \in (A, B)
\] (5)

The government is benevolent and maximizes a utilitarian welfare function:

\[
W = \int_k \int_h u_{kh} f(k, h) dk dh.
\] (6)

The budget constraint of the government is

\[
t_i w_i \bar{H}_i + \tau_i K_i - pz_i = 0, \quad i \in (A, B)
\] (7)

4 Optimal policy

In this section I derive the optimal policy of the government. Each country maximizes its welfare function by choosing tax rates and the level of the public goods, while taking the policy of the other country as given. In the symmetric Nash-equilibrium the two countries choose the same policy and there is no capital flow between them. Since the two countries are identical, it is sufficient to analyze the optimal policy of one country. I will look at country \( A \) and the corresponding Lagrangian function is

\[
\mathcal{L}_A = \int_k \int_h u(c_{kh}, z_A) f(k, h) dk dh + \lambda_A (t_A w_A \bar{H}_A + \tau_A K_A - pz_A),
\] (8)

whereby I use \( \lambda_A \) to denote the Lagrangian multiplier which measures the shadow price for tax revenue.

\(^4\)The private consumption of the individual who invests in foreign country is \( c_{kh} = (1 - t_i) w_i h + (r_i - \tau_i) (k - (1 - K_i)) + (r_j - \tau_j) (1 - K_i) - \phi = (1 - t_i) w_i h + (r_i - \tau_i) k + \phi, \quad i, j \in (A, B); \; i \neq j \) and \( r_i - \tau_i < r_j - \tau_j \).
4.1 Labor tax

The first-order-condition for labor tax rate $t$ is

$$\int_k \int_h (-w_A h) u_c(\cdot) f(k, h)dkdh + \lambda_A w_A \bar{H}_A = 0. \quad (9)$$

Following Atkinson and Stiglitz (1980), I define the distributional characteristic of labor income as $\xi_h \equiv -\frac{\text{cov}(u_c, h)}{E[u_c]E[h]}$, the negative normalized covariance between the marginal utility of private consumption and human capital endowment. It is zero if all individuals have the same income or if human capital is uniformly distributed. $\xi_h$ indicates how effective labor taxation is in changing income inequality. The higher $\xi_h$, the more unequal labor income and the more important is labor taxation in reducing income inequality. Using definition of $\xi_h$ the first-order condition (9) can be rewritten as

$$\frac{\lambda_A}{E[u_c]} = 1 - \xi_h. \quad (10)$$

where $E[u_c] \equiv \int_k \int_h u_c(\cdot) f(k, h)dkdh$. The left-hand-side of equation (10) can be interpreted as the marginal costs of public funds (MCF), defined as the shadow price of tax revenue divided by the average marginal utility of private income (see e.g. Sandmo, 1998). Since labor supply is assumed to be exogenous, there is no efficiency costs of taxing labor income. However, taxing labor income affects income distribution. Note that the assumption of a concave utility function and a utilitarian welfare function imply that the government has a distributive concern. Individual with higher private consumption has a lower marginal utility of consumption and features therefore a lower marginal welfare weight. If an individual endowed with higher human capital also exhibits higher private consumption, the distributional characteristic $\xi_h$ is positive. In this case, taxing labor income reduces income inequality and increases the welfare on this account. As a result, MCF by taxing labor income is smaller than 1. If $\xi_h$ is negative, MCF is larger than 1, because taxing labor income reduces welfare by increasing income inequality. Since labor income and capital income are assumed to be positively correlated, it applies that $\xi_h \geq 0$. 
4.2 Capital tax

Maximizing (8) with respect to $\tau$ and imposing a symmetric Nash-equilibrium\(^5\) yield (see Appendix A.1):

$$\frac{\lambda_A}{E[u_c]} = \frac{1 - \xi_k - \left(\frac{\partial v_A}{\partial r_A} (1 - \xi_k) + (1 - t_A) \frac{\partial w_A}{\partial r_A} (1 - \xi_k)\right)}{1 - \left(-t_A \frac{\partial w_A}{\partial r_A} - t_A \frac{\partial v_A}{\partial r_A}\right)}$$  \hfill (11)

whereby I define the distributional characteristic of capital income as $\xi_k \equiv - \frac{\text{cov}(u_c, k)}{E[u_c] E[k]}$. As for labor taxation, the MCF by means of taxing capital income depends on the distributional characteristic $\xi_k$. For a positive $\xi_k$, a marginal increase of capital tax rate increases welfare by reducing capital income inequality and the MCF is lower, and vice versa for a negative $\xi_k$.

However, taxing capital has additional welfare effects due to capital mobility. The bracket term in the numerator on the right-hand-side of (11) gives the additional welfare effects of capital tax by affecting the private consumption of individuals. Taxing capital reduces capital intensity and increases the gross return to capital. This benefits capital holders, making them lose less than the tax increase. However, a lower capital intensity decreases wage rate and harms individuals by reducing their labor income. Both effects are weighted by $(1 - \xi_k)$ and $(1 - \xi_h)$, respectively. With positive distributional characteristics, increase in gross return to capital is less welfare-improving, because it exaggerates capital income inequality. Similarly, decrease in wage income is less harmful for the reason that it mitigates labor income inequality. If these two welfare effects are positive in total, taxing capital becomes less costly, apart from the positive distributional effect $\xi_k$, and the MCF by taxing capital income becomes lower. If they are negative, the MCF becomes higher.

The bracket term in the denominator on the right-hand-side of (11) is the additional welfare effect of capital tax by affecting tax revenue. This revenue effect is unambiguously negative, because a lower capital intensity and a lower wage rate reduces tax revenue, i.e.

\(^5\)After setting $r_A - r_A = r_B - r_B$, the resulting best-response function (11) is identical for both countries, which implies that there is a symmetric Nash-equilibrium.
the tax revenue reduction \(-t_i \frac{\partial w_i}{\partial r_i} - \tau_i \frac{\partial w_i}{\partial r_i}\) is positive. The stronger this negative revenue effect, the more costly the capital tax and the higher the MCF. If capital is immobile, both bracket terms are equal to zero and equation (11) reduces to \(\frac{\lambda A}{E[w_i]} = 1 - \xi_k\), analogously to equation (10).

Combining (10) and (11), it can be derived that

\[
\xi_k - \xi_h = \left( -t_A \frac{\partial w_A}{\partial r_A} - \tau_A \frac{\partial \kappa_A}{\partial \tau_A} \right) (1 - \xi_h) - \left( \frac{\partial r_A}{\partial \tau_A} (1 - \xi_k) + (1 - t_A) \frac{\partial w_A}{\partial \tau_A} (1 - \xi_k) \right),
\]

(12)

This equation gives the inequality of net capital income relative to that of net labor income in the optimum. If there is no capital mobility, equation (12) reduces to \(\xi_k = \xi_h\).

Intuitively, if both taxes are non-distortionary, the marginal distributional effects of both taxes should be equalized in the optimum, or in other words, changing the mix of capital tax and labor tax cannot improve income distribution.

With capital mobility, the distributional characteristics of capital taxation and labor taxation are not equalized any more. The right-hand-side of (12) is the net welfare costs of capital mobility. The first bracket term is the loss in tax revenue caused by capital outflow. Multiplied by the MCF, which is equal to \(1 - \xi_h\), it gives the welfare costs of tax revenue loss. The third bracket term is the welfare effects of capital mobility by affecting individual private income, which can be either positive or negative. To determine the sign of the net welfare effect, I reformulate equation (12) by using (3) and substituting for \(\kappa_A = 1\) as

\[
\xi_k - \xi_h = \frac{\tau_A}{2b + \beta} (1 - \xi_h) > 0.
\]

(13)

Therefore, the net welfare costs of capital mobility is positive and \(\xi_k > \xi_h\).

Because of the negative welfare effect of capital mobility, the marginal distributional effect of capital income is larger than that of labor income in the optimum, implying that net capital income is more unequally distributed than net labor income. If it was not for capital mobility, a higher level of redistribution could be achieved by a marginal revenue-neutral shift from labor tax to capital tax\(^6\). Therefore, capital mobility leads

\(^6\)With \(\xi_k > \xi_h\), a marginal revenue-neutral shift from labor tax to capital tax would reduce income inequality as long as the income share of labor income is not too small. Because the wage shares in
to a under-taxation of capital income relative to labor income and a higher income inequality. The larger the net welfare costs of capital mobility, the larger the difference in marginal distributional effects, and the lower the optimal level of redistribution. The net welfare costs are determined among others by the production function parameter $b$ and the transaction costs parameter $\beta$, both determining the responsiveness of equilibrium capital intensity to tax rate. The lower $b$ and the lower $\beta$, the more capital flow is needed to reach the capital market equilibrium for a marginal increase of $\tau_A$, and therefore the larger the tax revenue loss and the higher the net welfare costs. Furthermore, the stronger the distributional concern and the more unequal capital endowment, the higher the $\xi_k$, the less the positive effect of capital outflow on gross return to capital is weighted and the higher the net welfare costs. The more important it is to redistribute capital income, the more costly the constraints capital mobility imposes on redistribution.

I formulate our results in Proposition 1:

**Proposition 1** The net welfare costs of capital mobility determine to which extent redistributing capital income is constrained relative to redistributing labor income. The more costly capital mobility, the less capital income is redistributed relative to labor income and the lower the level of optimal income redistribution.

4.3 Public goods provision

The first-order-condition for $z$ is given by

$$E \left[ \frac{u_z}{u_c} \right] (1 - \xi_z) = \frac{\lambda_A}{E[u_c]} p. \quad (14)$$

This condition is similar to that in Sandmo (1998). $E \left[ \frac{u_z}{u_c} \right]$ gives the average marginal willingness to pay for public goods. The distributional characteristic of public goods $\xi_z \equiv -\frac{\text{cov}(u_c, u_z)}{E[u_c]E[u_z]}$ is defined as the negative normalized covariance between the marginal utility of private consumption and the marginal willingness to pay. $\xi_z$ is positive if individuals who have higher private consumption also have higher willingness to pay for public goods. In most OECD countries are about 80% or above, this condition should be fulfilled.
public goods. It means that public goods benefit high-income earners more than low-income ones. Consequently, the welfare effect of public goods provision is lower than the average of willingness to pay. Analogously, providing public goods increases welfare by more than $E\left[\frac{u_z}{u_e}\right]$ if public goods benefit the low-income earners more than the high-income ones ($\xi_z < 0$). The right-hand-side of equation (14) gives the marginal costs of financing public goods, i.e. the MCF ($\frac{A_z}{E[u_e]}$) multiplied by the price of public goods $p$. In optimum, the marginal welfare effect of providing public goods is traded off against the marginal costs of doing so.

5 Increasing capital mobility

In this section I discuss how higher capital mobility affects the optimal capital tax rate and the optimal provision of public goods. To that end, I derive the comparative statics w.r.t. the transaction-cost parameter $\beta$. A higher value of $\beta$ implies higher transaction costs and a lower degree of capital mobility. In case of a very large $\beta$, capital becomes immobile.

For the derivation of the comparative statics I reformulate and combine the first-order-conditions of (8) to be

\[ F^1: \quad \xi_k - \xi_h - \tau_A \frac{1 - \xi_h}{2b + \beta} = 0, \tag{15} \]
\[ F^2: \quad E\left[\frac{u_z}{u_e}\right] (1 - \xi_z) - (1 - \xi_h) p = 0. \tag{16} \]

And using Cramer’s rule, it can be shown that (see Appendix A.2.1 and Appendix A.2.2):

\[
\text{sign} \left( \frac{d\tau}{d\beta} \right) = -\text{sign} \left( \frac{\partial F^2}{\partial \xi} \right); \quad \text{sign} \left( \frac{dz}{d\beta} \right) = \text{sign} \left( \frac{\partial F^2}{\partial \tau} \right) \tag{17} 
\]

From the second-order-condition of the governmental optimization problem, $\frac{\partial^2 F^2}{\partial \xi^2} < 0$ applies. Consequently, a higher $\beta$ increases the optimal capital tax rate, i.e. $\frac{d\tau}{d\beta} > 0$. This is very intuitive: higher transaction costs reduce the responsiveness of capital intensity to capital tax rate and therefore decrease its net welfare costs. As a result, capital tax
rate is optimally set higher.

In order to determine the sign of \( \frac{dz}{dj} \), I derive

\[
\frac{\partial F^2}{\partial \tau} = \left( \frac{\partial E \left[ \frac{u_z}{u_c} \right]}{\partial \tau} (1 - \xi_z) - E \left[ \frac{u_z}{u_c} \right] \frac{\partial \xi_z}{\partial \tau} \right) - \left( - \frac{\partial \xi_h}{\partial \tau} p \right),
\]

(18)

\( \frac{\partial F^2}{\partial \tau} \) is the partial effect of a higher capital tax rate on \( F^2 \), while keeping public goods constant and adjusting labor tax rate accordingly\(^7\). The first two terms in equation (18) give the effect on the marginal welfare gain of public goods provision \( E \left[ \frac{u_z}{u_c} \right] (1 - \xi_z) \), which I call the welfare effect. The sign of the welfare effect is determined by how a higher capital tax rate affects the average willingness to pay for public goods \( E \left[ \frac{u_z}{u_c} \right] \) and the distributional characteristic of public goods \( \xi_z \). The last term is the effect on the MCF, called the MCF effect. Its sign is the opposite to that of \( \frac{\partial \xi_h}{\partial \tau} \).

A revenue-neutral (for given \( z \)) increase of capital tax rate implies that labor tax rate has to be reduced\(^8\). If capital income is assumed to be more unequal than labor income at the initial equilibrium due to capital mobility (see proposition 1), a revenue-neutral shift from labor tax to capital tax reduces income inequality. A straightforward implication of a lower income inequality is that the distributional characteristic of labor income \( \xi_h \) decreases, because a lower income inequality reduces the variability of the marginal utility of consumption \( u_c \). For a perfectly equal distribution of income, \( \xi_h \) would be equal to zero. Since the MCF is equal to 1 − \( \xi_h \), the MCF effect of a higher capital tax rate is positive. The sign of the welfare effect in (18) depends on the sign of \( \xi_z \), i.e. whether public goods benefit the low-income individuals more.

If public goods have positive distributional effect (\( \xi_z < 0 \)), it applies that \( \frac{\partial E \left[ \frac{u_z}{u_c} \right]}{\partial \tau} < 0 \) and \( \frac{\partial \xi_h}{\partial \tau} > 0 \) (See Appendix A.2.2). Consequently, the welfare effect of a higher capital tax rate in equation (18) is negative. Because the MCF effect is positive, it implies that \( \frac{\partial F^2}{\partial \tau} < 0 \) and \( \frac{dz}{dj} < 0 \). This means that higher capital mobility (a lower \( \beta \)) increases the

\(^7\)The first-order-conditions \( F^1 \) and \( F^2 \) determine the optimal capital tax rate and the optimal level of public goods simultaneously, while the optimal labor tax rate is pinned down by the governmental budget constraint.

\(^8\)We assume that the optimal capital tax rate is on the upward side of Laffer-curve, i.e. the denominator of (11) is positive.
Table 1: Effects of lower mobility costs ($\beta \downarrow$) on optimal provision of public goods

<table>
<thead>
<tr>
<th></th>
<th>direct distributional effect of public goods</th>
<th>welfare effect $\xi_z$</th>
<th>MCF effect $\xi_z$</th>
<th>total effect $\xi_z$</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>positive ($\xi_z &lt; 0$)</td>
<td>$z \uparrow$</td>
<td>$z \uparrow$</td>
<td>$z \uparrow$</td>
</tr>
<tr>
<td></td>
<td>negative ($\xi_z &gt; 0$)</td>
<td>$z \downarrow$</td>
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<td>$z \uparrow \downarrow$</td>
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optimal level of public goods. Intuitively, higher capital mobility implies higher efficiency costs of capital taxation. Thus, capital tax rate is reduced and income inequality becomes higher. Because public goods have positive distributional effect, a higher level of public goods is needed to counteract the increasing income inequality (i.e. $\xi_z$ becomes larger in absolute value). Moreover, the average benefit of public goods provision increases as well. Both effects together imply that the marginal welfare gain of public goods provision increases, which calls for a higher level of public goods. At the same time, a higher income inequality reduces the MCF, which also calls for a higher level of public goods. In particular, a higher income inequality increases the need for labor taxation to redistribute income, because labor income and capital income are positively correlated. The larger distributional gain of labor taxation reduces the MCF. As a result, if capital becomes more mobile, the optimal level of public goods is unambiguously higher.

If public goods benefit high-income individuals more ($\xi_z > 0$), the welfare effect of a higher capital tax rate is positive, due to $\frac{\partial E(z)}{\partial \tau} > 0$ and $\frac{\partial E_z}{\partial \tau} < 0$ (See Appendix A.2.2). Since the MCF effect is also positive, the sign of $\frac{\partial F^2}{\partial \tau}$ and that of $\frac{dz}{d\beta}$ are not clear-cut. For distributional purpose, public goods should be reduced, because a higher income inequality worsens the negative distributional effect of public goods. In addition, the average benefit of public goods decreases as well. Both effects lead to lower marginal welfare gain of public goods, which calls for a lower level of public goods. However, higher capital mobility reduces the MCF, which works in the opposite direction than the welfare gain effect. How the optimal level of public goods changes depends therefore on which effect dominates. Table 1 gives an overview of the effects of higher capital mobility and the following proposition summarizes our results:
Proposition 2: If public goods benefit low-income individuals more than high-income ones, higher capital mobility increases unambiguously the optimal provision of public goods. If public goods have negative distributional effect, the effect of higher capital mobility on the optimal level of public goods depends on which of the welfare effect and the MCF effect dominates.

6 Discussion

Our result for the case of a positive distributional effect of public goods is exactly the opposite to the well-known result in tax competition literature that tax competition reduces the provision of public goods (see e.g. Zodrow and Mieszkowski, 1986). The latter is normally derived in a model with homogenous individuals, where public goods are only financed by capital taxation. Consequently, higher efficiency costs of capital taxation implied by tax competition reduces capital tax rate and thus the provision of public goods. However, in a model with heterogenous individuals and more tax instruments this result does not necessarily hold any more.

There are two reasons why our result differs. Firstly, by taking income redistribution into consideration, public goods provision is used as an instrument for income redistribution in addition to income taxation, as long as public goods benefit individuals with different income differently. Consequently, if public goods have positive (negative) direct distributional effect, a higher (lower) level of public goods is needed to counteract the higher income inequality caused by capital mobility. Secondly, by considering heterogeneity both in capital income and labor income, the distributional effect of labor taxation is strengthened by capital mobility, due to the fact that capital income and labor income are positively correlated. A less strong redistribution of capital income can be partly compensated by a stronger redistribution of labor income. This changes the intuition that public goods provision becomes more costly if they are only financed by capital taxation. In fact, it becomes less costly if labor taxation is also used to finance public goods.
I show that if public goods have positive direct distributional effect, there is a case for over-provision of public goods. More importantly, with positive correlation of capital income and labor income, providing public goods becomes less costly with capital mobility. Even if public goods have no direct distributional effect, higher capital mobility would lead to a higher level of public goods.

One important assumption for the results of lower MCF with increasing capital mobility is the exclusion of lump-sum tax. If lump-sum tax is allowed, the MCF of financing public goods would be equal to 1 and the effect of higher capital mobility depends only on the direct distributional effect of public goods, i.e. higher capital mobility leads to a higher (lower) level of public goods if they benefit high-income individuals less (more). However, as long as lump-sum tax is not available, which is not an unreasonable assumption, our results remain valid. In particular, allowing for lump-sum transfer would not change our results either, because lump-sum transfer can be seen as one type of public goods with positive direct distributional effect. Ihori and Yang (2008) show that redistribution is reduced by capital mobility, but the optimal public goods provision is not changed. They allow for lump-sum tax to finance public goods and they neither consider labor taxation nor the direct distributional effect of public goods. Consequently, their results differ from ours in that public goods provision and redistribution can be separated in their setting.

7 Conclusion

This paper embeds both public goods provision and redistribution in a single model framework, and shows that preferences for income redistribution may alter the standard result of under-provision of public goods under tax competition. In a standard two-country symmetric tax competition model, benevolent governments tax labor income and capital to finance public goods. Public goods can benefit low-income people more or less than high-income ones. Furthermore, capital income and labor income are positively

\footnote{One unit of lump-sum transfer benefit high-income individuals less, if the marginal utility of income is decreasing.}
correlated. Capital mobility increases the efficiency costs of capital taxation and reduces
the optimal capital tax rate. The more mobile capital is, the less capital income can be
redistributed compared to labor income and the lower the level of income redistribution.
However, public goods can be used as an instrument to fight against the increasing
income inequality, as long as individuals with different income benefit from public goods
differently. If public goods benefit high-income earners more (less), a higher capital
mobility calls for a lower (higher) level of public goods. Moreover, the marginal costs of
financing public goods decrease as a result of positive correlation of capital income and
labor income. In particular, a less strong redistribution of capital income can be partly
compensated by a stronger redistribution of labor income. As a result, labor tax becomes
less costly and the marginal costs of public funds decrease, which calls for a higher level
of public goods.

Further research can be done for asymmetric countries. They may differ in their
aggregate human capital and aggregate capital endowment or in their distributive prefer-
ence. With asymmetric countries, the degree of redistribution would be affected by the
relative endowment and capital mobility could be beneficial for one country.

A Appendix

A.1 Optimal policy

I derive in this appendix the first-order conditions in section 3. The Lagrangian function
for country \( A \) is

\[
\mathcal{L}_A = \int \int \nu (c_{kh}, z) f(k, h) dkdh + \lambda_A (t_A w_A H_A + r_A K_A - p z_A). \tag{19}
\]

whereby \( \lambda_A \) is the Lagrangian multiplier. If country \( A \) is capital exporting country, it is
assumed that only one individual invests in foreign country, who bears the transaction
costs $\phi_A$. His consumption is

$$c_{kh} = (1 - t_A) w_A h + (r_A - \tau_A) (k - (1 - K_A)) + (r_B - \tau_B) (1 - K_A) - \phi_A,$$

which can be rewritten as

$$c_{kh} = (1 - t_A) w_A h + (r_A - \tau_A) k + \phi_A. \tag{21}$$

by using the equilibrium condition for capital market. For all other residents in country $A$ the consumption is

$$c_{kh} = (1 - t_A) w_A h + (r_A - \tau_A) k. \tag{22}$$

A.1.1 Labor tax:

The first-order-condition for labor tax rate $t_A$ is

$$\frac{\partial \mathcal{L}_A}{\partial t_A} = \int_k \int_h u_c (-w_A h) f(k,h) dk dh + \lambda_A w_A = 0 \tag{23}$$

Using $E[xy] = E[x] E[y] + \text{cov}(x,y)$ and $E[h] = 1$ I reformulate equation (23) as

$$\lambda_A = E[u_c] \left( 1 + \frac{\text{cov}(u_c,h)}{E[u_c]} \right). \tag{24}$$

By defining $\xi_h \equiv -\frac{\text{cov}(u_c,h)}{E[u_c]}$, it leads to equation (10).

A.1.2 Capital tax:

A marginal increase of capital tax rate affects the wellbeing of the individual who invests in foreign country and all other individuals differently, because the individual who invests in foreign country bears all transaction costs. Since it is assumed that there is a continuum of individuals, the effect of changing capital tax rate on the wellbeing of the single individual who invests in foreign country can be ignored. The first-order-condition for capital tax
rate is therefore
\[
\frac{\partial L_A}{\partial \tau_A} = \int_k \int_h u_c \left( \frac{\partial (r_A - \tau_A)}{\partial \tau_A} k + (1 - t_A) \frac{\partial w_A}{\partial \tau_A} h \right) f(k, h) dk dh \\
+ \lambda_A \left( t_A \frac{\partial w_A}{\partial \tau_A} H_A + \tau_A \frac{\partial K_A}{\partial \tau_A} + K_A \right) \\
= 0. \quad (25)
\]

Equation (21) shows that the individual who invests in foreign country has a higher consumption of \( \phi_A \) than all other individuals. Assuming that there is only one investor investing in foreign country and therefore ignoring the welfare effect of increasing capital tax rate on this individual means that the consumption increase of \( \phi_A \) can be ignored in the analysis. This implies that the net welfare costs of increasing capital tax rate is overestimated. However, the transaction costs associated with capital flow, which would be caused by a marginal increase of capital tax rate in a symmetric equilibrium with no capital flow, could not be very large. Note that the transaction costs must be lower than the interest difference between the two countries. Therefore, ignoring the consumption increase of \( \phi_A \) does not affect our result qualitatively\(^{10}\) By defining the distributional characteristic of capital income as \( \xi_k = -\frac{\text{cov}(u_c, k)}{E[u_c]} \), I can rewrite the equation (25) as
\[
\left( \frac{\partial r_A}{\partial \tau_A} - 1 \right) (1 - \xi_k) + (1 - t_A) \frac{\partial w_A}{\partial \tau_A} (1 - \xi_h) + \frac{\lambda_A}{E[u_c]} \left( t_A \frac{\partial w_A}{\partial \tau_A} H_A + \tau_A \frac{\partial K_A}{\partial \tau_A} + K_A \right) = 0. \quad (26)
\]

Imposing symmetric Nash-equilibrium and substituting for \( K_A = 1 \) in (26) lead to equation (11) in text.

A.1.3 Public goods:

The last first-order-condition is for public goods \( z \):
\[
\frac{\partial L_A}{\partial z} = \int_k \int_h u_z f(k, h) dk dh - \lambda_{AP} = 0 \quad (27)
\]

\(^{10}\)As long as the consumption increase of \( \phi_A \) does not turn the net welfare costs of capital mobility into net welfare gain, our results are not changed qualitatively by this assumption. Net welfare gain of capital mobility would lead to over-taxation of capital, which contradicts the empirical observation of decreasing capital taxation.
Dividing both sides by $E[u_c]$ and using $u_z = u_c \frac{w_z}{u_c}$, I can reformulate (27) as

$$E\left[ \frac{u_z}{u_c} \right] \left( 1 + \frac{\text{cov}(u_c, u_z)}{E[u_c] E\left[ \frac{u_z}{u_c} \right]} \right) = \frac{\lambda_A}{E[u_c]} p, \quad (28)$$

which can be written as (14) after using the definition of $\xi_z \equiv -\frac{\text{cov}(u_c, u_z)}{E[u_c] E\left[ \frac{u_z}{u_c} \right]}$ as the distributional characteristic of public goods.

**A.2 Comparative statics of optimal policy**

**A.2.1 Derive the comparative statics**

I derive in this Appendix the comparative statics of the optimal policy. The complete first-order-conditions of the governmental optimization problem (8) are

$$t_A : \quad \frac{\lambda_A}{E[u_c]} = 1 - \xi_h, \quad (29)$$

$$\tau_A : \quad \frac{\lambda_A}{E[u_c]} = \frac{1 - \xi_k - \left( \frac{\partial r_i}{\partial r_i} (1 - \xi_k) + (1 - t_i) \frac{\partial w_i}{\partial r_i} (1 - \xi_h) \right)}{1 - \left( -t_i \frac{\partial w_i}{\partial r_i} - \tau_i \frac{\partial \rho_i}{\partial r_i} \right)}, \quad (30)$$

$$z_A : \quad E\left[ \frac{u_z}{u_c} \right] (1 - \xi_z) = \frac{\lambda_A}{E[u_c]} p, \quad (31)$$

$$\lambda_A : \quad t_A w_A \overline{H}_A + \tau_A K_A - p z_A = 0. \quad (32)$$

I substitute for (29) in (30) to have

$$1 - \xi_h = \frac{1 - \xi_k - \left( \frac{\partial r_i}{\partial r_i} (1 - \xi_k) + (1 - t_i) \frac{\partial w_i}{\partial r_i} (1 - \xi_h) \right)}{1 - \left( -t_i \frac{\partial w_i}{\partial r_i} - \tau_i \frac{\partial \rho_i}{\partial r_i} \right)}. \quad (33)$$

From (32) it can be written

$$t_A = \frac{q z - \tau_A K_A}{w_A}. \quad (34)$$
Substituting for (34) and using the derivatives in symmetric equilibrium $\frac{\partial w_i}{\partial r_i} = -\frac{2b}{4b+\beta}$ and $\frac{\partial w_i}{\partial r_i} = -\frac{1}{4b+\beta}$ in (33), it applies that

$$\xi_k - \xi_h - \tau A \frac{1 - \xi_h}{2b + \beta} = 0. \quad (35)$$

Combining (31) and (32) leads to

$$E \left[ \frac{u_z}{u_c} \right] (1 - \xi_z) - (1 - \xi_h) p = 0. \quad (36)$$

I have therefore a two-equation-system

$$F^1: \quad \xi_k - \xi_h - \tau A \frac{1 - \xi_h}{2b + \beta} = 0,$$

$$F^2: \quad E \left[ \frac{u_z}{u_c} \right] (1 - \xi_z) - (1 - \xi_h) p = 0. \quad (37)$$

This equation system determines the optimal capital tax rate and the optimal level of public goods, and the optimal labor tax rate is pinned down by equation (34). The comparative statics of capital tax rate and public goods w.r.t the parameter $\beta$ can be derived by total differentiation of the equation system (37):

$$\left( \begin{array}{c} \frac{\partial F^1}{\partial \tau} \\ \frac{\partial F^2}{\partial \tau} \end{array} \right) \left( \begin{array}{c} d\tau \\ dz \end{array} \right) + \left( \begin{array}{c} \frac{\partial F^1}{\partial \beta} \\ \frac{\partial F^2}{\partial \beta} \end{array} \right) d\beta = 0. \quad (38)$$

Take the inverse of the matrix $A \equiv \left( \begin{array}{cc} \frac{\partial F^1}{\partial \tau} & \frac{\partial F^1}{\partial z} \\ \frac{\partial F^2}{\partial \tau} & \frac{\partial F^2}{\partial z} \end{array} \right)$ and use $A^{-1} = \det (A)^{-1} \text{adj} (A)$ to have

$$\left( \begin{array}{c} d\tau \\ dz \end{array} \right) = \frac{1}{\det (A)} \left( \begin{array}{cc} \frac{\partial F^2}{\partial z} & -\frac{\partial F^1}{\partial z} \\ -\frac{\partial F^2}{\partial \tau} & \frac{\partial F^1}{\partial \tau} \end{array} \right) \left( \begin{array}{c} \frac{\partial F^1}{\partial \beta} \\ \frac{\partial F^2}{\partial \beta} \end{array} \right) d\beta. \quad (39)$$
Therefore, the comparative statics can be found to be
\[
\frac{d\tau}{d\beta} = \frac{1}{\det(A)} \left( \frac{\partial F^2 \partial F^1}{\partial z \partial \beta} + \frac{\partial F^1 \partial F^2}{\partial z \partial \beta} \right),
\]
\[
\frac{dz}{d\beta} = \frac{1}{\det(A)} \left( \frac{\partial F^2 \partial F^1}{\partial \tau \partial \beta} - \frac{\partial F^1 \partial F^2}{\partial \tau \partial \beta} \right).
\]

\[ (40) \]

\[ (41) \]

A.2.2 Determine the signs of comparative statics

In this appendix I determine the sign of the comparative statics \( \frac{d\tau}{d\beta} \) and \( \frac{dz}{d\beta} \). Because
\[
\frac{\partial F^1}{\partial \beta} = \tau_i \frac{1 - \xi_h}{(2b + \beta)^2} > 0 \quad \text{and} \quad \frac{\partial F^2}{\partial \beta} = 0,
\]
the sign of \( \frac{d\tau}{d\beta} \) is the opposite to that of \( \frac{\partial F^2}{\partial z} \) and the sign of \( \frac{dz}{d\beta} \) is the same as that of \( \frac{\partial F^2}{\partial \tau} \):
\[
\text{sign} \left( \frac{d\tau}{d\beta} \right) = -\text{sign} \left( \frac{\partial F^2}{\partial z} \right); \quad \text{sign} \left( \frac{dz}{d\beta} \right) = \text{sign} \left( \frac{\partial F^2}{\partial \tau} \right)
\]

(43)

To determine the sign of \( \frac{dz}{d\beta} \), it is derived that
\[
\frac{\partial F^2}{\partial \tau} = \frac{\partial E \left[ \frac{u_z}{u_c} \right]}{\partial \tau} (1 - \xi_z) - E \left[ \frac{u_z}{u_c} \right] \frac{\partial \xi_z}{\partial \tau} - \left( -\frac{\partial \xi_h}{\partial \tau} p \right). 
\]

(44)

Because the MCF effect of a higher capital tax rate is positive, the sign of the welfare effect in (18) depends on the sign of \( \xi_z \).

i) Public goods benefit low-income individuals more \((\xi_z < 0)\): For this case the marginal willingness to pay for public goods \( \frac{u_z}{u_c} \) decreases with private consumption. Therefore, a higher capital tax rate decreases the marginal willingness to pay of low-income people, but increases the marginal willingness to pay of high-income people. How the average willingness to pay changes depends on the functional form of \( \frac{u_z}{u_c} \) w.r.t. private consumption. If \( \frac{u_z}{u_c} \) is linearly decreasing in \( c \), it applies that
\[
\Delta E \left[ \frac{u_z}{u_c} \right] = \frac{\partial u_z}{\partial c} \int_k \int_h \triangle c_{k,h} f(k, h) dkdh. \quad \text{Because} \quad \int_k \int_h \triangle c_{k,h} f(k, h) dkdh = 0
\]
from constant tax revenue, \( \frac{\partial E [u_z]}{\partial \tau} = 0 \) applies. If \( \frac{u_z}{u_c} \) is convex (concave) in \( c \), a
lower income inequality decreases (increases) the average willingness to pay, i.e. \( \frac{\partial E[u_c]}{\partial \tau} < (>) 0 \). \( \frac{u_z}{u_c} \) is assumed to be convex in private consumption. As the standard assumptions for utility function, the assumption that the marginal willingness to pay is decreasing and convex avoids corner solution. Under this assumption, a marginal revenue-neutral increase of capital tax rate decreases the average willingness to pay, i.e. \( \frac{\partial E[u_c]}{\partial \tau} < 0 \). Furthermore, \( \frac{\partial E}{\partial \tau} > 0 \) applies from \( \xi_z < 0 \). The reason is that a lower income inequality makes the positive distributional effect of public goods less important, i.e. the absolute value of \( \xi_z \) becomes lower. If there is no income inequality, the distributional characteristic of public goods would be zero. Both effects taken together, the welfare effect of a higher capital tax rate is negative.

ii) Public goods benefit high-income individuals more (\( \xi_z > 0 \)): In the second case where public goods benefit high-income individuals more, i.e. \( \xi_z > 0 \), \( \frac{u_z}{u_c} \) is an increasing function of \( c \). As in the first case, the sign of \( \frac{\partial E[u_c]}{\partial \tau} \) depends on the functional form of \( \frac{u_z}{u_c} \) w.r.t. private consumption. If \( E\left[\frac{u_z}{u_c}\right] \) is linearly increasing in \( c \), a marginal tax-revenue increase of capital tax does not affect the average willingness to pay, \( \frac{\partial E[u_c]}{\partial \tau} = 0 \). If \( E\left[\frac{u_z}{u_c}\right] \) is convex (concave) in \( c \), a lower income inequality decreases (increases) the average willingness to pay, i.e. \( \frac{\partial E[u_c]}{\partial \tau} < (>) 0 \). It is assumed that the marginal willingness to pay is concave if it is an increasing function of \( c \). This assumption again avoids corner solution. Under this assumption the partial effect of a higher capital tax rate on \( E\left[\frac{u_z}{u_c}\right] \) is positive, i.e. \( \frac{\partial E[u_c]}{\partial \tau} > 0 \). For a positive distributional characteristic \( \xi_z \), a lower income inequality mitigates the negative distributional effect of public goods, i.e. \( \frac{\partial \xi_z}{\partial \tau} < 0 \). If income is equally distributed, the distributional characteristic of public goods would reduce to zero. Therefore, differently than for the first case, a marginal revenue-neutral increase of capital tax rate has a positive welfare effect.
References


