International tax competition with rising intangible capital and financial globalization

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Abstract

The last three decades have been characterized by two important trends: (a) the rise of intangible capital as a share of total capital and (b) financial globalization with an increase in cross-country investments. We study the importance of these two trends for international tax competition in a two-country model where governments choose profit and income tax rates without commitment to future policies and without international coordination. We find that a higher share of intangible capital leads to lower profit tax rates while higher cross-country investments lead to higher taxation of profits. Since the impact of the first change (high share of intangible) dominates the second (high cross-country investment), the combined changes lead to a net decline in profit taxes of 6 percent and a welfare gain of 0.55 percent of lifetime consumption.

1 Introduction

The idea that countries should coordinate a minimum floor to the taxation of profits has recently gained significant momentum with the formulation of a set of principles agreed in 2021 by the finance ministers of the G7 countries. The agreement received many welcoming remarks, including some leaders of major multinational companies. The question we ask in this paper is whether a minimum floor on the taxation of profits or, more generally, capital tax coordination is desirable from a welfare point of view.

An important principle in taxation theory is that taxes should not be uniform across all sources of incomes. Instead, the tax rate on a particular source should depend on the elasticity with which that source responds to a higher tax rate. The same principle applies
to the taxation of capital income vis-a-vis other types of income. In a globalized world where asset markets are highly integrated, the ability of a government to unilaterally tax capital income is somewhat reduced because multinationals have greater discretion in determining where to pay taxes. So it is not surprising that governments find optimal to lower capital income taxes in absence of cross-country coordination. The goal of coordinating a minimum tax floor embedded in the 2021 agreement was to limit this race to the bottom. But why is the issue of harmful tax competition receiving more attention now than in the past? After all, the process of financial globalization is not new.

In this paper we explore two major changes that could have been important in affecting the incentives of governments to tax profits. The first is the growth in the share of intangible capital. The second is the increase in financial globalization.

Figure 1 shows the share of intangible capital in total capital for US public companies from 1970 to 2010. At the beginning of the 1970s the share of intangible capital was about 10 percent but it increased to about 60 percent in 2010.

![Figure 1: The growing share of intangible capital. From “Rising Intangible Capital, Shrinking Debt Capacity, and the U.S. Corporate Savings Glut” by Falato, Kadyrzhanova, Sim & Steri, *Journal of Finance*, October 2022.](image)

An important property of intangible capital, vis-a-vis tangible capital, is the non-rivalry feature: once accumulated, intangible capital can be used simultaneously in multiple geographical locations by the same company. This raises the issue of how multinationals allocate the cost of intangible capital among the various worldwide operations. Although the cost allocation may be irrelevant for the global profits earned by multinationals, it is important for the total taxes paid by them. In general, a multinational has an incentive to allocate a greater share of operating costs in countries with higher taxation of profits, provided that it has the flexibility to do so. The difficulty in determining the precise contribution of intangible capital to the various worldwide operations gives
multinationals some discretion in the allocation of the associated costs. Because of this, a
country that chooses to unilaterally raise the profit tax rate might end up collecting less
tax revenues because multinationals will respond by shifting taxable income to other (low
tax) countries. This may refrain governments from raising the taxation of profits and,
potentially, seeding the conditions for a race to bottom in international tax competition.

The second trend examined in this paper is the growth in financial globalization. Figure
2 shows the stock of Foreign Direct Investments (FDI) and the stock of Portfolio
Equity Investment (PEI) for industrialized countries over the period 1990-2020. Both
assets and liabilities of these two categories of international capital have increased sub-
stantially during the last thirty years. The increase in FDI means that multinationals
invest more abroad. The increase in PEI can be interpreted as indicating that the share
of foreign ownership of multinationals has increased over time. It is important to em-
phasize that it is the growth in the ‘gross’ stocks (both FDI and PEI) that is especially
relevant for the optimal taxation of profits. The net foreign asset position, which for many
countries is relatively small, is not as important as the gross positions.

![Stock of Foreign Direct Investments](image1.png)

![Stock of Portfolio Equity Investments](image2.png)

Figure 2: Foreign direct investments and portfolio equity investments in industrialized
countries, 1990-2020. Source: External Wealth of Nations database (Lane and Milesi-
Ferretti (2018)).

The growth in gross foreign asset positions implies that a growing share of profits
earned by multinationals in a country belong to foreigners. As the foreign share of profits
earned in the country increases, the government of that country has a greater incentive to
tax these profits. Effectively, higher taxes on profits redistribute income from foreign res-
idents to domestic residents. This is the mechanism through which financial globalization
could lead to higher taxation of capital incomes.

This mechanism differs from the most popular view that greater financial integration
causes lower taxation of capital. According to this view, the reason capital taxes should
fall as international capital markets become more integrated is because globalization fa-
cilitates the international reallocation of capital. For this mechanism to be relevant in
an environment in which governments cannot commit to future policies, firms must have
the ability to reallocate quickly the capital that was installed in the past. Although there
are instances in which this is possible, it is unlikely that companies have the ability to reallocate quickly capital that has been already accumulated in the past. Taxes, of course, affect investments, that is, the accumulation of new capital. However, what matters for investment decisions are (primarily) future taxes, not current taxes. But in an environment without commitment, current governments do not have the credibility to promise lower taxes for the future. Current governments choose only current tax rates.

To study the impact of higher shares of intangible capital and greater international diversification in investment, we consider a two-country model with multinational firms that invest in two types of capital—tangible and intangible—and in two locations—domestically and abroad. Governments fund exogenous public spending by choosing two types of taxes: profit taxes based on the ‘source’ principle, and income taxes based on the ‘residence’ principle. Importantly, the tax rates are chosen without commitment to future policies (time-consistency) and without coordination among governments (policy competition).

There are two forces that are important for determining the equilibrium taxation of profits. On the one hand, the lack of policy commitment could lead to excessive taxation if the profits earned in a country belong to foreigners. Here the lack of policy commitment is key: taxing existing the income generated by existing capital does not distort the allocation of resources but it redistributes income away from foreigners to domestic residents. However, the market anticipation of higher tax rates also for the future discourages investments, which results in a sub-optimal equilibrium with lower capital. This is a standard problem in optimal taxation where taxes on capital are ex-ante inefficient but ex-post desirable. On the other hand, a higher tax rate on profits chosen unilaterally by a country causes a shift in taxable profits to other (low tax) nations, which reduces the total tax revenues collected by the country. Tax shifting acts as a counterbalancing force for the temptation to tax capital. It might result in profit tax rates that are too low (race-to-the-bottom). Whether the equilibrium taxation of profits is too high or too low depends on the relative importance of these two forces. If the time-consistency problem is the main concern, capital taxes would be too high. If the race to the bottom is the main concern, capital taxes would be too low.

The relative importance of these two forces (time-consistency and tax-shifting) changes with the growing share of intangible capital and globalization. On the one hand, the growing share of intangible capital makes the race-to-the-bottom more relevant because it facilitates tax-shifting for multinational companies. On the other, the increasing international diversification of investments alleviates the race-to-the-bottom because governments have greater ability to tax foreigners. Whether the first force dominates the second is a quantitative question which we address with a calibration exercise. More specifically, we calibrate the model to match empirical targets at the beginning of the 1990s and then we ask how the increase in the share of intangible capital and investment diversification that took place during the last thirty years affected equilibrium taxes and welfare.

We find that the tax impact of the growth in intangible capital dominated the impact of the increased investment diversification. The combined effects of the two changes led
to a reduction in profit tax rates of 6 percent and a consumption equivalent welfare
gain of 0.55 percent. Counterfactual exercises show that the reduction in the profit tax
rate and the welfare gain would have been much larger in absence of increased financial
globalization (no change in cross-country investment).

We also consider an extended version of the model with two types of heterogeneous
households: the first type of households earn only labor incomes while the second type
earn also capital incomes. This allows us to study how inequality (differences in incomes
between the two types of households), political bias (higher weight given to one of the two
types) and political myopia (higher discounting for future outcomes) affect equilibrium
taxation and welfare for both types of households. Heterogeneity could be important for
understanding why (some) policy makers desire higher taxation of profits even if it does
not lead to welfare improvements.

2 Related literature

The study of optimal taxation in dynamic environments with and without commitment
has a long tradition. A well known result is that, when the policy maker can commit to
future policies, it is optimal to tax capital in the short run but it should be decreased
afterwards. In the long-run the taxation of capital should be close to zero. See Ben-
result has a simple intuition. In the current period capital has already been accumulated
and, therefore, its taxation does not distort allocations. However, future taxes can affect
the accumulation of new capital, which is inefficient. More recent studies consider more
complex models and show that the optimal taxation of capital could be positive also in the
long-run. See, for example, Aiyagari (1995) and Golosov, Kocherlakota, and Tsyvinski
(2003). But even if the optimal tax rate on capital should be positive in the long-run, the
tension between short-term and long-term taxation is likely to remain.

In reality, we rarely see countries with capital taxes that are close to zero. Several
factors could contribute to this, not the least the fact that taxes have redistributive effects.
The taxation of capital then is the result of the political outcome where efficiency is not
the only consideration. But another reason taxes on capital could be higher than predicted
by standard models is that Ramsey policies are not implementable because of the lack
of commitment. There is also a rich literature that studies optimal and time-consistent
fiscal policies. The general result is that the absence of policy commitment creates the
conditions for higher taxation of capital. Examples include Krusell and Rios-Rull (1999)

The studies and results discussed above are conducted in environments with a single
country (closed economy). But countries are not isolated from each others and what a
country chooses in terms of fiscal policies will affect other countries. This is especially
important in the wave of globalization where economies are becoming more interdependent
and the issue of international tax competition has become more important. It became
important then to extend these models to an environment with multiple countries.

An early contribution in this literature is Kehoe (1989). This paper uses a two-period model to show that international tax competition could be welfare improving because it corrects for the excessive taxation of capital due to the lack of commitment. More specifically, the lack of policy commitment induces governments to choose high tax rates on capital that are inefficient because they discourage savings. However, tax competition introduces a counterbalancing force for the taxation of capital because, with high tax rates, capital could fly abroad. Thus, tax competition could improve welfare while tax coordination is not desirable.

Following Kehoe (1989), several papers explored the importance of tax competition quantitatively. Examples include Ha and Sibert (1997), Klein, Quadrini, and Rios-Rull (2005), Mendoza and Tesar (2003) and Quadrini (2005). A common feature of these papers is that tax competition affects the optimal choices of taxes because they impact on the allocation of savings. Although this is also a feature of the model studied in our paper, the primary mechanism that discourages the taxation of capital is the discretion with which multinational can determine the allocation of taxable income. What is central in our model is not that multinational firms can re-allocate capital to other countries. Rather, it is their ability to use accounting strategies to reduce taxable income in countries where taxes are high and increase taxable income in countries where taxes are low. This can be accomplished without making any changes in actual investments and production. With this mechanism we then study how the growth in intangible capital and financial globalization affect equilibrium taxation and welfare.

To our knowledge this is the first paper that studies how the growth of intangible capital affects equilibrium (endogenous) taxation and welfare. The study of financial globalization for equilibrium taxation, instead, is not new in the literature. However, our analysis and results are different. While the main conclusion of the existing literature is that capital liberalization reduces the taxation of capital when governments do not coordinate their policies, we find exactly the opposite. The reason is that the existing literature has focused mainly on the fact that financial integration makes easier for multinationals to reAllocate capital to other countries. But there is another dimension of financial globalization that has not been fully explored in the literature: This is the growth in gross financial holdings across countries, that is, the surge in both foreign assets and foreign liabilities. The implication of this surge is that the share of profits generated by foreign multinationals has increased considerably over time. As a result, a larger share of profits belong to foreigners and taxing them redistributes income from foreigners to domestic residents. This, in turn, increases the incentive of governments to tax profits.

Our paper is also related to Dyrda, Hong, and Steinberg (2023). This paper also considers the possibility that multinational firms use profit shifting to reduce their tax bill when intangible capital is an important factor of production. However, the goal of this paper is to consider the macroeconomic and welfare implications of recent tax reforms (which are exogenous in their model), the goal of our paper is to characterize how governments choose their taxes. We thus make government policies endogenous.
3 The model

There are two countries that are symmetric in technology and preferences. We refer to the first country as ‘Home’ country and to the second as ‘Foreign’ country. Following the notational convention often used in international economics, we use an asterisk to indicate variables pertaining to the Foreign country.

Each country is populated by a continuum of households of total measure 1 with lifetime utility

\[
\sum_{t} \beta^t u(c_t) \quad \text{and} \quad \sum_{t} \beta^t u(c_t^*),
\]

where \(c_t\) and \(c_t^*\) are consumptions at time \(t\) for, respectively, Home and Foreign households. The per-period utility takes the standard form \(u(c) = c^{1-\sigma}/(1-\sigma)\). Households supply one unit of labor inelastically only domestically (they cannot change the country of residence).

There is a measure 1 of competitive multinational firms headquartered in the Home country and a measure 1 headquartered in the Foreign country. Multinationals produce intermediate goods at home and abroad which are then used to produce final goods. A multinational headquartered in the Home country differs from a multinational headquartered in the Foreign country in two dimensions. The first is the share of domestic production (and investment) dictated by technological differences that will be described below. The second is the share of domestic ownership.

To simplify the analysis, we assume that a fixed share \(\theta\) of a Home multinational is owned by Home households and the remaining share \(1-\theta\) is owned by Foreign households. Symmetrically, a share \(\theta\) of a Foreign multinational is owned by Foreign households and the remaining share \(1-\theta\) is owned by Home households. We think that \(\theta > 1/2\) since the ownership structure of multinationals is typically characterized by home bias in ownership.

In addition to the ownership of multinational firms, households trade a zero-coupon bond denominated in units of tradable final goods. The price of the bond (also in units of the final good) is denoted by \(p_t\), while the traded units of the bonds by \(b_t\) and \(b_t^*\). Since countries are symmetric, in equilibrium we will have \(b_t + b_t^* = 0\).

A multinational headquartered in the Home country produces intermediate goods in the Home country and in the Foreign country with the following production functions

\[
\begin{align*}
    m_t & = F(x_t, k_t, l_t) = z \left( x_t^{\alpha} k_t^{1-\alpha} \right)^{\nu} l_t^{1-\nu}, \\
    \hat{m}_t & = F(x_t, \hat{k}_t, \hat{l}_t) = \hat{z} \left( x_t^{\alpha} \hat{k}_t^{1-\alpha} \right)^{\nu} \hat{l}_t^{1-\nu},
\end{align*}
\]

where \(z\) is the (constant) domestic productivity and \(\hat{z}\) is the (constant) productivity abroad. The variable \(x_t\) is the input of intangible capital which is the same in domestic production and abroad production. The variables \(k_t\) and \(\hat{k}_t\) are the inputs of tangible capital, while \(l_t\) and \(\hat{l}_t\) are the inputs of labor hired domestically (in the Home country) and abroad (in the Foreign country). Notice that we use the hat sign to indicate variables that pertain to multinational operations abroad.
The corresponding production functions for a multinational headquartered in the Foreign country are

\[ m^*_t = F(x^*_t, k^*_t, l^*_t) = z \left( (x^*_t)^\alpha (k^*_t)^{1-\alpha} \right)^\nu (l^*_t)^{1-\nu}, \]

\[ \hat{m}^*_t = \hat{F}(x^*_t, \hat{k}^*_t, \hat{l}^*_t) = \hat{z} \left( (x^*_t)^\alpha (\hat{k}^*_t)^{1-\alpha} \right)^\nu (\hat{l}^*_t)^{1-\nu}, \]

Intangible capital, \( x_t \) and \( x^*_t \), is non-rival within a multinational. What this means is that one unit of intangible capital can be used at the same time by the multinational for production in both countries. This explains the absence of the hat sign in the input of tangible for production abroad.

In each country, the intermediate inputs produced by domestic and foreign multinationals are used to produce a homogeneous and tradable final good with the production functions

\[ y_t = Q(m_t, \hat{m}_t^*) \equiv m_t^\lambda (\hat{m}^*_t)^{1-\lambda}, \]

\[ y^*_t = Q(m^*_t, \hat{m}_t) \equiv (m^*_t)^\lambda \hat{m}_t^{1-\lambda}. \]

By having intermediate inputs to be imperfectly substitutes, we will have a well defined composition of domestic and non-domestic production from multinational firms. This, in turn, allows us to have a well defined composition of domestic and foreign investments, which we will use as targets to calibrate the model. In particular, the composition of domestic and non-domestic investments is determined by the parameter \( \lambda \). We think of this parameter to be greater than 0.5 so that the model features home bias in investments. As we will see, this is important for the source taxation of profits because higher investments from foreign multinationals make the local taxation of profits more attractive.

We assume that the production of final goods is done by competitive local firms and the prices of intermediate inputs are equal to their marginal product, that is,

\[ q_t = \frac{\partial Q(m_t, \hat{m}_t^*)}{\partial m_t}, \]

\[ \hat{q}_t = \frac{\partial Q(m_t, \hat{m}_t^*)}{\partial \hat{m}_t^*}, \]

\[ q^*_t = \frac{\partial Q(m^*_t, \hat{m}_t)}{\partial m^*_t}, \]

\[ \hat{q}_t = \frac{\partial Q(m^*_t, \hat{m}_t)}{\partial \hat{m}_t}. \]

A key assumption is that multinationals have some discretion in the imputation of expenses associated with intangible capital. In particular, we assume that the total worldwide expenses imputed on intangible capital must be equal to its actual depreciation, which for convenience we set to the same rate as tangible capital, that is, \( \delta \). Thus, for a multinational headquartered in the Home country, we must have \( \zeta_t + \hat{\zeta}_t = \delta \). Therefore,
as long as the sum of the two imputed rates is constant and equal to $\delta$, the Home multinational can choose different values of $\zeta_t$ and $\hat{\zeta}_t$. For a Foreign multinational the constraint is $\zeta_t^* + \hat{\zeta}_t^* = \delta$.

The discretion in the choice of these rates allows multinationals to shift taxable profits in the country with the lowest tax rate on profits. However, there is also a cost in doing so. The cost can be interpreted as the risk of being audited and being fined if deviating from the targeted rates without valid justification. The costs for the Home multinational in the domestic operation and in the operation abroad are, respectively,

$$\varphi(\zeta_t) \cdot x_t \equiv \chi \cdot (\zeta_t - \lambda \delta)^2 \cdot x_t,$$

$$\hat{\varphi}(\hat{\zeta}_t) \cdot x_t \equiv \chi \cdot (\hat{\zeta}_t - (1 - \lambda) \delta)^2 \cdot x_t,$$

The parameter $\lambda$ is the final production share of domestic production. If the multinational allocates the depreciation of intangible to domestic operations by $\delta \lambda$ and foreign operations by $(1 - \lambda) \lambda$, the cost will be zero. This will be the optimal choice when the two countries have the same tax rates on profits. However, this will not be the case when the tax rates differ as we will see below.

The costs for the Foreign multinational take the same form, that is,

$$\varphi(\zeta_t^*) \cdot x_t^* \equiv \chi \cdot (\zeta_t^* - \lambda \delta)^2 \cdot x_t^*,$$

$$\hat{\varphi}(\hat{\zeta}_t^*) \cdot x_t^* \equiv \chi \cdot (\hat{\zeta}_t^* - (1 - \lambda) \delta)^2 \cdot x_t^*.$$

We can now define the profits earned by Home and Foreign multinationals, in each of the two countries. Profits are the difference between what the firm produces in a country minus the costs incurred in that country, that is,

$$\pi_t = q_t F(x_t, k_t, l_t) - w_t l_t - [\zeta_t + \varphi(\zeta_t)] x_t - \delta k_t,$$

$$\hat{\pi}_t = \hat{q}_t \hat{F}(x_t, \hat{k}_t, \hat{l}_t) - w_t^* l_t^* - [\hat{\zeta}_t + \hat{\varphi}(\hat{\zeta}_t)] x_t - \delta \hat{k}_t,$$

$$\pi_t^* = q_t^* F(x_t^*, k_t^*, l_t^*) - w_t^* l_t^* - [\zeta_t^* + \varphi(\zeta_t^*)] x_t^* - \delta k_t^*,$$

$$\hat{\pi}_t^* = \hat{q}_t^* \hat{F}(x_t^*, \hat{k}_t^*, \hat{l}_t^*) - w_t^* l_t^* - [\hat{\zeta}_t^* + \hat{\varphi}(\hat{\zeta}_t^*)] x_t^* - \delta \hat{k}_t^*,$$

where $w_t$ is the wage in the Home country and $w_t^*$ is the wage in the Foreign country. The variables $\zeta_t$, $\hat{\zeta}_t$, $\zeta_t^*$, $\hat{\zeta}_t^*$ are the imputed unitary expenses associated with intangible capital (as described above) and $\delta$ is the depreciation rate for tangible capital.

The initial states of a multinational headquartered in the Home country are given by the intangible capital, $x_t$, and the tangible capital installed in the two countries, $k_t$ and $\hat{k}_t$. Similarly, the states of the Foreign multinational are $x_t^*$, $k_t^*$ and $\hat{k}_t^*$.

For notational convenience we will use $a_t$ and $a_t^*$, respectively, to denote the total wealth of households in the Home and Foreign country, that is,

$$a_t = \theta(k_t + \hat{k}_t + x_t) + (1 - \theta)(k_t^* + \hat{k}_t^* + x_t^*) + b_t,$$

$$a_t^* = \theta(k_t^* + \hat{k}_t^* + x_t^*) + (1 - \theta)(k_t + \hat{k}_t + x_t) + b_t^*.$$
Government: Profits are taxed twice. They are first taxed at rate $\tau_t$ in the Home country and $\tau_t^*$ in the Foreign country, based on the ‘source’ principle. Then they are taxed again at rate $\phi_t$ and $\phi_t^*$, based on the ‘residence’ principle.

We refer to the first based on the source principle tax as ‘profit’ tax, and to the second ((based on the residence principle) as ‘income’ tax. The profit taxes paid by a Home multinational are

$$\tau \pi_t + \tau^* \pi^*_t.$$ 

The first part is the tax bill owed to the Home government, while the second part is the tax bill owed to the Foreign government. The profit taxes paid by a Foreign multinational are

$$\tau \pi^*_t + \tau^* \pi^*_t,$$

where the first part is paid to the Home government while the second part is paid to the Foreign government.

What is left after the payment of the profit taxes, is taxed at the household level according to the residence of the firm’s owners. Therefore, the income taxes collected by the Home government on the profits earned by their residents are

$$\phi_t \left[ \theta(1 - \tau_t)\pi_t + \theta(1 - \tau_t^*)\pi^*_t + (1 - \theta)(1 - \tau_t)\hat{\pi}_t^* + (1 - \theta)(1 - \tau_t^*)\hat{\pi}_t^* \right].$$

Home households receive net profits $\theta[(1 - \tau_t)\pi_t + (1 - \tau_t^*)\pi^*_t]$ from Home multinationals (since they own a share $\theta$ of these firms), and $(1 - \theta)[(1 - \tau_t)\pi_t^* + (1 - \tau_t^*)\pi^*_t]$ from Foreign multinationals (since they own a share $1 - \theta$ of these firms). On these profits they pay the income tax $\phi_t$.

The income taxes collected by the Foreign government are

$$\phi^*_t \left[ \theta(1 - \tau_t^*)\pi^*_t + \theta(1 - \tau_t)\pi_t^* + (1 - \theta)(1 - \tau_t^*)\hat{\pi}_t^* + (1 - \theta)(1 - \tau_t)\pi_t^* \right].$$

A remark is in order here. Income taxes are paid by households on their share of profits earned by firms, not the dividends they actually receive. Taxes on profits based on the residence principle and taxes on dividends, also based on the residence of their recipients, are not the same. For example, with dividend taxes, if the firm re-invests all the profits rather than paying them as dividends, households will not pay any income taxes, at least today. Instead, with a income tax that is applied on profits, households will pay taxes even if the profits are not distributed through dividends. In the steady state, net profits are equal to dividends. However, for taxation incentives they are not the same. We will discuss later the difference between the households’ taxation of profits and dividends.

Tax revenues are used to fund public expenditures for government purchases, which we denote by $G_t$ and $G_t^*$, and government transfers, which we denote by $T_t$ and $T_t^*$. The two types of public expenditures are exogenous in the model and government purchases do not enter directly the households’ utility. We abstract from public borrowing so that the government budget must balance in every period.
Governments choose the current tax rates at the beginning of every period to maximize the welfare of its own residents—the households—without commitment. The budget constraint for the governments of the two countries are

\[ G_t + T_t = \tau_t (\pi_t + \hat{\pi}_t) + \phi_t \left[ \theta (1 - \tau_t) \pi_t + \theta (1 - \tau_t^*) \hat{\pi}_t + (1 - \theta) (1 - \tau_t) \pi_t + w_t \right], \quad (5) \]

\[ G_t^* + T_t^* = \tau_t^* (\pi_t^* + \hat{\pi}_t) + \phi_t^* \left[ \theta (1 - \tau_t^*) \pi_t^* + \theta (1 - \tau_t) \hat{\pi}_t^* + (1 - \theta) (1 - \tau_t) \pi_t + w_t^* \right]. \quad (6) \]

4 Policy equilibrium

The governments of the two countries choose their policies by playing a non-cooperative game that takes into account how their choices affect equilibrium allocations. Thus, we need to characterize first the competitive equilibrium associated with given policies. We start doing this in Subsection 4.1 with the presentation of the optimization problems solved by firms and households when current and future tax rates are determined by some general policy rule \( \Psi(s) \). The variable \( s \) denotes the set of aggregate states that will be specified below. The policy rule depends only on \( s \) because the analysis is restricted to Markov strategies. After characterizing the agents’ problem for given policy rules, Subsection 4.2 specifies the policy objectives of the two governments and defines the time-consistent policy function that will emerge in equilibrium.

4.1 Agents’ problem and equilibrium for a given policy rule

In this subsection we characterize the agents’ problem and define the competitive equilibrium for given policy rules. We start with the optimization problem solved by a multinational firm.

4.1.1 Firm’s problem

The problem solved by a multinational firm can be separated in two sub-problems. In the first the multinational chooses the allocation of intangible expenses and the inputs of labor in domestic and non-domestic operations. In the second it chooses investments in both intangible and tangible capital. We start with the first problem.

Given the states \( k_t, \hat{k}_t, x_t \), a multinational firm headquartered in the Home country \( \zeta_t, \hat{\zeta}_t, l_t \), and \( \hat{l}_t \) to maximize profits by solving the problem

\[ \max_{\zeta_t, \hat{\zeta}_t, l_t, \hat{l}_t} \left\{ (1 - \tau_t) \pi_t + (1 - \tau_t^*) \hat{\pi}_t \right\}, \quad (7) \]

s.t.
\[ \zeta_t + \hat{\zeta}_t = \delta, \]
with domestic profits, \( \pi_t \), and profits earned abroad, \( \hat{\pi}_t \), defined in equations (1) and (2).

The objective is the maximization of the worldwide profits (sum of profits earned in the two countries) net of the profit taxes and the cost of shifting taxation. The solution is characterized by the first order conditions

\[
\left[ 1 + \varphi_\zeta(\zeta_t) \right] (1 - \tau_t) = \left[ 1 + \hat{\varphi}_\zeta(\hat{\zeta}_t) \right] (1 - \hat{\tau}_t),
\]

\[
q_t F_l(k_t, x_t, l_t) = w_t, \tag{9}
\]

\[
\hat{q}_t \hat{F}_l(\hat{k}_t, x_t, \hat{l}_t) = w_\hat{t}, \tag{10}
\]

where the subscript in the cost function denotes the first derivative.

Condition (8) is intuitive: higher is the domestic tax rate on profits, relatively to the tax rate paid abroad, and larger is the deviation of \( \zeta_t \) and \( \hat{\zeta}_t \) from their corresponding targets, \( \lambda \delta \) and \( (1 - \lambda) \delta \). When the profit tax rates are equalized between the two countries, the derivatives of the cost functions must be zero, which implies \( \zeta_t = \lambda \delta \) and \( \hat{\zeta}_t = (1 - \lambda) \delta \). The parameter \( \chi \) in the cost functions determines the sensitivity of \( \zeta_t \) and \( \hat{\zeta}_t \) to the tax differential: higher is the value of \( \chi \) and lower is the sensitivity of the responses of \( \zeta_t \) and \( \hat{\zeta}_t \) to the tax differential.

Conditions (9) and (10) determines the inputs of labor which are chosen to equalize the marginal productivity, domestic and abroad, to the wage rate in each country. The optimality conditions for a Foreign multinational are similar.

Even if capital cannot be reallocated internationally in the short run (although it can be done through new investments), when tax rates differ across countries, firms can reduce their tax bill by shifting the taxation of profits toward the country with the lowest tax rate. This introduces a mechanism for international tax competition. Even if higher profit taxes do not distort production in the current period, they can redistribute resources in favor of the domestic country. This is because some of the profits generated by multinationals headquartered in the Foreign country are generated in the Home country and part of the Home multinationals are owned by households that are residents of the Foreign country. This incentive, however, is alleviated by the flexibility with which multinationals can shift the taxation burden. Higher profit tax rates in the Home country will reduce the taxable profits in the Home country and increase them in the Foreign country.

We can now consider the investment decision of the Home multinational. Differently from the optimal hiring, the investment decision solves a dynamic problem which we write recursively as

\[
V(s, x, k, k'; \Psi) = \max_{n,i,\hat{i}} \left\{ d + \hat{\beta} V(s'; x', k', \hat{k}'; \Psi) \right\}
\]

s.t.

\[
d = (1 - \hat{\phi}) \left[ (1 - \tau) \pi + (1 - \hat{\tau}) \hat{\pi} \right] - n - i - \hat{i}, \tag{12}
\]

\[
x' = x + n, \tag{13}
\]
\[ k' = k + i, \quad (14) \]
\[ \hat{k}' = \hat{k} + \hat{i}, \quad (15) \]
\[ \hat{\phi} = \theta \phi + (1 - \theta) \phi^*, \quad (16) \]
\[ (\tau, \tau^*, \phi, \phi^*) = \Psi(s), \quad (17) \]
\[ s' = \Upsilon(s; \Psi). \quad (18) \]

The variable \( d \) denotes the dividends net of taxes (both profit and income taxes) paid by the multinational. Even if income taxes are paid by households, firms maximizes the value of these profits for households taking into account the ownership structure of the firm. The Home multinational knows that a fraction \( \theta \) of its profits belong to Home households who pay the income tax rate \( \phi \). The remaining fraction \( 1 - \theta \), instead, belong to Foreign households and they pay the income tax rate \( \phi^* \). Therefore, domestic profits have a value of \((1 - \phi) (1 - \tau) \pi\) for shareholders residing in the Home country and \((1 - \phi^*) (1 - \phi) \pi\) for shareholders residing in the Foreign country. By the same token, the profits generated abroad by the Home multinational has a value of \((1 - \phi) (1 - \tau^*) \hat{\pi}\) for shareholders residing in the Home country and \((1 - \phi^*) (1 - \phi^*) \hat{\pi}\) for shareholders residing in the Foreign country. The value for the multinational is then the weighted sum of these values, that is,

\[
(1 - \bar{\phi}) \left[ (1 - \tau) \pi + (1 - \hat{\tau}) \hat{\pi} - \phi(\zeta)x \right],
\]

where \( \bar{\phi} = \theta \phi + (1 - \theta) \phi^* \). The weights \( \theta \) and \( 1 - \theta \) are the corresponding shares of Home and Foreign owners of a multinational headquartered in the Home country.

The variable \( n \) is the net (of depreciation) investment in intangible capital while \( i \) and \( \hat{i} \) are net investments in tangible capital in Home and Foreign countries, respectively. We used net investments because depreciation has already been subtracted in the profits \( \pi \) and \( \hat{\pi} \). The discount factor \( \tilde{\beta} \) is time varying and will be derived below from the discount factors of shareholders. A firm is atomistic and, therefore, it takes \( \tilde{\beta} \) as given. Having specified the problem recursively, we have omitted time subscripts and used the prime sign to indicate next period variables. Finally, we would like to emphasize that the profits \( \pi_t \) and \( \hat{\pi}_t \) are the maximized profits, that is, those obtained with the optimal inputs of labor and optimal tax shifting.

The first order conditions for the investment chosen by a Home multinational are

\[
\tilde{\beta} \left[ 1 + (1 - \bar{\phi}') \left[ (1 - \tau') \frac{\partial \pi'}{\partial x'} + (1 - \tau^*)' \frac{\partial \hat{\pi}'}{\partial x'} - \varphi'(\zeta') \right] \right] = 1, \quad (19)
\]
\[
\tilde{\beta} \left[ 1 + (1 - \bar{\phi}')(1 - \tau') \frac{\partial \pi'}{\partial k'} \right] = 1, \quad (20)
\]
\[
\tilde{\beta}_j \left[ 1 + (1 - \bar{\phi}')(1 - \tau^*)' \frac{\partial \hat{\pi}'}{\partial k'} \right] = 1. \quad (21)
\]

Lower values of the discount factor \( \tilde{\beta} \) require higher marginal productivity of capital, both intangible and tangible. Higher future tax rates on profits, \( \tau' \) and \( \tau^{*'} \), and income,
\( \phi' \), will be associated with higher marginal productivity of capital and, therefore, lower investment.

**Lemma 4.1** If the profit tax rates chosen by the two countries are the same, that is, \( \tau = \tau^* \), the next period share of intangible capital is \( \alpha \).

**Proof 4.1** See appendix.

This property is valid as long as the profit tax rates are the same. If they differ, the share of intangible capital is not \( \alpha \). The symmetry of the two countries implies that in the steady state they choose the same tax rates and, therefore, the share of intangible capital is \( \alpha \).

### 4.1.2 Household’s problem

The household’s problem in the Home country is relatively simple and can be written recursively as

\[
\Omega(s, b; \Psi) = \max_{c,b'} \left\{ u(c) + \beta \Omega(s', b'; \Psi) \right\} \quad (22)
\]

\text{s.t.}

\[
c = (1 - \phi)w + \theta d + (1 - \theta)d^* + T + b - pb',
\]

\[
\phi = \Psi \phi(s),
\]

\[
s' = \Upsilon(s; \Psi).
\]

In addition to wages, households receive dividends paid by Home multinationals in proportion to their share ownership, \( \theta d \), and Foreign multinationals, \( (1 - \theta)d^* \). They also receive government transfers, \( T \). The variable \( b \) denotes the bond purchased in the previous period and \( b' \) the new bond purchased at price \( p \). We assume that the interests earned on the bonds are not taxed. This assumption is not important for the results of the paper but it is convenient analytically.\(^1\) Notice that the dividends are already net of the income taxes paid by households, which explains why they do not show explicitly in the household’s budget constraint.

The first order condition for the choice of the new bond returns

\[
u_c(c)p = \beta u_c(c'),
\]

which provides us with an expression to derive the bond price \( p \). The condition says that the utility cost of purchasing one unit of bonds today, \( u_c(c)p \), must be equal to the discounted utility value of the next period repayment, that is, \( \beta u_c(c') \).

---

\(^1\)Since the determination of the current tax rates depends on the taxed interests on bonds that are earned today but are based on the interest rate determined in the previous period, we would need to keep track of the interest rate as an additional state variable. Keeping track of an additional state variable would be a major complication for the numerical computation of the equilibrium.
Since multinationals maximize the value of their shareholders, they take into consideration how dividends are valued by shareholders. In particular, one unit of dividends paid today by a Home multinational has a utility value of $\theta u_c(c)$ for Home shareholders (since they will receive a share $\theta$ of dividends) and $(1 - \theta)u_c(c^*)$ for Foreign shareholders. Thus, the total value of one unit of dividends is

$$\theta u_c(c) + (1 - \theta)u_c(c^*).$$

(24)

As an alternative to paying the dividend today, the firm could invest that unit in new capital—let’s say in domestic tangible capital—and this will generate a return in the next period of $(1 - \bar{\phi})(1 - \tau)\partial \pi' / \partial k'$. The return can be paid to shareholders in the next period together with the unit invested, which has a present value of

$$\beta \left( \theta u_c(c') + (1 - \theta)u_c(c^{''}) \right) \left[ 1 + (1 - \bar{\phi})(1 - \tau)\frac{\partial \pi'}{\partial k'} \right].$$

(25)

Utility maximization requires that the value of paying one unit of dividends today—equation (24)—must be equal to the value of reinvesting that unit and paying it the next period together with the return from the investment—equation (25). Equalizing the two terms and re-arranging we obtain

$$1 = \frac{\beta \left( \theta u_c(c') + (1 - \theta)u_c(c^{''}) \right)}{\theta u_c(c) + (1 - \theta)u_c(c^*)} \left[ 1 + (1 - \bar{\phi})(1 - \tau)\frac{\partial \pi'}{\partial k'} \right].$$

This shows that Home multinationals discount future payments by the factor

$$\bar{\beta} = \frac{\beta \left( \theta u_c(c') + (1 - \theta)u_c(c^{''}) \right)}{\theta u_c(c) + (1 - \theta)u_c(c^*)}.$$  

(26)

Next we want to show that the discount factor used by firms is equal to the price of the bond. The households’ first order conditions in the choice of bonds, for Home and Foreign households are, respectively,

$$u_c(c)p = \beta u_c(c'),$$

(27)

$$u_c(c^*)p = \beta u_c(c^{''}).$$

(28)

Multiplying the first equation by $\theta$ and the second equation by $1 - \theta$, summing them together and re-arranging, we obtain

$$p = \frac{\beta \left( \theta u_c(c') + (1 - \theta)u_c(c^{''}) \right)}{\theta u_c(c) + (1 - \theta)u_c(c^*)}.$$  

(29)

Equations (26) and (29) show that $\bar{\beta} = p$. 

15
4.1.3 Equilibrium for given policy rules

We provide here a formal definition of a competitive equilibrium when tax rates are determined by a policy function $\Psi$.

**Definition 4.1** A recursive competitive equilibrium for a given policy rule $\Psi$ is given by: (i) aggregate functions for wages, $w(s;\Psi)$ and $w^*(s;\Psi)$, price of bonds, $p(s;\Psi)$, allocations of intangible expenses, $\zeta(s;\Psi)$, $\zeta^*(s;\Psi)$, $\zeta^*(s;\Psi)$, investments in intangible, $N(s;\Psi)$ and $N^*(s;\Psi)$, investment in tangible, $I(s;\Psi)$, $\hat{I}(s;\Psi)$, $I^*(s;\Psi)$ and $\hat{I}^*(s;\Psi)$, law of motion for aggregate states, $\Upsilon(s;\Psi)$; (ii) firm values, $V(s,x,k,\hat{k};\Psi)$ and $V^*(s,x^*,k^*,\hat{k}^*;\Psi)$, firms’ decision rules for allocation of intangible expenses, $g^c(s,x,k,\hat{k};\Psi)$, $g^c(s,x,K,\hat{K};\Psi)$, $g^c(s,x^*,k^*,\hat{k}^*;\Psi)$, $g^c(s,x^*,k^*,\hat{k}^*;\Psi)$, input of labor $g^l(s,x,k,\hat{k};\Psi)$ and $g^l(s,x^*,k^*,\hat{k}^*;\Psi)$, intangible investment, $g^n(s,x,k,\hat{k};\Psi)$ and $g^n(s,x^*,k^*,\hat{k}^*;\Psi)$, tangible investment, $g^i(s,x,k,\hat{k};\Psi)$, $g^i(s,x,k,\hat{k};\Psi)$, $g^i(s,x^*,k^*,\hat{k}^*;\Psi)$, $g^i(s,x^*,k^*,\hat{k}^*;\Psi)$; (iii) households’ values $\Omega(s,b;\Psi)$ and $\Omega^*(s,b^*;\Psi)$, and households’ decision rules for the acquisition of bonds $g^b(s,b;\Psi)$ and $g^b(s,b^*;\Psi)$, such that: (i) the decision rules of firms and households solve their corresponding problems and $V(s,x,k,\hat{k};\Psi)$, $V^*(s,x^*,k^*,\hat{k}^*;\Psi)$, $\Omega(s,b;\Psi)$ and $\Omega^*(s,b^*;\Psi)$ are the associated value functions; (ii) firms and households are representative, that is,

$$g^c(s,X,K,\hat{K};\Psi) = \zeta(s;\Psi),$$
$$g^c(s,X,K,\hat{K};\Psi) = \hat{\zeta}(s;\Psi),$$
$$g^c(s,X^*,K^*,\hat{K}^*;\Psi) = \zeta(s;\Psi),$$
$$g^c(s,X^*,K^*,\hat{K}^*;\Psi) = \hat{\zeta}(s;\Psi),$$
$$g^l(s,X,K,\hat{K};\Psi) + g^l(s,X,K,\hat{K};\Psi) = 1,$$
$$g^l(s,X^*,K^*,\hat{K}^*;\Psi) + g^l(s,X^*,K^*,\hat{K}^*;\Psi) = 1,$$
$$g^n(s,X,K,\hat{K};\Psi) = N(s;\Psi),$$
$$g^n(s,X^*,K^*,\hat{K}^*;\Psi) = N^*(s;\Psi),$$
$$g^i(s,X,K,\hat{K};\Psi) = I(s;\Psi),$$
$$g^i(s,X,K,\hat{K};\Psi) = \hat{I}(s;\Psi),$$
$$g^i(s,X^*,K^*,\hat{K}^*;\Psi) = I^*(s;\Psi),$$
$$g^i(s,X^*,K^*,\hat{K}^*;\Psi) = \hat{I}^*(s;\Psi),$$
$$g^b(s,B;\Psi) + g^b(s,B;\Psi) = 0,$$

(iv) governments balance their budget every period, equations (5) and (6).

4.2 Determination of policies

When governments choose the current tax rates—$\tau$ and $\phi$ in the Home country, and $\tau^*$ and $\phi^*$ in the Foreign country—they take as given the rule that determines future policies,
that is, the function $\Psi$. Furthermore, each government takes as given the policy variables of the other country. Effectively, a government chooses only the profit tax rate, $\tau$ or $\tau^*$, because the income tax rate, $\phi$ or $\phi^*$, will be determined endogenously by the budget constraint of the governments. For the same reason, each government takes as given only the profit tax rate of the other country since the income tax rate will be determined endogenously by the government budget of the other country.

We define first the equilibrium when current policies are exogenously given and future policies are determined by $\Psi$. The problem solved by a multinational firm headquartered in the Home country can be written recursively as

$$
\tilde{V} \left( s, x, k, \hat{k}, \tau, \tau^*; \Psi \right) = \max_{\zeta, l, n, \hat{l}, i} \left\{ d + pV \left( s', x', k', \hat{k}' ; \Psi \right) \right\}
$$

subject to

$$
d = (1 - \bar{\phi}) \left[ (1 - \tau) \pi + (1 - \tau^*) \hat{\pi} \right] - n - i - \hat{i},
$$

$$
x' = x + n,
$$

$$
k' = k + i,
$$

$$
\hat{k}' = \hat{k} + \hat{i},
$$

$$
\bar{\phi} = \theta \phi + (1 - \theta) \phi^*
$$

$$
(\phi, \phi^*) = \tilde{B}(s; \tau, \tau^*)
$$

$$
s' = \tilde{Y}(s, \tau, \tau^*; \Psi),
$$

The next period value function is for a given policy rule $\Psi$ as we defined in the previous section. For the current period, instead, the value function has the current policies $\tau$, $\tau^*$ as explicit arguments. As we explained above, the income tax rates, $\phi$ and $\phi^*$, are determined by the budget constraints of the two governments. This is indicated in the problem by the function $\tilde{B}(s; \tau, \tau^*)$, which is a compact notation for the government budget constraints. All functions that depend on current policies $\tau$ and $\tau^*$ are denoted with a tilde sign to distinguish them from the analogous functions where policies are determined by the policy rule $\Psi$.

The problem solved by households in the Home country is

$$
\tilde{\Omega}(s, b, \tau, \tau^*; \Psi) = \max_{c, b'} \left\{ u(c) + \beta \Omega \left( s', b' ; \Psi \right) \right\}
$$

subject to

$$
c = (1 - \phi)w + \theta d + (1 - \theta) d^* + T + b - pb',
$$

$$
\phi = \tilde{B}_\phi(s, \tau, \tau^*; \Psi),
$$

$$
s' = \tilde{Y}(s, \tau, \tau^*; \Psi),
$$

with the continuation value defined in the previous section. The definition of the equilibrium for given current policies, $\tau$ and $\tau^*$, is analogous to the definition provided earlier.

We are now ready to define the problem solved by the government of the Home country. This consists in the choice of $\tau$ to maximize the welfare of its own residents, that is, the
function $\tilde{\Omega}(s, B, \tau, \tau^*; \Psi)$. Formally, the problem solved by the Home government is
\[
\max_{\tau} \tilde{\Omega}(s, B, \tau, \tau^*; \Psi). \tag{32}
\]

The solution is given by a function $h(s; \tau^*, \Psi)$ that returns the optimal profit tax rate $\tau$ as a function of the profit tax rate chosen by the Foreign government $\tau^*$ (in addition to be a function of the aggregate states). This is the response function of the Home government to the policy of the Foreign government.

The problem solved by the Foreign government is similar and can be written as
\[
\max_{\tau^*} \tilde{\Omega}^*(s, -B, \tau, \tau^*; \Psi). \tag{33}
\]

In equilibrium, the bonds held by households in the Home country, $B$, must be equal to the negative of the bonds held by households in the Foreign country. This is why the objective function of the Foreign government has $-B$ as a state variable. The solution is given by a function $h^*(s; \tau, \Psi)$ which represents the response function of the Foreign government to the policy of the Home government. We can now define a Nash policy equilibrium.

Definition 4.2 (Nash one-step equilibrium) Given the states $s$ and the policy rule $\Psi$ determining future policies, a Nash one-step equilibrium is given by tax rates $\tau$ and $\tau^*$ that satisfy $\tau = h(s, \tau^*; \Psi)$ and $\tau^* = h(s, \tau; \Psi)$.

We denote the solution to the Nash game for given states $s$ by the function $(\tau, \tau^*) = \psi(s; \Psi)$. This is the equilibrium ‘current policy rule’ when the two governments expect that future policies will be determined by the policy rule $\Psi(s)$. We now have all the elements to define the equilibrium time-consistent policies.

Definition 4.3 (Time-consistency) The equilibrium time-consistent policy rule satisfies $\Psi(s) = \psi(s; \Psi)$.

In words, the policy rule $\Psi$ is time consistent if the solution to the current policy game replicates the rule that determine future policies.

5 Policy coordination

For policy coordination we think of an environment in which the two governments choose common tax rates on profits, that is, $\tau = \tau^*$, in order to maximize the sum of the welfare of the two countries. This is still done without commitment to future policies. The objective of the coordinating governments is
\[
\max_{\tau} \left\{ \tilde{\Omega}(s, B, \tau, \tau; \Psi) + \tilde{\Omega}^*(s, -B, \tau, \tau; \Psi) \right\}. \tag{34}
\]

With symmetric countries the coordinated policies are indeterminate. This is because, with inelastic labor supply, current taxes are not distortionary. Capital is already
installed so changing the taxation of capital cannot change its current allocation. Similarly, changing the taxation of income, which includes the taxation of wages, cannot change the quantity of labor used in production since the supply is inelastic. The tax rates cannot generate cross-country redistribution since they are the same. Therefore, changing the common profit tax rate $\tau$ simply changes the composition of tax revenues without affecting production and consumption.

Because the coordinated time-consistent policy is undetermined, it is not possible to characterize the precise tax rates that would emerge in a globalized environment in which taxation is fully coordinated across countries. In reality, full coordination of fiscal policies is unlikely to be achieved. Even with highly integrated economies such as the European Union, attempts to the full coordination of fiscal policies have failed so far. What is more likely is some form of partial coordination such as a minimum level of taxation. This is what the US Treasury Secretary has promoted. Therefore, what we will do in the quantitative analysis is to explore the welfare implication of setting a lower bound to profit tax rates.

6 Quantitative analysis

We now turn our attention to the main question addressed in this paper: How the increased role of intangible capital and cross-country investments affected equilibrium taxation. We will also ask the question of whether a lower floor on profit tax rates is more desirable given these changes.

To answer these questions we conduct a quantitative analysis where we increase both the share of intangible capital, and the cross-country investment and ownership of multinationals. Since in the model the share of intangible capital is dictated by the parameter $\alpha$, the quantitative exercise compares equilibria with low value of $\alpha$ (inducing low shares of intangible capital like in the early 1990s) to a higher values of $\alpha$ (inducing high shares of intangible capital like in the 2000s). To capture the importance of financial globalization we compare equilibria with high values of $\lambda$ and $\theta$ (low shares of foreign investments and ownership like in the early 1990s) to lower values of $\lambda$ and $\theta$ (high shares of foreign investments and ownership like in the 2000s). We start with the description of how we calibrate the baseline model.

6.1 Calibration

We think of the baseline model as capturing the structural conditions that prevailed in the early 1990s. Most components of the model are standard and, for these components we assign the typical parameter values used in the literature. We set the discount factor to $\beta = 0.95$ and the curvature of the utility function to $\sigma = 2$.

Both types of capital depreciate at rate $\delta = 0.06$ and the capital income share is set to $\nu = 0.4$. The share parameter for intangible capital is set to $\alpha = 0.3$. The reason we choose this value is because we think of the early 1990s as the starting point for our quantitative exercise. Although data on intangible capital is available since the 1970s,
we will focus on the period that starts at the beginning the 1990s because, by then, international markets were quite integrated and the issue of international tax competition started to become quite relevant. Remember that our model features capital mobility which was heavily controlled before the mid-1980s. We then compare the early 1990s when the share of intangible capital was about 30% to the last five years of data shown in Figure 1 where the share of intangible capital reached the value of 60%.

The parameter $\lambda$ is the share of intermediate inputs produced by domestic multinationals in the production of final goods. The remaining share $1 - \lambda$ of intermediate inputs are produced by non-domestic multinationals. Since this parameter also determines the share of investments made by multinationals domestically and abroad, we calibrate it by targeting the level of Foreign Direct Investments (FDI) at the beginning of the 1990s. As shown in the first panel of Figure 2, the average value of FDI among industrialized countries was about 15% the value of GDP at the beginning of the 1990s. Therefore, we choose $\lambda$ so that in the steady state the value of foreign capital, $(1 - \lambda)x + \hat{k}$, is 15% the value of final output, $y_t$.

An issue associated with changing the values of $\alpha$ and $\lambda$ is that, in addition to changing the equilibrium shares of the two types of capital and the allocation of capital domestically and abroad, they also change aggregate production and consumption. This happens even if total capital (the sum of tangible and intangible) and the profit tax rates do not change. Because of this, it would be difficult to assess the welfare implications of a change in $\alpha$ and $\lambda$. To circumvent this issue we re-normalize the productivity of intermediate production. We do that by assuming that intermediate productivities take the following forms

$$z = z^* = \frac{\bar{z}\lambda^{\alpha\nu}}{\alpha^{\alpha\nu}(1 - \alpha)^{(1 - \alpha)\nu}},$$

$$\hat{z} = \hat{z}^* = \frac{\bar{z}(1 - \lambda)^{\alpha\nu}}{\alpha^{\alpha\nu}(1 - \alpha)^{(1 - \alpha)\nu}}.$$

It can be verified that, with this specification, if the profit tax rates do not change, steady state output and consumption are independent of $\alpha$ and $\lambda$. Therefore, the real effects induced by a change in $\alpha$ or $\lambda$ are only driven by the endogenous responses of taxes. The parameter $\bar{z}$ acts as a re-scaling factor and we choose its value so that the steady state output in the baseline calibration is equal to 1 (normalization).

We discuss next the calibration of the parameter $\theta$, that is, the domestic ownership share of multinationals. To calibrate this parameter, we use data on Portfolio Equity Investment shown in the second panel of Figure 2. At the beginning of 1990s, the average Portfolio Equity Investment (PEI) held by foreigners in industrial countries was about 5% of GDP. Therefore, we choose $\theta$ so that the steady state value of capital held by foreigners in a multinational, $(1 - \theta)(k + \hat{k} + x)$, is 5 percent the value of final output, $y_t$. Notice that this parameter does not affect the steady state values of output and consumption if tax rates do not change. The only macroeconomic impact induced by $\theta$ is through the response of tax rates.

Public spending—$G, G^*, T$ and $T^*$—are exogenous in the model. We assume that they are constant in absolute value so that we can focus on the (endogenous) composition
of taxes. Since their absolute values remain constant when we change $\alpha$, $\lambda$ and $\theta$, the output share of public spending does not change in the steady state if the tax rates do not change (remember that, with the normalization of productivities, steady state output changes only in response to tax rates). The values of government purchases, $G$ and $G^*$, and transfers, $T$ and $T^*$, are chosen so that in the steady state government purchases and transfers are, respectively, 20% and 15% the value of final output.

We are now left with the parameter $\chi$, that is, the cost of tax shifting. Higher values of $\chi$ make more costly for multinationals to shift the taxation of profits from one country to the other. This increases the incentive of governments to tax profits and, as a result, the equilibrium taxation of profits will be higher. We pin down $\chi$ by targeting an equilibrium profit tax rate of 30%, that is, $\tau = \tau^* = 0.3$. To match this calibration target we use an iterative procedure: we guess $\chi$, solve for the steady state equilibrium associated with the guess, and then verify whether the equilibrium tax rate is $\tau = \tau^* = 0.3$.

The equilibrium in the baseline calibration will be compared to the equilibrium with new values of $\alpha$, $\lambda$ and $\theta$. These three parameters are re-calibrated to match the shares of intangible capital, and the cross-country investment and ownership at the end of the sample. In particular we set $\alpha = 0.6$ since the share of intangible capital shown in Figure 1 at the end of the sample period is about 60%. The values of $\lambda$ and $\theta$ are chosen so that the stock of FDI and PEI in 2020 are, respectively, 40% and 50% the value of GDP for industrialized countries. These are the approximate numbers shown in the two panels of Figure 2. The full set of parameter values are reported in Table 1.

<table>
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<tr>
<th>Description</th>
<th>Parameter</th>
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<th>New calibration</th>
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<tr>
<td>Utility curvature</td>
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<tr>
<td>Productivity</td>
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<td>Share domestic ownership of multinationals</td>
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<td>Cost of tax shifting</td>
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<tr>
<td>Government transfers</td>
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</tr>
</tbody>
</table>

### 6.2 Steady state comparisons

We fist compare two steady states: (i) the initial steady state associated with the baseline calibration of $\alpha$, $\lambda$ and $\theta$, targeting data for 1990; and (ii) the terminal steady state
associated with the calibration of $\alpha$, $\lambda$ and $\theta$ that target the most recent data. The results are reported in Table 2.

Table 2: Steady state variables.

<table>
<thead>
<tr>
<th></th>
<th>Baseline calibration</th>
<th>New calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
<td>2020</td>
</tr>
<tr>
<td>Profit tax rate</td>
<td>0.300</td>
<td>0.240</td>
</tr>
<tr>
<td>Income tax rate</td>
<td>0.346</td>
<td>0.349</td>
</tr>
<tr>
<td>Public purchases-output ratio</td>
<td>0.200</td>
<td>0.193</td>
</tr>
<tr>
<td>Public transfers-output ratio</td>
<td>0.150</td>
<td>0.145</td>
</tr>
<tr>
<td>Stock of capital</td>
<td>2.287</td>
<td>2.487</td>
</tr>
<tr>
<td>Output</td>
<td>1.000</td>
<td>1.034</td>
</tr>
</tbody>
</table>

As a result of the changes in $\alpha$, $\lambda$ and $\theta$, the steady state tax rate on profits drops from 30% to 24%. The income tax rate increases but only slightly: from 34.6% to 34.9%. The reason the income tax increases only slightly despite the decline in profit tax rate and the need to fund the same government expenditures is because output increases and, therefore, the tax base for income taxes increases. This is driven by the increase in the stock of capital which increases from 2.287 to 2.487.

The changes shown in Table 2 result from the combined effects of the changes in $\alpha$, $\lambda$ and $\theta$. To show how these parameters affect the equilibrium we conduct a sensitivity analysis for each of them. Before doing so, however, it would be instructive to show how the choice of the current profit tax rate affects the government’s objective.

Figure 3 plots the government’s value for country 1 as a function of the profit tax rate. The figure plots the current utility, $u_t$, the continuation utility, $\beta \Omega_{t+1}$, and the total value $\bar{\Omega}_t = u_t + \beta \Omega_{t+1}$, computed assuming that the states variables take the steady state values and the profit tax rate chosen by the other country is also at the steady state value. Therefore, the graphs plot the deviation of country 1 from the steady state profit tax rate. The top panels are for the steady state of the baseline calibration (1990) while the bottom panels are for the calibration that targeted the most recent data (2020).

Current utility and continuation utility are both concave and reach a maximum at the steady state. For low profit tax rates (relative to the other country tax rate), the current utility increases while for high tax rates (also relative to the other country tax rate) the utility decreases. To understand why, we have to consider how an increase in the tax rate in country 1 affects tax revenues. On the one hand, the volume of taxable profits declines since multinationals shift taxable profits abroad. This reduces tax revenues generated from the taxation of profits and it is not desirable because country 1 collects fewer taxes from foreign earners, while domestic earners will pay more taxes to the foreign government. On the other, each unit of foreign profits that continue to be taxed in country 1 will pay a higher tax rate. This is desirable for country 1. It turns out that the second effect dominates when the initial tax rate is (relatively) low, while the second effect dominates
when the initial tax rate is (relatively) high. At the pick, the two effects compensate each other and the government does not have an incentive to deviate from that particular tax rate.

Figures 3: Government value as a function of the current profit tax rate: Deviation from the steady state.

The continuation utility follows a similar pattern. This is because, when an increase in profit tax rate raises tax revenues, the government can reduce income taxes to residents, which in turn increases disposable income. This increases next period capital and, therefore, next period continuation utility. When the increase in profit tax rate decreases the overall taxation of foreign profits, it also reduces the disposable income of residents, leading to a reduction in both current and continuation utilities.

As anticipated, the bottom panels plot the same variables when the model is calibrated using the end of period targets. As can be seen, the functions display similar shapes, which can be explained in the same way we did for the top panels. However, the pick or maximum is at a lower value of the profit tax rate: 24% versus 30% for the model calibrated using beginning of period targets. To understand why the new calibration leads to a lower taxation of profits, we will now conduct a sensitivity with respect to each of the three parameters $\alpha$, $\lambda$, and $\theta$.

We first change the share of intangible capital $\alpha$ from 0.2 to 0.7, with increments of 0.1. We would like to reiterate that, given our specification of productivities, if the common tax rates do not change in the two countries, steady state production and consumption also do not change with $\alpha$. This is because intangible and tangible capital depreciate at the same rate, productivities are re-scaled when $\alpha$ changes, and incomes generated by the two types of capital are taxed at the same rates. Thus, if total capital, output and consumption change in response to a change in the share of intangible, it is because different values of $\alpha$ affect equilibrium tax rates.

The top panels of Figure 4 plot the steady state tax rates (panel (a)), and capital
and output (panel (b)), for different shares of intangible $\alpha$. The increase in the share of intangible leads to a decline in the profit tax rate $\tau$ and a slight increase in the income tax rate. The reason the income tax rate increases only slightly, despite the sizable drop in profit taxes, is because the stock of capital and, therefore, the tax base rises. In fact, panel (b) shows that total capital and output increase significantly with $\alpha$. Going from a share of intangible of 20% to a share of 70%, the stock of capital increases by 65 percent while output increases by 22%.

Figure 4: Steady state tax rates, capital and output for different shares of intangible capital (determined by $\alpha$), foreign investments (determined by $\lambda$), and foreign ownership of multinationals (determined by $\theta$).

The middle panels of Figure 4 plot the sensitivity to the share of domestic inputs
in final production, the parameter $\lambda$. In this exercise we use the more recent share of intangible, that is, $\alpha = 0.6$, but the baseline value of $\theta = 0.978$. The parameter $\lambda$ does not have a sizable impact on the equilibrium tax rates, which at first may be surprising. This derives from two contrasting effects. On the one hand, a higher share of foreign capital increases the incentive to tax profits because a large share of them are generated in the country by foreign multinationals. On the other, as we decrease $\lambda$, the cost of tax shifting also change. The chosen specification of this cost implies that the overall cost of deviating from the target allocation of intangible depreciation decreases as $\lambda$ declines and gets closer to 0.5. It turns out that the quantitative importance of this second effect is not that different from the first and, as a result, the equilibrium tax rates change only slightly.

The bottom panels of Figure 4 show the sensitivity to the foreign ownership of multinationals, which is determined by the parameter $\theta$. The foreign ownership of multinationals is important because it affects the profits earned by foreigners in the country, which in turn affects the incentive of the country to tax profits. In this regard, it is important to point out that $\theta$ is only the ownership of domestic multinationals, not the effective domestic ownership of capital invested in the domestic country.\(^2\)

The bottom panels of Figure 4 are constructed using $\alpha = 0.6$ and $\lambda = 0.825$, that is, the values that target for the 2020 moments. As we can see, the taxation of profits increases when a larger share of multinationals are owned by foreigners. This is because a larger share of profits earned in the country belong to foreigners, which increases the incentive of the local government to tax these profits. For example, when the value of multinationals owned by foreigners is 10% the value of output, the profit tax rate is 15.3%. When the foreign ownership is 50% the value of output, the profit tax rate is 24%.

Overall, when we switch from the baseline calibration with $\alpha = 0.3$, $\lambda = 0.934$ and $\theta = 0.978$ to the new calibration with $\alpha = 0.6$, $\lambda = 0.825$ and $\theta = 0.781$, the steady state profit tax rate drops from 30% to 24%. This implies an increase in the steady state stock of capital of 8.7% and an increase in the steady state output of 3.4%.

To summarize, Figure 4 shows that the two major trends documented in the introduction—increase in the share of intangible and international diversification of capital—had opposite effects on the choice of tax rates in a regime without commitment and without

\(^2\)Since multinationals invest in both countries, the effective ownership of capital invested in a country owned by foreigners is greater than $1 - \theta$. In the baseline calibration we imposed $\lambda = 0.934$ and $\theta = 0.978$. This means that Home multinationals invest 93.4% in the Home country and 6.6% in the Foreign country. Furthermore, 97.8% of Home multinationals are owned by Home households and 2.2% by Foreign households. Since Home multinationals invest 93.4% domestically, the effective domestic ownership of Home households is 93.4% $\times$ 97.8% = 91.3%. At the same time, Home households own 2.2% of Foreign multinationals that invest 93.4% of their capital in the Home country. This implies that Home households also hold 6.6% $\times$ 2.2% = 0.14% of the capital invested by Foreign multinationals in the Home country. Therefore, the share of capital owned by Home households in the Home country is 91.3% + 0.14% = 91.44%, while the remaining 8.56% is owned by Foreign households. More generally, in a symmetric steady state, the foreign ownership of capital invested in a country is $(1 - \lambda)\theta + \lambda(1 - \theta)$. This implies that, provided that there is home bias—$\lambda, \theta \in (0.5, 1.0]$—the foreign ownership of capital invested in the Home country increases either because $\lambda$ declines or because $\theta$ declines.
international coordination. The next step is to explore the welfare implications of these changes.

### 6.3 Transition dynamics and welfare

We are interested in the structural changes during the last three decades, starting at the beginning of the 1990s. By then, international markets were highly integrated, at least among industrialized countries. We then assess the implications of the higher share of intangible capital and higher financial integration across countries as shown in Figures 1 and 2.

Simply focusing on steady states, the top panels of Figure 4 shows that, if the only change during this period was the increase in the share of intangible capital from 30% to 60% (the respective values in 1990 and 2010), the profit tax rate would have dropped from 30% to 18.1%. This, in turn, would have generated an increase in the stock of capital of about 21%. At the same time, however, this period is characterized by a significant increase in foreign investments and foreign ownership of multinationals. Together with the increase in the stock of FDI (from 15% to 40% of output) and PEI (from 5% to 50% of output), the steady state tax rate drops from 30% to 24% and the stock of capital increases by 8.7%. The goal of this subsection is to show the transition dynamics bringing the economy to the new steady state.

Figure 5 shows the dynamics of tax rates, capital and output. Suppose that we start from a steady state with a share of intangible capital of \( \alpha = 0.3 \). The steady state capital is \( K + \bar{K} + X = 2.286 \). Starting from the steady state of the baseline model, we assume that, unexpectedly, the share of intangible capital rises to from \( \alpha = 0.3 \) to \( \alpha = 0.6 \), keeping \( \lambda \) and \( \theta \) constant at their baseline calibration values of 0.934 and 0.978, respectively. The transition dynamics is shown in the top two panels of Figure 5. The bottom panels, instead, plots the transition dynamics when also \( \lambda \) and \( \theta \) change to the new calibration values of 0.825 and 0.781, respectively. As can be seen, when only \( \alpha \) changes, the responses of taxes, capital and output are larger than the responses when all parameters change. This is consistent with the steady state results shown in Figure 4.

We now ask whether the increased share of intangible capital and globalization are welfare improving. To answer this question we cannot compare steady states. Since the steady state capital in the economy with 30% intangible is lower (due to higher taxes), households’ utility is likely to be lower than in the steady state with 60% intangible. But the higher capital needs to be accumulated by lowering current consumption. Therefore, to properly compute the welfare implications we need to take into account the transition shown in Figure 5.

Denote by \( \Omega(s; \alpha, \lambda, \theta) \) the lifetime utility of households in the Home country for given constant values of \( \alpha \), \( \lambda \) and \( \theta \), and given initial states \( s \). We would like to compute the percentage change in every period consumption in the initial steady state that is necessary to make households’ utility equal to the utility in the transitional equilibrium induced by the change in \( \alpha \), \( \lambda \) and \( \theta \). Formally, we would like to compute the value of \( g \) that solves
Figure 5: Dynamics of tax rates, capital and output in response to changes in $\alpha$, $\lambda$ and $\theta$.

The following equation,

$$(1 + g)^{1-\sigma}\Omega(s_0; \alpha = 0.3, \lambda = 0.934, \theta = 0.978) = \Omega(s_0; \alpha = 0.6, \lambda = 0.825, \theta = 0.781).$$

Here the vector $s_0 = (K_0, \hat{K}_0, X_0, K^*_0, \hat{K}^*_0, X^*_0, B_0)$ contains the states in the steady state equilibrium before the structural change.

After computing the values of $\Omega(s_0; \alpha = 0.3, \lambda = 0.934, \theta = 0.978)$ and $\Omega(s_0; \alpha = 0.6, \lambda = 0.825, \theta = 0.781)$, we can solve the above equation for $g$. This represents the proportional increase in consumption that needs to be given to households living in the steady state with $\alpha = 0.3$, $\lambda = 0.934$ and $\theta = 0.978$, in order to make them indifferent between staying in that steady state equilibrium (but with the additional consumption) or moving to a new economy with the same initial states but experiencing a transition induced by the changes in $\alpha$, $\lambda$ and $\theta$, or changes in a subset of these three parameters.

The first panel of Figure 6 plots the welfare gains for different values of $\alpha$, when $\lambda = 0.934$ and $\theta = 0.978$, that is, their baseline calibration values. The second panel, instead, plots the welfare gains induced by changes in $\theta$, when $\alpha = 0.6$ and $\lambda = 0.825$, that is, the new calibration values. As can be seen, the welfare gains increase with the share of intangible capital, but decline when the foreign ownership of multinationals increases. If we increase the value of foreign ownership as a fraction of output from 0.05 to 0.5 (keeping $\alpha = 0.6$ and $\lambda = 0.825$), the two countries experience a welfare loss of about

27
0.8% of consumption. However, if only the share of intangible capital changes from 0.3 to 0.6 while \( \lambda \) and \( \theta \) stay constant at 0.934 and 0.978, respectively, the two countries would experience a welfare gain of 1.3% of consumption.

If we combine the changes in \( \alpha \), \( \lambda \) and \( \theta \) from their baseline values (targeting the 1990 moments) to the new calibration values (targeting the 2020 moments), the two countries experience a welfare gain of 0.55% of consumption.

6.4 The welfare effects of lower bounds on profit taxes

TBD.

7 Inequality and taxation

The analysis of taxation conducted so far is based on a model where households are homogeneous. In that set up, the structure of taxes are chosen only on the basis of efficiency. In reality, there is considerable heterogeneity and the structure of taxes is important also for internal redistribution.\(^3\)

If we lived in a truly homogeneous agents world, it would be difficult to justify the concern about excessively low corporate taxes (besides, of course, efficiency considerations). But the reality is that some households earn a larger share of income from capital while other households earn a larger share of income from wages. As a result, a reduction in profit tax rates shifts the taxation burden toward the second category of households, which in general have lower incomes (poorer). In addition to the direct redistribution impact of taxes, a change in their composition could have indirect effects through the general equilibrium. This is because the general equilibrium effects impact prices which could have an heterogeneous impact on the incomes earned by different households.

\[^3\]In the model considered so far, taxes could generate some redistribution between Home and Foreign households if the two countries choose different tax rates. However, there is not redistribution within a country.
Extending the model with rich heterogeneity would make the characterization of the equilibrium policies very complex. However, it is possible to introduce some stylized heterogeneity that could capture the main redistributive channels discussed above (heterogeneous tax burdens and heterogeneous general equilibrium effects), while keeping the simplicity of the model.

Suppose that in each country there are two types of agents. A measure \( \mu \) have the same characteristics as the households considered in the representative-agent model studied so far. The remaining measure of households \( 1 - \mu \), instead, are hand-to-mouth and simply consume their wages. The first type of households earn both capital and labor income, while the second earn only labor income. In this environment, taxes have a redistributive impact both directly and indirectly through general equilibrium effects, and this will be taken into consideration by governments when they chose the optimal tax rates.

The objective function of the Home government can now be written as

\[
\max_{\tau} \left\{ \mu \tilde{\Omega}(s, B, \tau, \tau^*; \Psi) + (1 - \mu) \tilde{U}(s, \tau, \tau^*; \Psi) \right\},
\]

where \( \tilde{\Omega}(s, B, \tau, \tau^*; \Psi) \) is the lifetime utility of households that participate in capital markets and, therefore, earn both labor and capital incomes. We can derive this function by solving the previous household’s Problem (31). The function \( \tilde{U}(s, \tau, \tau^*; \Psi) \), instead, is the value for hand-to-mouth households, which we derive by solving the following Bellman’s equation,

\[
\tilde{U}(s, \tau, \tau^*; \Psi) = u(c) + \beta \tilde{U}(s', \Psi)
\]

\[\text{s.t.}\]
\[
c = (1 - \phi)w + T, \\
\phi = B(s, \tau, \tau^*; \Psi), \\
\]
\[
s' = \tilde{\Upsilon}(s, \tau, \tau^*; \Psi),
\]

The Foreign government solves a similar problem,

\[
\max_{\tau^*} \left\{ \mu \tilde{\Omega}^*(s, -B, \tau, \tau^*; \Psi) + (1 - \mu) \tilde{U}^*(s, \tau, \tau^*; \Psi) \right\}. 
\]

Equilibrium taxes are determined as the solution to the Nash game played by the two countries in the same way we defined it for the model with homogeneous households.

### 7.1 Equilibrium taxes with heterogeneous households

We explore the importance of heterogeneity focusing on the calibration that targets the most recent period. Thus, we set \( \alpha = 0.6 \), \( \lambda = 0.825 \) and \( \theta = 0.781 \). See last column of Table 1.

The first panel of Figure 7 plots the steady state tax rates as a function of \( 1 - \mu \), the share of hand-to-mouth households. This is a measure of inequality: When \( 1 - \mu = 0 \), we
go back to the representative agent model studied earlier. As we increase $1 - \mu$, capital incomes are earned by a smaller fraction of households. Thus, income disparity between hand-to-mouth households (who earn only wage income) and other households (who earn both wages and capital incomes) increases. The figure shows that higher inequality is associated with very small increase in profit taxes and very tiny decline in income taxes. Only when the share of hand-to-mouth households becomes large, the increase in profit tax rate becomes sizable. For example, when the share of hand-to-mouth households is 90%, and therefore, capital incomes are earned only by 10% of the population, the profit tax rate increases to about 27%. In this case the individual pre-tax income of hand-to-mouth households is 0.6 while the individual pre-tax income of other households is 4.6. The 10% of rich households earn an individual income that is 7.6 times bigger than the individual income of the remaining 90 percent of the population.

![Figure 7: Taxes and welfare gains as a function of inequality $1 - \mu$.]

The finding that profit taxes increase with inequality is intuitive. Remember that now the structure of taxes has a redistributive effect also domestically, that is, between hand-to-mouth and other households. To illustrate this, Figure 8 plots the utility values for other households (panels in first row) and hand-to-mouth households (panels in second row), when $\mu = 0.3$. The graphs show how current and continuation utilities for the two types of agents change when the government of country 1 changes the profit tax rate. The current states and the profit tax rate of country 2 are at the steady state values with $\mu = 0.3$. As can be seen, the current utility of other households declines with a higher profit tax rate while the current utility of hand-to-mouth households is mostly increasing. At some point the current utility of hand-to-mouth households starts declining because of the loss of revenues from foreign profits becomes quite strong. The continuation utility is decreasing for both types of households. This is because higher profit taxes reduce the income of savers (the other households) and, therefore, next period capital. Lower capital is harmful in the future also for hand-to-mouth households.

The last row of Figure 8 contains two graphs. The first is the government value, that is, the weighted sum of the welfare of both types of households (other and hand-to-mouth). The maximum is reaches at about 26%. The last panel with the dashed line, instead,
plots the value of the government if the size of other households is $\mu = 1$. This implies that there is no inequality. Notice that the states and profit tax rate chosen by country 2 remain the same when we change $\mu$ from 0.3 to 1. As can be seen, if there is no inequality, the government’s value would be decreasing in the profit tax rate. Thus, the government would choose a lower tax rate.

Although higher taxation of profits reduces the tax burden of poor households, the economy also experiences higher profit taxes in the future, which discourages capital accumulation. Lower accumulation of capital could be harmful for poor households because it reduces future wages. This is a consequence of the lack of policy commitment: because governments do not have the ability to commit to future policies and current taxes affect capital accumulation only marginally, the government chooses higher profit tax rates in every period and, therefore, also in the future.

Is the increase in taxation welfare improving then? On the one hand, higher current profit taxes redistribute resources to agents with higher marginal utility of consumption (the poor), which should increase welfare for hand-to-mouth households. On the other, the lower accumulation of capital decreases future incomes, including wages, which is the only income earned by hand-to-mouth households. Therefore, it is not obvious whether the higher taxation of profits is necessarily welfare improving for poor households.

The second panel of Figure 7 plots the welfare gains for different values of $1 - \mu$ (the
share of hand-to-mouth households). The welfare gains are computed by comparing two equilibria. The first is the steady state equilibrium for a particular value of $1 - \mu$, when the profit tax rate is set to the steady state value with $1 - \mu = 0$ (representative agent model). The second is the transition equilibrium when, starting from the steady state just described, the government of the two countries choose the tax rates optimally but without coordination (Nash equilibrium policies). The welfare gains are calculated by comparing the utilities in these two equilibria, separately for hand-to-mouth households and for other households. A positive number means that the change in tax rates improves welfare for the particular type of households. A negative number means that the endogenous change in tax rates reduces welfare.

As can be seen, higher inequality is associated with negative welfare gains (losses) for other households and a much smaller welfare gain for hand-to-mouth households compared to other households. The fact that hand-to-mouth households experience small welfare gains shows that the magnitudes of the two contrasting effects on the utility of these households are similar. As already mentioned, an increase in current profit taxes is beneficial for hand-to-mouth households because it allows for lower taxation of wages. However, this also reduces capital accumulation which affects adversely future wages.

7.2 Political bias and political myopia

The idea of a benevolent policy maker that weights equally all households is a frequent assumption in economic theory. In reality, however, a ruling government may weight certain groups differently from others. In this section we ask the question of how the equilibrium outcome would change if the policy maker assigns different weights to different types of households.

We generalize the government objective to

$$
\max_\tau \left\{ \rho \cdot \mu \cdot \tilde{\Omega}(s, B, \tau, \tau^*; \Psi) \right. \left. + (2 - \rho) \cdot (1 - \mu) \cdot \tilde{U}(s, \tau, \tau^*; \Psi) \right\}, \quad (38)
$$

The new parameter $\rho \in \{0, 2\}$ captures the differential weights used by the government in the choice of policies. When $\rho = 1$, the government weights equally hand-to-mouth households and other households, which is the case considered in the previous subsection. When $\rho = 0$, the government cares only about hand-to-mouth households while with $\rho = 2$ the government cares only about other households.

We compare two cases. In the first case the government weights the two types of households equally, that is, $\rho = 1$ (as before). In the second case, instead, the preferences of governments are tilted toward hand-to-mouth households (political bias). In the quantitative exercise we set $\rho = 0.5$. Thus the weight assigned to hand-to-mouth households is $1 - \rho = 1.5$, which is three times the weight assigned to other households. The tax and welfare implications of the shift from $\rho = 1$ to $\rho = 0.5$ are shown in Figure 9.

The first panel plots the change in steady state tax rates induced by the change in $\rho$. For any positive share of hand-to-mouth households $1 - \mu$, the change in profit tax rate is positive while the change in income tax rate is almost zero (very tiny decline in
Figure 9: Tax changes and welfare gains when the governments’ weight shifts toward hand-to-mouth households for different shares of hand-to-mouth households, $1 - \mu$.

income tax rates). This was to be expected since hand-to-mouth households could benefit, at least in the short-term, from higher profit taxes. The second panel plots the welfare gains for both types of households. We find that the shift in political weight toward hand-to-mouth households (lower $\rho$) leads to sizable welfare losses for other households but relatively small gains for hand-to-mouth households.

Considering that the gains experienced by hand-to-mouth households are quite small, compared to the welfare losses experienced by other households, it may be surprising that governments choose to increase profit taxes. Remember that, even if governments assign more weight to hand-to-mouth households, other households are still part of the government welfare. Why do governments choose policies that do not seem to bring benefits on average? Again, time inconsistency due to lack of commitment is the key. This induces current governments to focus on the short-term effects of policies because they have limited ability to influence the decision of future governments.

The focus on the short-term effects of policies could also be the consequences of the political cycle that creates incentives for elected officials to focus on short-term outcomes. According to this view, short-term results are essential for re-election. Sound policies that take longer to show their positive effects could be beneficial for the society as a whole. However, they are not very useful for ruling politicians in search of re-election. This could lead to a form of policy myopia.\footnote{Here myopia does not mean irrationality. In fact, ruling governments behave rationally. It is just that the institutional environment encourages them to ‘rationally’ deviate from the socially optimal policies.} In our model this could further increase the taxation of profits.

To illustrate this point we assume that governments discount future outcomes more heavily than households. Specifically, the government of the Home country solves the
problem
\[
\max_{\tau} \left\{ \mu \left[ u(\bar{c}(s, B, \tau, \tau^*; \Psi)) + \gamma \beta \Omega(s, B'; \Psi) \right] + (1 - \mu) \left[ u(c_{hm}(s, \tau, \tau^*; \Psi)) + \gamma \beta U(s; \Psi) \right] \right\},
\]
where $c_{hm}(.)$ is consumption for hand-to-mouth households and $\bar{c}(.)$ is consumption for other households. The parameter $\gamma < 1$ captures the fact that the government discounts next period values more heavily than households (policy myopia).

Figure 10 shows the change in tax rates (left panel) and welfare gains (right panel) when $\gamma$ changes from 1 to 0.5. Policy myopia leads to higher taxation of profits and, as expected from the previous analysis, to welfare gains for hand-to-moth households and welfare losses to other households. Importantly, the welfare gains for hand-to-mouth households are relatively small when compared to the welfare losses incurred by other households. The losses for other households induced by policy myopia become especially large when the fraction of hand-to-mouth households is large and, therefore, there is sizable income inequality between the two types of households.

Figure 10: Tax changes and welfare gains when governments become myopic ($\gamma = 0.5$), as a function of inequality $1 - \mu$.

8 Conclusion

We have studied the potential impact of two recent trends on international tax competition: (i) the growing role of intangible capital for production, and (ii) the cross-country diversification of investments. While the rise in intangible capital decreases the incentive of governments to tax profits, the rise in cross-country portfolio diversification has the opposite effect, that is, it increases the incentive to tax profits. Given the popular view that financial globalization should create the conditions for stronger tax competition, the finding that international portfolio diversification increases the incentive to tax profits is unexpected. However, it has a simple intuition: when financial markets are more integrated, a larger share of profits earned in the country belong to foreigners, which enhances the government incentive to tax the profits.
The quantitative exercise conducted with the calibrated model shows that the taxation impact of the first trend (intangible) has dominated the impact of the second trend (financial globalization). Their combined effects led to a net decline in profit tax rates of 6 percent. The lower taxation of profits, in turn, stimulates capital accumulation and lead to a welfare gain of about 0.55 percent of consumption.

We have also studied a version of the model with households heterogeneous in the sources of income: some earn capital income (the rich) while others earn only wage income (the poor). In general, higher is the fraction of households for which wages is the primary source of income (the poor) and higher is the taxation of profits. This is especially true when this type of households receive higher political weight. However, the higher taxation of profits brings very limited benefits for poor households while it causes relatively much larger losses for rich households.
References


