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Product market integration, tax distortions and public sector size

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Product market integration, tax distortions and public sector size*

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Abstract

The implications of product market integration for public sector activities (transfers and public consumption) are considered in a standard setting. The analysis supports that a larger public sector (higher tax rate) tends to increase wages and worsen wage competitiveness. However, the implications of product market integration for the public sector are far from straightforward. The reason is gains-from-trade effects which tend to increase the tax base and decrease the opportunity costs of public consumption (marginal utility of private consumption falls). It follows that the retrenchment view that product market integration inevitable leads to a downward pressure on public sector activities does not get support in a standard setting. A particularly noteworthy finding is that a country with a large public sector (strong preferences for public consumption) may benefit more by integrating with a country with a smaller public sector (weak preferences for public consumption).

JEL: H2, F1, J22

Keywords: labour taxation, product market integration, public sector, policy spill-over

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1 Introduction

The future of the welfare state is a topical issue in many industrialized countries. In particular it is a widely held view that globalization makes it more difficult to maintain a large and extended welfare state. The public debate centres around the nexus between taxes needed to finance public sector activity and competitiveness. If taxes tend to lead to higher wages and thus a deterioration of competitiveness, and if globalization makes competitiveness more important for economic activity[1], the obvious reasoning seems to be that globalization tends to make it more expensive in terms of efficiency losses to maintain a large public sector. Retrenchment of the public sector therefore must follow (for unchanged preferences) from the inevitable fact that the social costs of maintaining public sector activities become larger.

There is indeed a large body of literature[2] building on an extensive tradition in trade and open macroeconomics supporting that higher taxes[3] or a higher level of public sector activities may harm competitiveness[4]. Empirical analyses have also found support that fiscal policy via a cost channel harms competitiveness (see e.g. Alesina and Perotti (1997), Daveri and Tabellini (2000), Lane and Perotti (2003)). But does this immediately support the retrenchment view? These arguments seem to neglect the gains from trade which under standard assumptions lead to higher income and private consumption; i.e. there is a benefit side to globalization which has to be considered on par with the cost side before statements on the effects on public sector activities can be made.

In the present paper we merge elements from trade theory, macroeconomics and public finance into a general equilibrium setting allowing for an endogenous determination of production, specialization, and thus trade structure across countries. Ricardian models have recently been widely used to analyse the effects of international integration since this framework allows for an endogenous determination of production, trade and specialization structure, depending on trade frictions as a metric of market integration. Since globalization driven by both political and technological changes lowers trade frictions, it follows that this framework captures essential elements of the changes and effects associated with the globalization process[5]. This literature builds on Dornbusch, Fischer and Samuelson (1977), and recent contributions build on Eaton and Kortum (2002). We follow this approach modelling product market integration as reductions in trade frictions, which in turn implies that the non-tradeable sector shrinks and that there is reallocation of production and employment according to comparative advantages and thus gains from specialization. The public sector finances public consumption (service provision) and transfers via an income tax. In this general equilibrium setting, we analyse how fiscal policy affects various key variables, including wage competitiveness, and we consider the optimal determination of both transfers and public consumption. We also analyse how the effects of fiscal policy and the optimal policy (for given policy objectives) change in the wake of further international integration.

In a companion paper (Andersen and Sørensen (2012))[6] we consider how a welfare state financed by taxation of labour income is affected by product market integration in a general equilibrium setting where labour taxation distorts labour supply and thus competitiveness, goods are traded internationally and trade and production structures are endogenously determined. Under a utilitarian social welfare function optimal policies are determined by a variant of the Samuelson rule in which the marginal utility of private consumption plays a crucial role (part of the opportunity costs of higher public activities). In addition to the "competitiveness"-effect, two other effects are at play and released by gains from trade. First, an increase in employment and income due to market integration tends, for given tax rates, to increase tax revenue and thus the scope for financing public sector activities (or given activities can be financed at lower tax rates). Second, an increase in private consumption tends to lower the marginal benefit of private consumption, which in turn tends to increase the optimal level of public activities by reducing the opportunity costs of such activities. Hence, even though the "competitiveness effect" is present so

[1] Often phrased as production or employment becoming more sensitive to relative prices and wages, i.e. elasticities go up, see e.g. Rodrik (1997), Burda (1999), OECD (2007).

[2] See e.g. Bruce and Purvis (1985) and Marston(1985). Similar effects are found in the "New Open Macroeconomics" literature, see e.g. Botman et al. (2006).

[3] This applies to taxes financing public activities which in no way improve production possibilities.

[4] This holds with both competitive and imperfectly competitive markets. In competitive models, pre-tax wages increase as labour supply contracts provided that substitution effects dominate income effects, as is usually found empirically, see e.g. Evers et al. (2005). In imperfectly competitive labour markets, the tax wedge causes higher wage costs, and this tends to harm competitiveness (see e.g. Layard et al. (2005)).

[5] Tax base mobility is an important aspect of globalization. Mobile tax bases may change location to minimize tax payments, and this creates a specific channel through which taxation is affected by globalization (see e.g. Razin and Sadka (2005)). This has led to an intensive debate on tax competition in relation to taxation of corporations (see e.g. EEAG (2007) for a recent discussion). While an important issue it is of secondary importance to the financing of public sector activities since the revenue accruing from the tax bases becoming mobile is below 5-10 % for all OECD countries, and moreover (tax driven) labour migration is relatively low. Hence, to focus on the main mechanisms migration is disregarded.

[6] See also Andersen and Sørensen (2011).

are "gains from trade", and it follows that the fear of a retrenchment of the public sector may be exaggerated. In particular in Andersen and Sørensen (2012) we showed the following: First, in case of cooperative tax policy the effect of further product market integration (equivalent to a productivity increase in the private sector) on the optimal labour income tax is ambiguous. Second, provided the elasticity of labour supply is constant (or decreasing in wages) marginal costs of public funds in case of cooperative policy decrease with product market integration for a given revenue constraint. Thirdly, in the non-cooperative case it is more likely that the optimal tax (and hence public sector activities) increases than in the cooperative case.

The abovementioned results are derived in a setting with integration between symmetric countries (similar technologies and similar preferences with respect to public sector activities). However, asymmetries or heterogeneity among integrating countries are prevalent, and it is thus an open question how such asymmetries affect the abovementioned channels. This paper considers these issues in a simplified version of Andersen and Sørensen (2012) using specific functional forms and numerical analysis to address the role of asymmetries across integrating countries. Two questions are of particular interest. If a country with a large public sector (strong preferences for public consumption) integrates with a country with a smaller public sector, is the former country to a larger extent under pressure from the competitiveness-effect? Does this lead to a convergence of public sector size to the lower of the two levels (race to the bottom)? Related, what role do differences in productivities (and thus income levels) play for the effects of product market integration on public sector activities?

In policy debates it is a widespread idea that if taxes harm competitiveness, it is to be expected that countries acting non-cooperatively choose too low taxes (a race to the bottom) and thus the level of public sector activities is too low. However, a very robust result from explicit general equilibrium models is that countries acting non-cooperatively tend to choose too high levels of public activities and thus taxes. The reason is that countries perceive that they can affect the terms of trade to their advantage. This effect is not present in the cooperative case, and therefore there is an upward bias in taxes determined in the non-cooperative case (see e.g. Chari and Kehoe (1990), Devereux (1991), Turnovsky (1988), van der Ploeg (1987, 1988), and Andersen et al. (1996)). Epifani and Gancia (2009) build on this literature and show in a model with specific functional forms, exogenous labour supply and exogenous production/specialization structures how globalization may increase public sector activity, and they present empirical evidence in support of this finding. In Andersen and Sørensen (2012) we showed in a rather general setting with endogenous labour supply and production/specialization structure that this non-cooperative bias not only applies to public consumption but also to transfers. Below we show that the bias becomes stronger with more tight product market integration; i.e. the non-cooperative tax rate is higher than the cooperative tax rate, and the differences are higher the more markets are integrated.

The rest of the paper is organized as follows: Section 2 sets up the basic structure of the Ricardian trade model with trade frictions and a public sector and shows that there exists a unique equilibrium. Section 3 considers the symmetric case paying particular attention to the upward bias in tax policy and how it is affected by product market integration. Section 4 considers the effects of product market integration when countries are asymmetric, and finally section 5 offers a few concluding remarks. Appendices provide further technical material and proofs.

2 The Model

We set up a highly stylized two-country economy applying standard textbook functional forms. We consider a standard Ricardian trade model (see Dornbusch, Fischer and Samuelson (1977)) with a public sector financed by labour income taxation. The structures of the two countries are identical and therefore we only describe the structure of the home economy. However, parameters may differ across countries, and foreign variables and parameters are denoted with an asterisk ($*$).

2.1 Households

The economy consists of a continuum of homogenous households with unit mass. A household derives utility from private (B) and public (G) utility bundles in the following way

$$U = \frac{1}{1-\beta}B^{1-\beta} + \bar{G}\frac{1}{1-\lambda}G^{1-\lambda}; \qquad \beta > 0, \lambda > 0 \tag{1}$$

The parameter $\bar{G}$ weights the relative importance of utility from public activities to the utility from private consumption. The private utility bundle is defined as[7]

$$B = C - kL^{\gamma}, \gamma > 1, k > 0 \tag{2}$$

where L is labour and C is the consumption bundle defined over a continuum of goods as

$$C = \left[\int_0^1 c\left(i\right)^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}}, \theta > 1$$

implying a price index given by

$$P \equiv \left[\int_0^1 q\left(i\right)^{1-\theta} di\right]^{\frac{1}{1-\theta}} \tag{3}$$

where $q\left(i\right)$ denotes the price of good i. Given the CES preferences over goods, demand for each good $i \in [0,1]$ is given by

$$c_i = \left[\frac{q\left(i\right)}{P}\right]^{-\theta} \frac{I}{P} = q\left(i\right)^{-\theta} \left[P\right]^{\theta-1} I = q\left(i\right)^{-\theta} \left[\int_0^1 q\left(i\right)^{1-\theta} di\right]^{-1} I \tag{4}$$

where I denotes disposable income.

The household receives labour income (WL), profits (Π) and public transfers (TR). Labour income and profits[8] are taxed at a constant marginal tax rate t, thus

$$I = \left[1-t\right]\left[WL + \Pi\right] + TR \tag{5}$$

In the present set-up, the transfer part of public sector activities seems needless as the representative household framework precludes any welfare gains from redistribution. Yet, restricting public sector activities to transfers is interesting since it highlights the distortionary effects of taxation. In particular it allows us to identify effects driven by financing public expenditures (supply side effects) without mixing them up with the well-known expansionary bias due to expenditure switching (demand side effects).

To maximize utility (1) subject to the budget constraint (5) the representative household supplies the following amount of labour

$$L^s = \left[\frac{W}{P}\frac{\left[1-t\right]}{k\gamma}\right]^{\frac{1}{\gamma-1}} \tag{6}$$

We normalize the mass of households and thus the size of the home country to 1. The size of the foreign country is set to $n \gtreqless 1$.

2.2 Public sector

The government may be engaged in providing transfers to households (TR) and in the production of public services (G). Public services are produced by use of labour (L^g) and it is assumed[9] that $G = L^g$ (productivity is constant and for simplicity normalized to one). These activities are financed by a proportional tax levied on income[10] by the rate t, and hence the budget constraint reads

$$t\left[WL + \Pi\right] = WL^g + TR \tag{7}$$

where L is total employment; i.e. $L = L^p + L^g$, where L^p (L^g) denotes labour used in the private (public) sector.

To allow for an easy way of analysing the two main activities of the government (transfers and public services), it is assumed that a fraction $\xi \in [0,1]$ of the tax revenue is distributed as lump-sum transfers to individuals and the rest is used for public consumption/employment. For $\xi = 1$ we have a pure tax-transfer scheme without any aggregate demand effects, but only a supply side effect via the tax rate on income. This special case allows an identification of the pure distortion effect without mixing it up with other effects of public sector activities.

[7] This formulation implies no income effect in the labour supply decision and a constant labour supply elasticity of $\frac{1}{\gamma-1}$.

[8] In equilibrium profits are zero due to competitive markets. Hence it is irrelevant whether profits are taxed.

[9] The assumption implies that public activities are directed towards a non-tradeable, namely, labour. Notice that the assumption here to a first approximation captures the fact that about 2/3 of public consumption expenditures are wage expenditures.

[10] Observe that there is no profit in equilibrium due to competitive product markets and there is no issue as to whether labour and profit income should be taxed at different rates.

Using the public sector budget constraint and the fact that profits are zero in equilibrium disposable income can be written

$$I = [1-t]\,WL + \Pi + TR = WL^p \tag{8}$$

i.e. disposable income is determined by the income generated in the private sector[11]. Using that profits are zero it also follows from the public budget constraint (7) that

$$L^g = \frac{[1-\xi]\,t}{1-[1-\xi]\,t} L^p \tag{9}$$

Using (6) and (9) private and public consumption bundles, respectively, are given by

$$\begin{aligned} B &= \left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}} \left[\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}} \left[\frac{\gamma-1}{\gamma}\,[1-t] + \xi t\right] \\ G &= [1-\xi]\,t \left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}} \end{aligned}$$

2.3 Firms

Firms are competitive and produce subject to constant returns production functions with labour as the only input; cf. the standard Ricardian trade model, i.e.

$$Y(i) = A(i)\,L(i) \tag{10}$$

Good specific productivity varies across countries. For each good i, let $A(i)$ and $A^*(i)$ denote domestic and foreign productivity in producing good i, respectively, and let $a_i \equiv \frac{A_i}{A_i^*}$ be relative productivity. Assume without loss of generality that goods are ordered such that a_i is increasing in i. To be specific assume that domestic (foreign) productivity of good i is given by $A(i) = Ae^{\alpha i}$ ($A^*(i) = A^* e^{\alpha[1-i]}$), and hence $a_i \equiv \frac{A_i}{A_i^*} = \frac{Ae^{\alpha[2i-1]}}{A^*}$, which is increasing in i.

2.3.1 Trade structure

Due to trade frictions (Iceberg type) a firm has to ship $z \geq 1$ units in order to supply one unit to the export market. As a slight abuse of language we term z trade frictions in the following. Constant returns to scale and competitive markets imply marginal costs pricing. It is endogenous whether a good is traded[12]. Letting $w \equiv \frac{W}{W^*}$ denote the relative wage, good i is only produced domestically if

$$\frac{zW}{A(i)} < \frac{W^*}{A^*(i)} \Leftrightarrow a_i > wz \Leftrightarrow i > \frac{\ln\left(\frac{A^*}{A}wz\right)}{2\alpha} + \frac{1}{2} \equiv i^E(w,z),$$

only produced abroad if

$$\frac{W}{A(i)} > \frac{zW^*}{A^*(i)} \Leftrightarrow a_i < wz^{-1} \Leftrightarrow i < \frac{\ln\left(\frac{A^*}{A}wz^{-1}\right)}{2\alpha} + \frac{1}{2} \equiv i^H(w,z)$$

and produced in both countries and non-traded if

$$i \in \left[i^H(w,z), i^E(w,z)\right]$$

A higher relative wage implies higher i^E and i^H; that is, domestic firms both produce and export fewer types of goods. The intuition is straightforward since it derives from the worsening of wage competitiveness. The more integrated the markets (lower z), the higher i^H and the lower i^E; i.e. with lower trade frictions fewer goods are

[11] Note that the gross domestic product as conventionally measured in national accounts is given as (measured from the factor side)

$$GDP = WL^p + WL^g$$

[12] Given the Cobb-Douglas preferences endogeneity of the trade structure is the key to allow for cross-country variation in the size of the private sector.

produced domestically, but more goods are exported. In other words, the number of non-tradeable goods decreases and production is further specialized in goods in which the country has a comparative advantage. Hence, changes in both wage competitiveness (endogenous) and the trade friction (exogenous) cause a change in the trade and specialization structure.

We will only consider equilibria with international trade; i.e. some goods are tradeable and thus impose the following restrictions[13]:

1. Home must export: $i^E(w,z) < 1 \Leftrightarrow w < \frac{A}{A^*}\frac{e^\alpha}{z}$
2. Home must import: $i^H(w,z) > 0 \Leftrightarrow w > \frac{A}{A^*}\frac{z}{e^\alpha}$

2.4 Equilibrium

The equilibrium is determined by solving for the relative wage which subsequently determines all other real variables. The equilibrium condition arises from inserting product market equilibria conditions into the aggregate labour demand relation and setting this equal to labour supply. This condition is equivalent to the balanced trade condition. See Appendix A for the derivation.

Throughout we present outcomes of a simple numerical analysis of the model either to illustrate results or to indicate possible effects where no analytical results can be readily found. We apply the following baseline parameter values[14] unless otherwise stated: $A = \alpha = k = \bar{G} = 1, \beta = \lambda = \theta = 3, \gamma = 4$ for both countries and $n = 1$.

3 Symmetric countries

We start by considering the simple case where all exogenous variables/parameters of the countries are identical in the two countries except for the good specific productivities and potentially for endogenous policy parameters.

In the following we consider optimal policies under the assumption of a utilitarian social welfare function. We consider both non-cooperative and cooperative policy settings.

3.1 Equilibrium wages and competitiveness[15]

As a prelude to the subsequent analysis it is useful to note that lower trade frictions are associated with gains from trade. Consider the symmetric equilibrium where fiscal policies are the same in the two countries; i.e. $t = t^*$ and $\xi = \xi^*$ and thus $w = 1$. In this case a reduction in the trade friction (z) increases welfare for given fiscal policies. The utility gain has two components: increasing private (B) and public (G) utility bundles. The former captures standard gains from trade. The latter arises because one of the gains from integration is higher employment, which in turn means a higher tax base and thus revenue and therefore (under the balanced budget constraint) more public sector activities. Alternatively, to maintain a given level of public services, there would be room for a tax reduction, which in turn would increase the private utility bundle further. In the following we will refer to the mechanism that integration expands the tax base and thus gives room for a tax reduction as the tax base effect. The gains from trade are also reflected in the fact that the real wage ($\frac{W}{P}$) is decreasing with trade frictions (z).

More interesting for the subject of this paper is the fact that a unilateral increase in the tax rate (t) raises the relative wage (w), which in turn deteriorates wage competitiveness but improves the terms of trade. Intuitively a large domestic (relative to foreign) tax burden causes a lower domestic labour supply, and this tends to increase the relative wage. This confirms the common perception that an increase in the tax rate tends to increase relative wages and thereby worsen wage competitiveness, cf. introduction. The increase in the relative wage (reduction in competitiveness) causes a reduction in the number of goods exported and produced in the domestic country; i.e. i^E and i^H increase, and in line with public concerns production moves abroad. This underlines that the mechanisms often highlighted in public debates (cf. the introduction) are supported by the present analysis. However, the higher relative wage, and thus reduced competitiveness, also implies a terms of trade improvement and allows the country to specialize in goods in which it has stronger comparative advantages.

Cross-country variations in both size and composition of the public sector activities are large. In policy debates it is often taken for granted that a large public sector is tantamount to a worsening of the competitive position, and partial models confirm this. With the present framework, we can analyse two key asymmetries, namely differences in size and composition of the public sector. Consider first size. If $t > t^*$ and $\xi = \xi^*$, i.e. the domestic public sector

[13] These restrictions imply that $z < e^\alpha$; i.e. they put an upper bound on trade frictions.

[14] These values imply risk aversion measures of 3 and a labour supply elasticity of $\frac{1}{3}$.

[15] For proof of results on this section see Andersen and Sørensen (2012).

is more extended than the foreign, but the relative composition (services and transfers) is the same, it follows that home is less competitive than foreign, $w > 1$. Turning to composition we have that if $\xi > \xi^*$ and $t = t^*$, i.e. the domestic public sector is relatively more focused on transfers than on public services compared to foreign, but the size of the public sector is the same, it follows that home is more competitive than foreign, $w < 1$.

Intuitively a large domestic (relative to foreign) tax burden causes a lower domestic labour supply, and this tends to increase the relative wage. When a country focuses more on transfers than on provision of public services, the labour requirement of the public sector is lower (compared to foreign). The lower public labour requirement increases labour supply to the private sector and thereby reduces the relative wage. These results stress that both the size and the composition of the public sector/fiscal policy are important for competitiveness. An important implication is that a country with a relatively large public sector may indeed be competitive provided it uses a relatively high fraction of tax revenue on transfers[16].

3.2 Marginal costs of public funds (pure transfer case, $\xi = 1$)

The problem of choosing the optimal tax rate (t) under a constraint that a real revenue of $\widehat{T}$ should be collected can be formulated as the following Lagrange problem

$$\max_t \Upsilon = U(B, 0) + \mu \left[tR - \widehat{T} \right],$$

where μ is the Lagrange multiplier measuring the effects on utility of changing the revenue requirement. The first order condition reads

$$U_B B_t + \mu \left[R + tR_t \right] = 0$$

and the marginal costs of public funds measured in monetary equivalents are

$$MCPF \equiv \frac{\mu}{U_B} = -\frac{B_t}{R + tR_t} \tag{11}$$

where R denotes real income generated in the private sector; i.e. $R \equiv \frac{W}{P} L$. The $MCPF$ thus measure how much real income private households lose if the real income going to the public sector increases by one unit. In the cooperative equilibrium marginal costs of public funds are given by

$$MCPF = \frac{t \frac{1}{\gamma - 1} \frac{1}{1-t}}{1 - t \frac{1}{\gamma - 1} \frac{1}{1-t}}$$

which increases with trade frictions for a given revenue constraint and is invariant to trade frictions for a given tax rate. The $MCPF$ increase in the tax rate. Accordingly, as higher trade frictions imply a lower tax base and thus a higher tax rate for a given revenue constraint, it follows directly that $MCPF$ increase with trade frictions.

In the pure transfer case all public resources are devoted to redistribution of income. Optimal policy may in this case at first seem trivial due to the representative agent framework. However, as we will see, this is not the case due to a terms of trade effect of taxation in the non-cooperative policy case. This case also describes the situation in which public consumption is waste[17], i.e. $\bar{G} = 0$. Finally this case is a stepping stone to the more complicated case of optimal public consumption where integration also affects taxation due to relative changes in marginal utilities of private and public consumption.

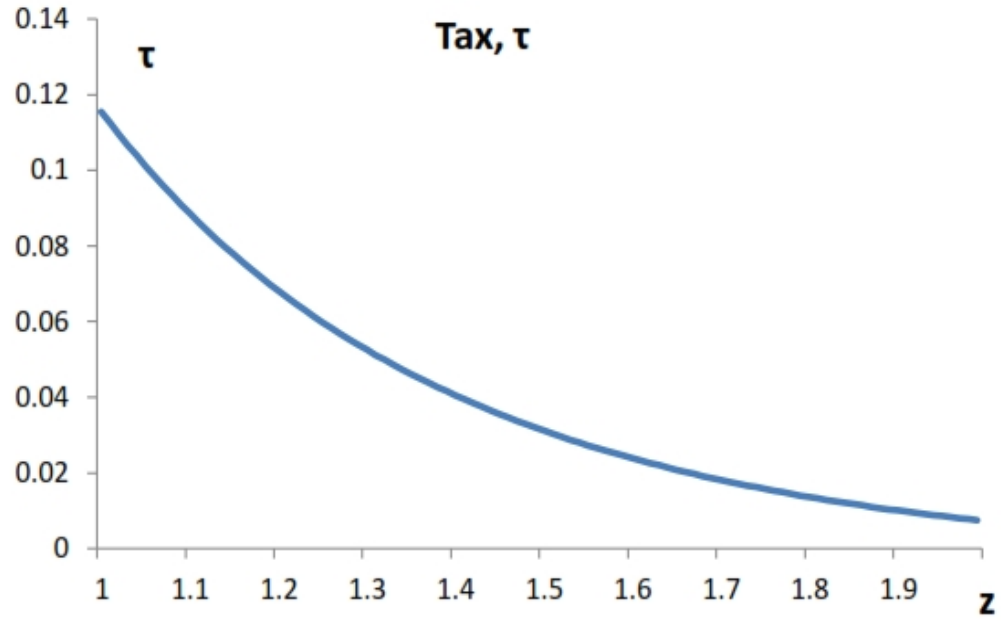
For cooperative policy makers the optimal tax rate is zero as the income tax is distortionary and there are no gains from redistribution (representative agent setting). Non-cooperative policy makers have incentives to impose distortionary labour taxes in order to obtain a terms of trade advantage. In the symmetric equilibrium the terms of trade effect will never be realized for the countries. The optimal cooperative tax rate is zero while the optimal non-cooperative tax rate is positive; hence there is an upward bias in non-cooperative tax policy.

Is the non-cooperative bias larger with more product market integration? Figure 1a displays the optimal tax rate as a function of the trade cost. It is seen that a lower trade friction leads to a higher tax rate in the non-cooperative case, and hence the difference between the cooperative ($t = 0$) and non-cooperative equilibrium widens; i.e. the bias in non-cooperative policies is larger the tighter product markets are integrated.

Figure 1: Tax rate in non-cooperative equilibrium, transfers only

[16] Note that public consumption is assumed to be "pure" consumption having no direct effect on labour supply or productivity.

[17] We have that $MCPF^{\text{Public consumption}} = MCPF^{\text{Transfers}} + 1$.



3.3 Public consumption ($\xi = 0$)

Now we consider the scenario with no redistribution of income; i.e. all public revenue is devoted to public consumption. If marginal utility of public consumption is sufficiently high, this corresponds to optimal policy where both t and ξ are chosen optimally.

Cooperative policies

Cooperative policy makers set the tax rate in order to maximize welfare. The optimality condition reads

$$\begin{aligned} \Gamma &= B^{-\beta}\frac{\partial B}{\partial t} + \bar{G}G^{-\lambda}\frac{\partial G}{\partial t} = 0 \\ \Gamma_t &< 0 \end{aligned}$$

We have that the effect of integration on optimal taxation is ambiguous since

$$sign\frac{dt}{dz} = sign\left(\gamma\left[1-\beta\right] - \left[1-\lambda\right]\right)$$

Note that γ is the relative risk aversion measure for the disutility from work, $1-\lambda$ measures the relative risk aversion for public consumption, and $1-\beta$ measures the relative risk aversion for private consumption. Hence, the sign $\frac{dt}{dz}$ depends on the weighting of disutility to work compared to the relative value of public consumption to private consumption. However, the effect of integration on public consumption is more complex as public consumption increases with integration for a given tax rate due to gains from trade. Public consumption increases with integration unless $\beta < 1 - \frac{1}{\gamma}\frac{1}{1-t\frac{\gamma}{\gamma-1}} < 1$ where t is the (endogenous) optimal tax rate[18]. It follows that for $\beta \in \left(1 - \frac{1}{\gamma}\frac{1}{1-t\frac{\gamma}{\gamma-1}}, 1 - \frac{1-\lambda}{\gamma}\right)$ public consumption increases although the tax rate decreases.

3.3.1 The case of non-cooperative policy

In this case the optimality condition reads

$$\Psi = B^{-\beta}\left[\frac{\partial B}{\partial t} + \frac{\partial B}{\partial w}\frac{dw}{dt}\right] + \bar{G}G^{-\lambda}\left[\frac{\partial G}{\partial t} + \frac{\partial G}{\partial w}\frac{dw}{dt}\right] = 0$$

As $\Psi = \Gamma + B^{-\beta}\frac{\partial B}{\partial w}\frac{dw}{dt} + \bar{G}G^{-\lambda}\frac{\partial G}{\partial w}\frac{dw}{dt} > \Gamma$, it follows that the tax is higher in the non-cooperative case. Hence as in the pure transfer case we have an upward bias in tax/fiscal policy. It turns out that no clear analytical results on the effect of market integration on the optimal non-cooperative tax are available.

[18] Unfortunately we cannot get a closed solution for the optimal tax rate.

Figure 2: Tax rate in non-cooperative and cooperative equilibrium, public consumption only.

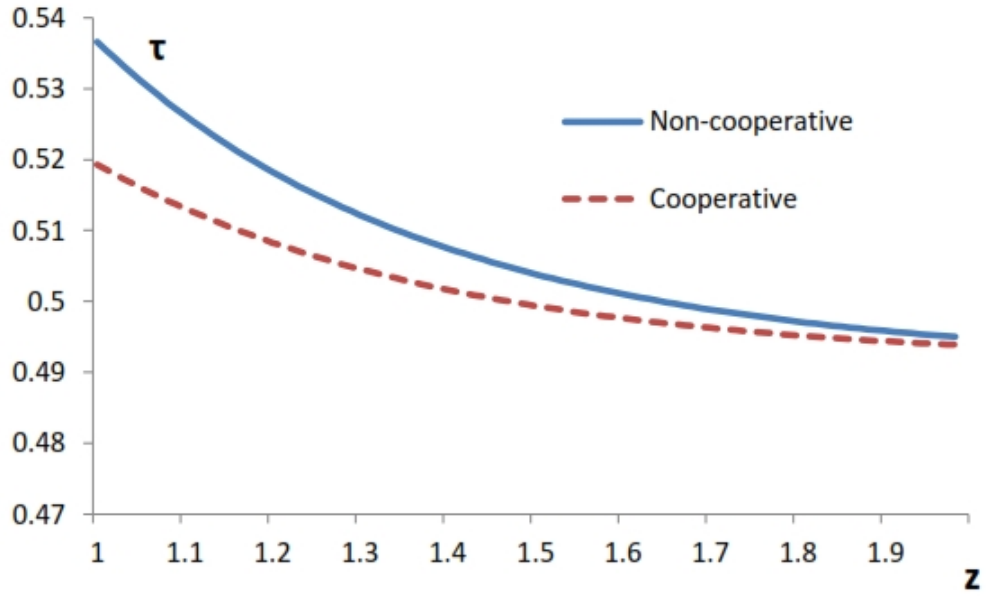


Figure 2 illustrates the optimal tax rate in the cooperative and non-cooperative case[19]. It is seen that the tax is increasing in both the cooperative and the non-cooperative case when markets integrate (lower trade friction z). The non-cooperative bias is also larger, the more integrated product markets are.

4 Asymmetric countries

The integration process is proceeding among countries which in various ways differ, and therefore we now turn to a consideration of heterogeneities or asymmetries across countries. For the present purpose it is particularly interesting to consider the implications of asymmetries with respect to preferences for public consumption ($\overline{G}$). In countries - like the Nordic - with a relatively large public sector it is an important question how integration with other countries with a smaller public sector affects the need and scope for public sector activities. We consider this question below and also comment on the implications of asymmetries arising from productivity (A). In case of asymmetric countries we only consider non-cooperative policies. It is not obvious how to distribute gains from cooperative policies and furthermore in the absence of lump-sum transfers side payments distort the economy. Accordingly the cooperative case becomes quite complex. Despite the simplicity of the model only few analytical results can be obtained in the case of country heterogeneities and therefore the following numerical results are suggestive in terms of possible results.

4.1 Preferences for public consumption

A straightforward way to model differences in preferences for public consumption and thus the size of the public sector measured in terms of public consumption is via $\overline{G}$. If $\bar{G}^* < \overline{G}$, it follows that the home country has a stronger preference for public consumption relative to private consumption than the foreign country, and vice versa.

To what extent are policies affected by integration with a country with a weaker (stronger) preference for public consumption than the home country? How do foreign preferences affect the home country for a given level of product market integration, and how are these aspects influenced by further product market integration?

Figure 3 below has the parameter for public consumption in the home country constant ($\overline{G} = 1$) and considers three different levels of foreign preferences for public consumption; weaker ($\bar{G}^* = 0.5$), identical ($\bar{G}^* = 1$), and stronger ($\bar{G}^* = 1.5$).

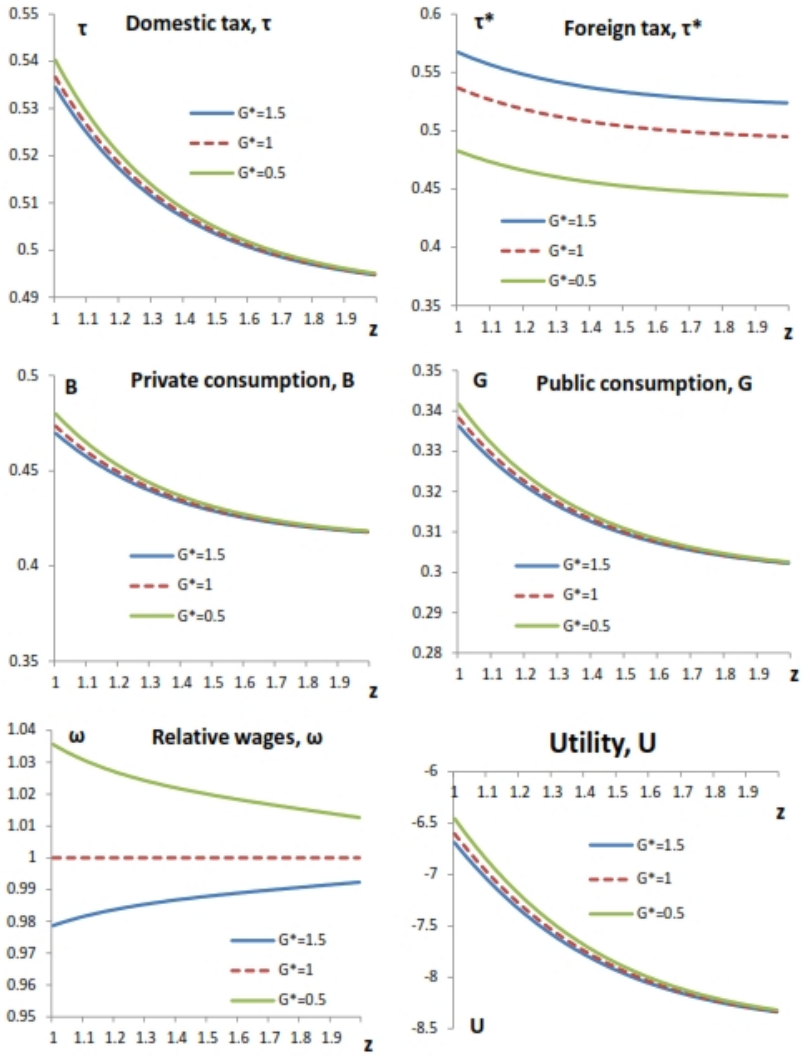
Consider first the home country implications of foreign preferences for public consumption. It is seen from Figure 3 that weaker government consumption preferences in the foreign country tend to imply a larger tax and thus level of public consumption in the home country. The levels of public consumption are therefore strategic substitutes.

[19] Note that other parameter values may imply that the tax is decreasing when the trade cost z decreases, cf. expression above.

The reason being that a weaker preference for public consumption in the foreign country leads to a lower tax rate and hence a larger labour supply for the private sector. This increases private consumption in the home country, and thus leads to higher public consumption. This is a striking result since integration with a country with a lower preference for public consumption often in the public debate is taken to imply a "race to the bottom"; that is, a convergence to tax rates and levels of public consumption dictated by the countries with the lowest preferences for public sector activities.

It is seen from Figure 3 that further product market integration (lower z) leads to a higher tax in both countries. The response is non-linear. As above the tax is fairly insensitive to the product market integration when trade frictions are high, but becomes more sensitive at lower levels of trade frictions. It also means that although product market integration in the past may not have had significant effects on tax rates, it may have so in the future with further product market integration.

Figure 3: Non-cooperative equilibrium - the role of preferences for public consumption



It is seen that if the foreign country has a weak preference for public consumption, wage competitiveness of the home country is worse ($\omega > 1$) than if the foreign country has a strong preference for public consumption. The difference is non-linear in the trade-friction, and largest when product markets are most tightly integrated.

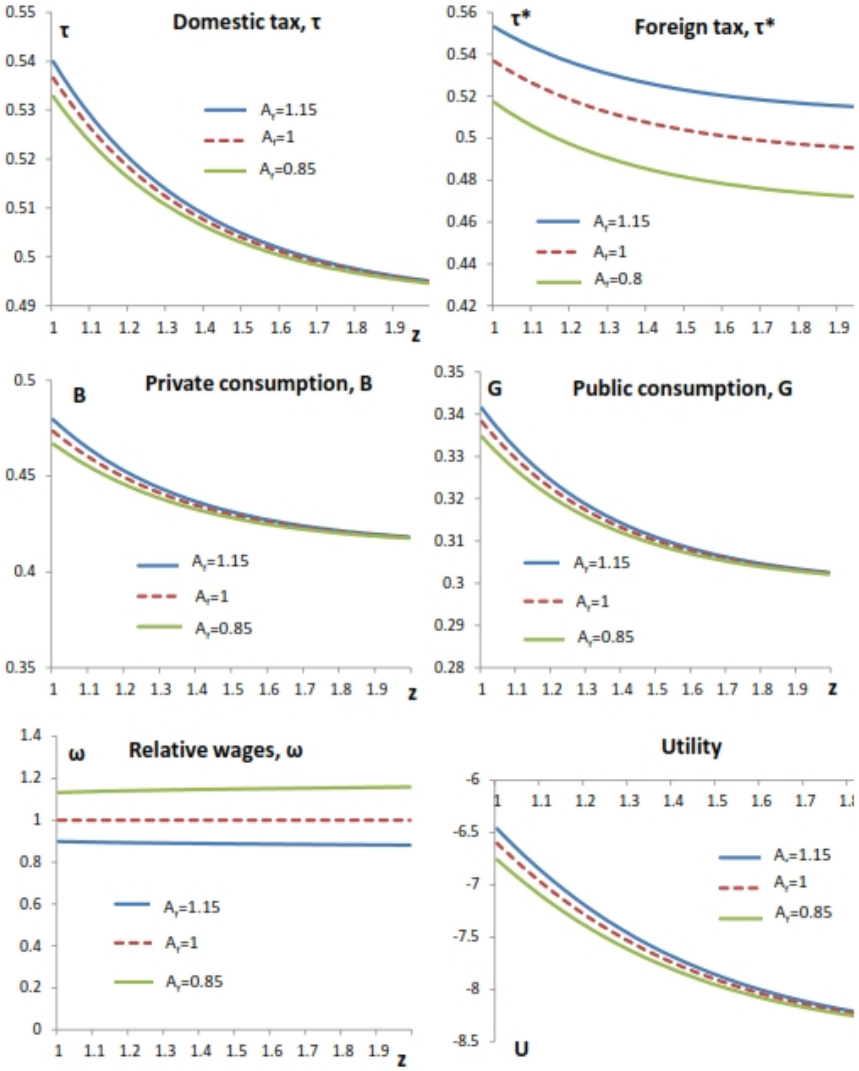
The utility consequences are shown in Figure 3. As expected for highly non-integrated product markets the utility consequences for the home country of the preferences for public consumption in the foreign country are marginal. Even for tightly integrated product markets the consequences are rather small compared to the gains from trade. This indicates that the utility consequences of the spill-over effects running via the public sector (and differences herein across countries) are of marginal importance.

4.2 Heterogeneity in productivity

An important dimension of integration is that of countries with different income levels which in the present setting can be captured by different productivity levels. Below we consider variation in foreign productivity where the parameter $A^*$is set at 0.85, 1 and 1.15, respectively (home productivity: $A = 1$).

The main results are illustrated in Figure 4. The tax in the home country is higher, the higher productivity in the foreign country. The reason is that the higher productivity in the foreign country tends to increase foreign production. As a consequence foreign goods become cheaper, and this leads to an increase in private consumption at home. Since private and public consumption are substitutes in preferences, it follows that there is a shift towards public consumption, and hence the result. Therefore, the higher productivity in the foreign country, the larger the level of both private and public consumption at home. Utility at home is higher when foreign productivity is high.

Figure 4: Non-cooperative equilibrium - the role of aggregate productivity



5 Concluding remarks

We have considered the role of product market integration for public sector activities (transfers and public consumption). Although the analysis supports that a larger public sector (higher tax rate) tends to increase wages and worsen wage competitiveness, the implications of product market integration for the public sector are far from straightforward. The reason is a "gains from trade" effect which tends to increase the tax base and decrease the opportunity costs of public consumption (marginal utility of private consumption falls). It is worth stressing that the present analysis builds on standard assumptions in trade theory and open macroeconomics. It follows that

the retrenchment view that product market integration inevitable leads to a downward pressure on public sector activities does not get unconditional support in a standard setting.

A particularly noteworthy finding is that a country with a large public sector (strong preferences for public consumption) may benefit more by integrating with a country with a smaller public sector. Likewise integrating with a country with a higher productivity (income) level is not necessarily detrimental to public sector activities. The terms of trade effects of public sector activities are crucial to these effects. The terms of trade effect is also the reason that non-cooperative policies tend to imply more public sector activity (transfers or public consumption) than in the cooperative case, and we show that the non-cooperative bias may be strengthened with further product market integration.

This paper has only considered one aspect of the globalization process, namely, product market integration. Clearly globalization is a wider concept, and other aspects may challenge the public sector through different channels. One such mechanism is increased factor mobility forcing tax reductions on the mobile factors and thus causing a revenue drag[20]. This can be interpreted as a direct threat to the public sector in the sense that the market enforces a change in policies (see e.g. Tanzi (2000) and Razin and Sadka (2011)). A significant increase in migration coupled with selection mechanisms such that there is net-inflow of less skilled and net-outflow of high skilled may be a serious threat to a tax financed welfare model. It is an interesting topic for future research to integrate these mechanisms in a framework also highlighting the effects considered in this paper.

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[20] For evidence on such downward competitiveness on taxes see e.g. EAAG (2007)

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6 Appendix A

In this appendix we derive the main equations of the model and prove existence and uniqueness of the equilibrium for given policy variables; i.e. for given t, t^*, ξ and ξ^*.

6.1 Consumer prices

Markets are perfectly competitive implying that firms set prices equal to marginal costs and thus home market equilibrium consumer prices are

$$q(i) = \begin{cases} z\frac{W^*}{A_i^*} = \frac{zW^*}{A^* e^{\alpha(1-i)}} & \text{if} \quad i \in M \Leftrightarrow i < \frac{\ln\left(\frac{A^*}{A}w\right) - \ln z}{2\alpha} + \frac{1}{2} = i^H(w,z) \\ \frac{W}{A_i} = \frac{W}{Ae^{\alpha i}} & \text{if} \quad i \in H \Leftrightarrow i \geq \frac{\ln\left(\frac{A^*}{A}w\right) - \ln z}{2\alpha} + \frac{1}{2} = i^H(w,z) \end{cases}$$

and similar for foreign consumer prices

$$q^*(i) = \begin{cases} \frac{W^*}{A_i^*} = \frac{W^*}{A^* e^{\alpha(1-i)}} & \text{if} \quad i \in H^* \Leftrightarrow i < \frac{\ln\left(\frac{A^*}{A}w\right) + \ln z}{2\alpha} + \frac{1}{2} = i^E(w,z) \\ z\frac{W}{A_i} = \frac{zW}{Ae^{\alpha i}} & \text{if} \quad i \in M^* \Leftrightarrow i \geq \frac{\ln\left(\frac{A^*}{A}w\right) + \ln z}{2\alpha} + \frac{1}{2} = i^E(w,z) \end{cases}$$

The consumer price index accordingly becomes

$$\begin{aligned} P &= \left[\int_0^1 q(i)^{1-\theta} di\right]^{\frac{1}{1-\theta}} = \left[[zW^*]^{1-\theta} \int_0^{i^H(w,z)} [A_i^*]^{\theta-1} di + W^{1-\theta} \int_{i^H(w,z)}^1 A_i^{\theta-1} di\right]^{\frac{1}{1-\theta}} \\ &= \frac{zW^*}{A^*} \left[\frac{1}{\alpha[\theta-1]} \left[e^{\alpha[\theta-1]} \left[1 + \left[\frac{A^*}{A}\frac{w}{z}\right]^{1-\theta}\right] - 2e^{\frac{1}{2}\alpha[\theta-1]} \left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{1-\theta}{2}}\right]\right]^{\frac{1}{1-\theta}} \end{aligned}$$

Similar for foreign

$$P^* = \frac{zW}{A} \left[\frac{1}{\alpha[\theta-1]} \left[e^{\alpha[\theta-1]} \left[1 + \left[\frac{A}{A^*}\frac{1}{wz}\right]^{1-\theta}\right] - 2e^{\frac{1}{2}\alpha[\theta-1]} \left[\frac{A}{A^*}\frac{1}{wz}\right]^{\frac{1-\theta}{2}}\right]\right]^{\frac{1}{1-\theta}}$$

6.2 Consumption bundles

Private consumption bundle

$$B = C - kL^\gamma = \frac{I}{P} - kL^\gamma = \frac{W}{P}L^p - kL^\gamma$$

Using $L^p = [1-[1-\xi]t]L$ and $L = \left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}$ we have

$$B = \left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}} \left[\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}} \left[\frac{\gamma-1}{\gamma}[1-t] + \xi t\right]$$

Public consumption bundle

$$G = L^g = \frac{[1-\xi]t}{1-[1-\xi]t} L^p = [1-\xi]tL = [1-\xi]t \left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}$$

Similar for the foreign country

$$\begin{aligned} B^* &= \left[\frac{W^*}{P^*}\right]^{\frac{\gamma}{\gamma-1}} \left[\frac{1-t^*}{k\gamma}\right]^{\frac{1}{\gamma-1}} \left[\frac{\gamma-1}{\gamma}[1-t^*] + \xi^* t^*\right] \\ G^* &= [1-\xi^*]t^* \left[\frac{W^*}{P^*}\frac{1-t^*}{k\gamma}\right]^{\frac{1}{\gamma-1}} \end{aligned}$$

6.3 Consumption and budget shares

Given the CES preferences over goods, demand for each good $i \in [0,1]$ is given by

$$c_i = \left[\frac{q(i)}{P}\right]^{-\theta} \frac{I}{P} = q(i)^{-\theta} [P]^{\theta-1} I = q(i)^{-\theta} \left[\int_0^1 q(i)^{1-\theta} di\right]^{-1} I \tag{12}$$

The budget share of good i accordingly reads

$$e_i = \frac{q(i)c_i}{I} = \frac{q(i)^{1-\theta}}{\int_0^1 q(i)^{1-\theta} di}$$

The similar expressions for the foreign country read

$$\begin{aligned} c_i^* &= q^*(i)^{-\theta} \left[\int_0^1 q^*(i)^{1-\theta} di\right]^{-1} I^* \\ e_i^* &= \frac{q^*(i)^{1-\theta}}{\int_0^1 q^*(i)^{1-\theta} di} \end{aligned}$$

We have the share of home income spent on home goods

$$\begin{aligned} N^H &= \int_{i^H}^1 e_i di = \int_{i^H}^1 \frac{q(i)^{1-\theta}}{\int_0^1 q(i)^{1-\theta} di} di = \frac{\int_{i^H}^1 q(i)^{1-\theta} di}{\int_0^{i^H} q(i)^{1-\theta} di + \int_{i^H}^1 q(i)^{1-\theta} di} \\ &= \frac{1}{\frac{\int_0^{i^H} q(i)^{1-\theta} di}{\int_{i^H}^1 q(i)^{1-\theta} di} + 1} = \frac{1}{\frac{\int_0^{i^H} \left[\frac{zW^*}{A_i^*}\right]^{1-\theta} di}{\int_{i^H}^1 \left[\frac{W}{A_i}\right]^{1-\theta} di} + 1} = \frac{1}{\left[\frac{z}{w}\right]^{1-\theta} \frac{\int_0^{i^H(w,z)} \left[A_i^*\right]^{\theta-1} di}{\int_{i^H(w,z)}^1 A_i^{\theta-1} di} + 1} \end{aligned}$$

Share of home income spent on foreign goods

$$\begin{aligned} N^M &= \int_0^{i^H} e_i di = \int_0^{i^H} \frac{q(i)^{1-\theta}}{\int_0^1 q(i)^{1-\theta} di} di = \frac{\int_0^{i^H} q(i)^{1-\theta} di}{\int_0^{i^H} q(i)^{1-\theta} di + \int_{i^H}^1 q(i)^{1-\theta} di} \\ &= \frac{1}{1 + \frac{\int_{i^H}^1 q(i)^{1-\theta} di}{\int_0^{i^H} q(i)^{1-\theta} di}} = \frac{1}{1 + \frac{\int_{i^H}^1 \left[\frac{W}{A_i}\right]^{1-\theta} di}{\int_0^{i^H \left[\frac{zW^*}{A_i^*}\right]^{1-\theta}} di}} = \frac{1}{1 + \left[\frac{w}{z}\right]^{1-\theta} \frac{\int_{i^H}^1 A_i^{\theta-1} di}{\int_0^{i^H} \left[A_i^*\right]^{\theta-1} di}} \end{aligned}$$

Consider the derivative w.r.t. the relative wage, w

$$\frac{\partial N^H}{\partial w} = -\left[N^H\right]^2 \left[\frac{z}{w}\right]^{1-\theta} \frac{\int_0^{i^H(w,z)} \left[A_i^*\right]^{\theta-1} di}{\int_{i^H(w,z)}^1 A_i^{\theta-1} di} \left[\frac{\theta-1}{w} + \left(\frac{\left[A_{i^H(w,z)}^*\right]^{\theta-1}}{\int_0^{i^H(w,z)} \left[A_i^*\right]^{\theta-1} di} + \frac{A_{i^H(w,z)}^{\theta-1}}{\int_{i^H(w,z)}^1 A_i^{\theta-1} di}\right) \frac{\partial i^H(w,z)}{\partial w}\right] < 0$$

Now consider the share of foreign income spent on home goods

$$\begin{aligned} N^{*M} &= \int_{i^E}^1 e_i^* di = \int_{i^E}^1 \frac{q^*(i)^{1-\theta}}{\int_0^1 q^*(i)^{1-\theta} di} di = \frac{\int_{i^E}^1 q^*(i)^{1-\theta} di}{\int_0^{i^E} q^*(i)^{1-\theta} di + \int_{i^E}^1 q^*(i)^{1-\theta} di} \\ &= \frac{1}{\frac{\int_0^{i^E} q^*(i)^{1-\theta} di}{\int_{i^E}^1 q^*(i)^{1-\theta} di} + 1} = \frac{1}{\frac{\int_0^{i^E} \left[\frac{W^*}{A_i^*}\right]^{1-\theta} di}{\int_{i^E}^1 \left[z\frac{W}{A_i}\right]^{1-\theta} di} + 1} = \frac{1}{[zw]^{\theta-1} \frac{\int_0^{i^E(w,z)} \left[A_i^*\right]^{\theta-1} di}{\int_{i^E(w,z)}^1 A_i^{\theta-1} di} + 1} \end{aligned}$$

Again consider the derivative w.r.t. the relative wage, w

$$\frac{\partial N^{*M}}{\partial w} = -\left[N^{*M}\right]^2 [zw]^{\theta-1} \frac{\int_0^{i^E(w,z)} \left[A_i^*\right]^{\theta-1} di}{\int_{i^E(w,z)}^1 A_i^{\theta-1} di} \left[\frac{\theta-1}{w} + \left(\frac{\left[A_{i^E(w,z)}^*\right]^{\theta-1}}{\int_0^{i^E(w,z)} \left[A_i^*\right]^{\theta-1} di} + \frac{A_{i^E(w,z)}^{\theta-1}}{\int_{i^E(w,z)}^1 A_i^{\theta-1} di}\right) \frac{\partial i^E(w,z)}{\partial w}\right] < 0$$

For the assumed productivities we have

$$N^H = \left[\left[\frac{z}{w}\right]^{1-\theta} \left[\frac{A^*}{A}\right]^{\theta-1} \frac{e^{\frac{1}{2}\alpha(\theta-1)} - \left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{1-\theta}{2}}}{e^{\frac{1}{2}\alpha(\theta-1)} - \left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{\theta-1}{2}}} + 1\right]^{-1}$$

$$N^M = \left[1 + \left[\frac{w}{z}\frac{A^*}{A}\right]^{1-\theta} \frac{e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{\theta-1}{2}}}{e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{1-\theta}{2}}}\right]^{-1}$$

$$N^{*M} = \left[[zw]^{\theta-1} \left[\frac{A^*}{A}\right]^{\theta-1} \frac{e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A}wz\right]^{\frac{1-\theta}{2}}}{e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A}wz\right]^{\frac{\theta-1}{2}}} + 1\right]^{-1}$$

By definition $N^M = 1 - N^H$ and $N^{*H^*} = 1 - N^{*M}$.

6.4 Labour demand

Labour demand in the private sector can be written

$$\begin{aligned} L^{dp} &= \int_{i^H}^{1} \frac{1}{A(i)} c(i)\, di + \int_{i^E}^{1} \frac{z}{A(i)} c^*(i)\, di \\ &= L^p \int_{i^H}^{1} e(i)\, di + \frac{1}{w} L^{*p} \int_{i^E}^{1} e^*(i)\, di \\ &= L^p N^H + \frac{1}{w} L^{*p} N^{*M} \end{aligned}$$

Using that $N^M = 1 - N^H$ and that $L^{dp} = L^p$ we obtain in equilibrium that

$$L^p = L^{dp} = \frac{1}{w} L^{*p} \frac{N^{*M}}{N^M}$$

6.5 Real wage

Using the expression for P the real wage can be calculated

$$\frac{W}{P} = A e^{\frac{1}{2}\alpha} \left[\frac{1}{\alpha[\theta-1]} \left[e^{\frac{1}{2}\alpha[\theta-1]} \left[1 + \left[\frac{A^*}{A} \frac{w}{z} \right]^{\theta-1} \right] - 2 \left[\frac{A^*}{A} \frac{w}{z} \right]^{\frac{\theta-1}{2}} \right] \right]^{\frac{1}{\theta-1}}$$

$$\frac{\partial \frac{W}{P}}{\partial \frac{w}{z}} = \frac{W}{P} \left[\frac{w}{z} \right]^{-1} \frac{\left[\frac{A^*}{A} \frac{w}{z} \right]^{\theta-1} \left[e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A} \frac{w}{z} \right]^{\frac{1-\theta}{2}} \right]}{e^{\frac{1}{2}\alpha[\theta-1]} \left[1 + \left[\frac{A^*}{A} \frac{w}{z} \right]^{\theta-1} \right] - 2 \left[\frac{A^*}{A} \frac{w}{z} \right]^{\frac{\theta-1}{2}}}$$

Note that $e^{\frac{1}{2}\alpha[\theta-1]} - \left[\frac{A^*}{A} \frac{w}{z} \right]^{\frac{1-\theta}{2}} > 0 \iff e^{\alpha} > \frac{A}{A^*} \frac{z}{w} \iff i^H(w,z) > 0$. Hence, $\frac{\partial \frac{W}{P}}{\partial \frac{w}{z}} > 0$, $\frac{\partial \frac{W}{P}}{\partial w} > 0$ and $\frac{\partial \frac{W}{P}}{\partial z} < 0$

6.6 Labour supply

Labour supply for the private sector. Using $L^g = (1-\xi)\, tL$ and $L^p = L - L^g = [1 - [1-\xi]\, t]\, L$ and

$$L^s = \left[\frac{W}{P} \frac{[1-t]}{k\gamma} \right]^{\frac{1}{\gamma-1}}$$

It follows that labour supply to the private sector is

$$\begin{aligned} L^{sp} &= [1-[1-\xi]\, t] \left[\frac{W}{P} \frac{[1-t]}{k\gamma} \right]^{\frac{1}{\gamma-1}} \\ &= [1-[1-\xi]\, t] \left[\left[\frac{1}{\alpha[\theta-1]} \left(e^{\alpha[\theta-1]} \left[1 + \left[\frac{A^*}{A} \frac{w}{z} \right]^{1-\theta} \right] - 2 e^{\frac{1}{2}\alpha[\theta-1]} \left[\frac{A^*}{A} \frac{w}{z} \right]^{\frac{1-\theta}{2}} \right) \right]^{\frac{1}{\theta-1}} \frac{wA^*}{z} \frac{[1-t]}{k\gamma} \right]^{\frac{1}{\gamma-1}} \end{aligned}$$

and

$$\frac{\partial L^{sp}}{\partial w} = \frac{1}{\gamma - 1} [1-[1-\xi]\, t] \left[\frac{W}{P} \frac{[1-t]}{k\gamma} \right]^{\frac{1}{\gamma-1}} \frac{1-t}{k\gamma} \frac{\partial \frac{W}{P}}{\partial w} > 0$$

6.7 Equilibrium

Rewriting the labour market equilibrium condition we obtain

$$\begin{aligned} L^{dp} &= L^p = L^{sp} \iff L^{dp} = [1-[1-\xi]\,t]\,L^s \iff \frac{1}{w}L^{*p}\frac{N^{*M}}{N^M} = L^p \\ &\iff w\frac{\int_0^{i^H} e_i di}{\int_{i^E}^1 e_i^* di}\frac{\left[\frac{W}{P}\frac{[1-t]}{k\gamma}\right]^{\frac{1}{\gamma-1}}}{\left[\frac{W^*}{P^*}\frac{[1-t^*]}{k\gamma}\right]^{\frac{1}{\gamma-1}}} = n\frac{1-[1-\xi^*]\,t^*}{1-[1-\xi]\,t} \\ &\iff w\frac{1-N^H}{1-N^{H*}}\frac{\left[\frac{W}{P}\frac{[1-t]}{k\gamma}\right]^{\frac{1}{\gamma-1}}}{\left[\frac{W^*}{P^*}\frac{[1-t^*]}{k\gamma}\right]^{\frac{1}{\gamma-1}}} = n\frac{1-[1-\xi^*]\,t^*}{1-[1-\xi]\,t} \end{aligned}$$

Note that the left-hand side is strictly increasing as $\frac{\partial \frac{W}{P}}{\partial w} > 0$, $\frac{\partial \frac{W^*}{P^*}}{\partial w} < 0$, $\frac{\partial N^H}{\partial w} < 0$, $\frac{\partial N^{H*}}{\partial w} > 0$, cf. above. The strictly increasing left-hand side combined with the property that $i^H \to 0$ as $w \to \frac{A}{A^*}\frac{z}{e^\alpha}$ and $i^E \to 1$ as $w \to \frac{A}{A^*}\frac{e^\alpha}{z}$ ensure that the equilibrium relative wage exists and is unique. Inserting expressions from above this can be rewritten as

$$\begin{aligned} & w^{1+\gamma}\left[\frac{e^{\alpha[\theta-1]}\left[1+\left[\frac{A^*}{A}\frac{w}{z}\right]^{1-\theta}\right]-2e^{\frac{1}{2}\alpha[\theta-1]}\left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{1-\theta}{2}}}{e^{\alpha[\theta-1]}\left[1+\left[\frac{A}{A^*}\frac{1}{wz}\right]^{1-\theta}\right]-2e^{\frac{1}{2}\alpha[\theta-1]}\left[\frac{A}{A^*}\frac{1}{wz}\right]^{\frac{1-\theta}{2}}}\right]^{\frac{1}{\theta-1}}\left[\frac{1+\left[zw\frac{A^*}{A}\right]^{\theta-1}\frac{e^{\frac{1}{2}\alpha[\theta-1]}-\left[\frac{A^*}{A}wz\right]^{\frac{1-\theta}{2}}}{e^{\frac{1}{2}\alpha[\theta-1]}-\left[\frac{A^*}{A}wz\right]^{\frac{\theta-1}{2}}}}{1+\left[\frac{w}{z}\frac{A^*}{A}\right]^{1-\theta}\frac{e^{\frac{1}{2}\alpha[\theta-1]}-\left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{\theta-1}{2}}}{e^{\frac{1}{2}\alpha[\theta-1]}-\left[\frac{A^*}{A}\frac{w}{z}\right]^{\frac{1-\theta}{2}}}}\right]^{\gamma-1} \\ = & \left[n\frac{1-[1-\xi^*]\,t^*}{1-[1-\xi]\,t}\right]^{\gamma-1}\frac{A\,[1-t^*]}{A^*\,[1-t]} \end{aligned}$$

This determines the equilibrium relative wage

$$w = w\,(A, A^*, t, t^*, \xi, \xi^*, z, n)$$

which in turn determines all the other endogenous variables for given policy parameters.

7 Appendix B

7.1 Symmetric countries

7.1.1 Marginal cost of public funds (pure transfer case, $\xi = 1$)

Marginal cost of public funds

$$MCPF \equiv \frac{\mu}{U_B} = -\frac{B_t}{R + tR_t}$$

Revenue generated by the private sector

$$R = \frac{W}{P}L^p = \frac{W}{P}\left[\frac{W}{P}\frac{[1-t]}{k\gamma}\right]^{\frac{1}{\gamma-1}} = \left[\frac{[1-t]}{k\gamma}\right]^{\frac{1}{\gamma-1}}\left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}}$$

Consumption bundle

$$B = \left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}}\left[\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}\left(1-\frac{1-t}{\gamma}\right)$$

Consider the cooperative equilibrium ($w = 1 \implies \frac{\partial w}{\partial t} = 0$)

$$\begin{aligned} B_t &\equiv \frac{\partial B}{\partial t} = -\left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}}\left[\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}\left[t\frac{1}{\gamma-1}\frac{1}{1-t}\right] \\ R + tR_t &= \left[\frac{W}{P}\right]^{\frac{\gamma}{\gamma-1}}\left[\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}\left[1-t\frac{1}{\gamma-1}\frac{1}{1-t}\right] \end{aligned}$$

Inserting into the expression for marginal cost of public funds we find

$$MCPF|_{cooperative} = \frac{t\frac{1}{\gamma-1}\frac{1}{1-t}}{1-t\frac{1}{\gamma-1}\frac{1}{1-t}}$$

It follows that

$$\frac{d\ MCPF|_{cooperative}}{dz} = \frac{\partial\ MCPF|_{cooperative}}{\partial t}\frac{\partial t}{\partial z} > 0$$

where $\frac{\partial t}{\partial z} > 0$ follows from the tax base effect.

7.1.2 Fiscal consumption ($\xi = 0$)

Coordinated public policy Assume $n = 1$. In a symmetric equilibrium $w = 1$ and hence the optimality condition reads

$$\begin{aligned} \Gamma &= B^{-\beta}\frac{\partial B}{\partial t} + \bar{G}G^{-\lambda}\frac{\partial G}{\partial t} = 0 \\ \Gamma_t &< 0 \end{aligned}$$

where

$$\begin{aligned} \Gamma &= -B^{1-\beta}\frac{\gamma}{\gamma-1}\frac{1}{1-t} + \bar{G}G^{1-\lambda}\left[\frac{1}{t} - \frac{1}{\gamma-1}\frac{1}{1-t}\right] = \bar{G}G^{1-\lambda}\frac{1}{t} - \left[\gamma B^{1-\beta} + \bar{G}G^{1-\lambda}\right]\frac{1}{\gamma-1}\frac{1}{1-t} \\ &= -\left[\frac{W}{P}[1-t]\right]^{\frac{\gamma[1-\beta]}{\gamma-1}}\left[\frac{1}{k\gamma}\right]^{\frac{1-\beta}{\gamma-1}}\left[\frac{\gamma-1}{\gamma}\right]^{1-\beta}\frac{\gamma}{\gamma-1}\frac{1}{1-t} + \bar{G}t^{1-\lambda}\left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1-\lambda}{\gamma-1}}\left[\frac{1}{t} - \frac{1}{\gamma-1}\frac{1}{1-t}\right] \end{aligned}$$

and where $\frac{1}{t} - \frac{1}{\gamma-1}\frac{1}{1-t} > 0$ in optimum, cf. the laffer-curve. From this we have

$$\frac{dt}{dz} = -\frac{\Gamma_z}{\Gamma_t}$$

and thus

$$sign\frac{dt}{dz} = sign\Gamma_z$$

since $\Gamma_t < 0$, cf. the second order condition. We have that (using the expression for $\Gamma = 0$)

$$\Gamma_z = \left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1-\lambda}{\gamma-1}}\frac{1}{\frac{W}{P}}\bar{G}t^{1-\lambda}\left[\frac{1}{t} - \frac{1}{\gamma-1}\frac{1}{1-t}\right]\frac{1}{\gamma-1}\left[-\gamma[1-\beta] + 1 - \lambda\right]\frac{d\frac{W}{P}}{dz}$$

Hence

$$sign\frac{dt}{dz} = sign\left[\left[-\gamma[1-\beta] + 1 - \lambda\right]\frac{d\frac{W}{P}}{dz}\right] = sign\left[\gamma[1-\beta] - [1-\lambda]\right]$$

and optimal taxation may be increasing or decreasing in product market integration depending on preferences and the labour supply elasticity. Note if $\gamma[1-\beta] - [1-\lambda] = 0$, then t is independent of $\frac{W}{P}$ and accordingly of z. We have that an implicit solution to the optimal tax rate is given by

$$\left[\frac{W}{P}[1-t]\right]^{\frac{\gamma[1-\beta]-1+\lambda}{\gamma-1}}\left[\frac{1}{k\gamma}\right]^{\frac{\lambda-\beta}{\gamma-1}}\left[\frac{\gamma}{\gamma-1}\right]^{\beta}\frac{1}{1-t} = \bar{G}t^{1-\lambda}\left[\frac{1}{t} - \frac{1}{\gamma-1}\frac{1}{1-t}\right]$$

Regarding public consumption we have

$$\begin{aligned} sign\frac{dG}{dz} &= sign\frac{d\left[t\left[\frac{W}{P}\frac{1-t}{k\gamma}\right]^{\frac{1}{\gamma-1}}\right]}{dz} \\ &= sign\left(t\left[\frac{W}{P}\right]^{\frac{1}{\gamma-1}}[1-t]^{\frac{1}{\gamma-1}}\left[\frac{1}{t}\frac{dt}{dz} - \frac{1}{\gamma-1}\frac{1}{1-t}\frac{dt}{dz} + \frac{1}{\gamma-1}\frac{1}{\frac{W}{P}}\frac{d\frac{W}{P}}{dz}\right]\right) \\ &= sign\left(\frac{1}{t}\gamma[1-\beta] - [1-\beta]\frac{\gamma}{\gamma-1}\frac{1}{1-t} - \frac{1}{1-t} - \frac{1}{t}\right) \end{aligned}$$

Hence

$$\frac{dG}{dz} > 0 \Leftrightarrow \beta < 1 - \frac{1}{\gamma}\frac{1}{1-t\frac{\gamma}{\gamma-1}}$$

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