Abstract
With the completion of EMU, tax competition is high on the EU policy agenda. In contrast to the standard neo-classical reasoning, recent advances in the theory of trade and location have shown that tax competition is not inevitable. In this recent discussion the role of government spending is however unduly neglected. In this paper we introduce a more elaborate government sector by including government spending and government production in an economic geography model. By changing the relative size, direction or efficiency of the production of public goods, governments can change the equilibrium between agglomerating and spreading forces. Ultimately this means that restricting locational competition to tax competition, one ignores that governments themselves may contribute to the attractiveness of a country as a location for the mobile factors of production.

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JEL Code: H10, F12, F15
1. Introduction

Tax harmonization is high on the political agenda of the EU-countries. It is widely believed that with the arrival of economic and monetary union (EMU) the EU-countries must harmonize their national policies and tax harmonization is the most prominent example. The standard line of reasoning is that in the absence of a policy of tax harmonization full-fledged economic integration in the EU will lead to a “race to the bottom”. For the EU this line of reasoning has already been aptly summarized by Sinn (1990). A race to the bottom would mean that in a truly common market in the EU, the mobile factors of production (in particular high-skilled labor and capital) will locate in the country with the lowest tax rate, with the result that all EU-countries are forced to adopt this tax rate. Or, in other words, economic integration could go along with fierce tax competition between the EU-countries. Tax competition is thought to be harmful because it would imply a sub-optimal (=too low) provision of public goods. In order to avoid this outcome a policy of tax harmonization is deemed necessary. However, taxes are only part of the story. Locational competition is not only about taxes but also about location specific government expenditures. In other words, the location decision of the mobile production factors also depends on the quality of a country's social and economic infrastructure.

In essence a discussion about locational competition is a discussion about the importance of geography. However, in the analysis of the effects of tax or expenditure differences the role of geography has been neglected. The recent literature on geographical economics shows, however, the importance of including geography into the analysis. This leads potentially to very different conclusions with respect to tax competition and harmonization. In a much-discussed paper Baldwin and Krugman (2000), for instance, show that there is no need for a race to the bottom to begin with and, stronger still, a policy of tax harmonization could make all countries worse off. The main idea is that economic integration could lead to (or sustain) a core-periphery outcome, with an agglomeration rent for the production factors located in the core. This rent reflects the fact that the production factors earn more (in real terms) in the core than in the periphery. The rent can be taxed and up to a certain degree the agglomeration rent allows the core countries to have a higher tax rate than the peripheral countries (see also Andersson and Forslid, 1999). As a consequence, tax
competition is not leading to a race to the bottom which is an important result because it corresponds with observed lack of a race to the bottom in reality.

Although the contributions of Baldwin and Krugman (2000), and Andersson and Forslid (1999) challenge the standard views about tax competition their treatment of the government sector is still rather rudimentary. The emphasis is on taxes and not on the effects of public expenditures on the economy. In the context of EU integration this is rather one-sided because public spending is used by policy makers as a main policy instrument of locational competition. Countries try to increase their attractiveness as a location by investing in location-specific infrastructure. The Dutch Ministry of Economic Affairs, for example, formulated three key characteristics of location policy, one reads "a competitive location policy is a comprehensive policy...that includes all aspects that define the attractiveness of a location" (see Dutch Ministry of Economic Affairs, 1999, p.114-5). Similarly, during the European Council meeting of the EU in Lisbon in March 2000, the EU member states agreed upon a (benchmarking) method to determine the competitiveness of the EU economies. To this end 54 (!) indicators were devised and, besides taxes, the quality of the social and economic infrastructure features prominently in this set of indicators.

When the effects of agglomeration are thought to be important tax and spending policies represent two opposing forces. All other things remaining the same, higher taxes stimulate spreading even though the existence of an agglomeration rent may prevent the spreading from actually taking place. Similarly, an increase in public spending stimulates agglomeration if this spending enhances the attractiveness of the location for the mobile factors of production. But all things do not remain the same in the sense that higher taxes typically also imply higher public spending and vice versa. Also, the extent to which a larger government sector (meaning higher public spending and taxes) really leads to a better quality of the country's infrastructure is an issue that has troubled EU policy-makers for a long time. In the present paper we therefore extend Baldwin and Krugman (2000) and Andersson and Forslid (1999) in two ways. First, we allow for public spending to affect the cost of production and this has an

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1 We do not address the difficult question about the most likely outcome of locational competition between governments. In the absence of ideal market conditions international welfare maximization is not guaranteed (see Sinn, 2002).
impact on the location decisions of firms and workers. Second, we also take into account that the production of public goods takes up resources which cannot be used in the production of the manufacturing (private) sector and that countries may differ in the efficiency of the provision of public goods. The main contribution of this paper is that it takes as its starting point the interdependency between taxes and spending and in doing so we focus on the role of government spending.

The paper is organized as follows. Section 2 briefly presents some stylized facts for the EU about cross-country differences in corporate rate income taxation, public spending, location indicators and the corresponding differences in location decisions. Section 3 presents the model. In section 4 we analyze the model and focus on the combined effect of taxation and public spending. We also take into account that the government production takes up resources and that the efficiency of this production might differ between countries. In section 5 we use the fact that our model can be solved to derive analytical results. Section 6 concludes.

2. Stylized facts about taxation and public spending in the EU

Following Baldwin and Krugman (2000) we first illustrate that a race to the bottom in the EU is not inevitable. We concentrate on the taxation of capital because in our model we assume that capital is mobile and labor is not. This is in accordance with the, certainly for the EU, observed higher degree of capital mobility as compared to labor mobility. Tax competition is therefore concerned with capital taxation. Table 1 shows for the EU countries for the period 1990-1999 the development of the corporate income taxes. This period can be looked upon as a period of increasing economic integration. Table 1 gives the effective corporate income tax rates which differ from the “nominal” corporate tax rates because the former takes into account the implications of differences in tax base, allowances for depreciations etc. that exist between EU-countries. These effective rates reflect the real capital tax burden on a firm in any of these countries. The corporate income tax rates are the tax rates paid by individual firms and the data in Table 1 are based on micro data from the financial accounts of individual firms.
Table 1 offers, of course, no conclusive evidence but a number of things are worth pointing out:

- The large countries of the EU (Germany, the UK, France and also Italy) clearly have an above-average tax rate.2
- The smaller and “peripheral” countries, notably Greece, Portugal and Spain started out with a below-average tax rate, but their corporate income tax rates clearly increased during the 1990s (Ireland is a notable exception).
- The average EU corporate income tax rate is fairly constant through time, in any case shows no discernible downward trend.

2 These 4 countries are also the core countries in the sense that their share in total EU manufacturing production for instance is about 75% and this share remains fairly constant through the 1990s.
The standard deviation has strongly decreased from 1990 to 1999, so there is some tax rate convergence, but not towards the lowest rate. These four observations offer some (very preliminary) support for the lack of a race to the bottom. Core/large countries persistently have higher tax rates and small/peripheral countries even display some “catching up” in terms of their tax rates.³

Baldwin and Krugman (2000) explain the lack of a race to the bottom for taxation in the EU by the fact that despite higher tax rates, the after tax income in the core EU countries is still larger than in the more peripheral EU countries due to a positive agglomeration rent. These rents are the result of positive pecuniary externalities. By looking only at taxation government policy either has no impact at all on the location of economic activity as long as the tax rate is not too high or, if the tax rate exceeds a specific threshold, the agglomeration equilibrium can no longer be sustained. A core country can thus afford a higher tax rate but in essence taxation is a potential spreading force. So, government policies, in principle, do not contribute to the agglomeration forces. However, we stress that public spending is an essential part of the story. Our main point is that government policies can increase the attractiveness of a country (besides offering a sufficiently low tax rate).⁴ We do, however, not simply add an extra agglomeration force; the efficiency of the government sector might frustrate the effectiveness of extra spending.

Tables 2A and 2B illustrate that, with respect to government spending, the EU-countries are not involved in a race to the bottom. Table 2A shows that for most EU countries there is no downward trend in (central) government expenditures as a percentage of GDP. This is certainly true for the core EU-countries Germany, France and the UK. Furthermore, in some of peripheral EU-countries there is an increase in

³ Note that we do not claim that there is not tax competition at all in the EU. Sinn (2002, p. 8) for instance shows that the average tax burden for subsidiaries of US companies in the EU has decreased strongly in the various EU countries between 1986 an 1992. In general, tax competition seems more relevant where it concerns the taxation of foreign direct investment.

⁴ To some extent the issue here, as we will show in our model, is the difference between pure and pecuniary externalities. The former are absent in the standard economic geography models whereas we emphasize that the provision of public goods has a positive impact on the relationship between inputs and outputs.
this expenditure ratio. As a crude proxy for government expenditures that have a bearing on a country's attractiveness as a location Table 2B gives capital expenditures as a percentage of total government expenditure. Two observations can be made. First, for the core countries there is a downward trend in capital expenditures as a share of total government expenditure. Second, the reverse is true for peripheral EU-countries like Greece, Ireland and Portugal. To get a grasp of the cross-country differences in capital expenditures, data on capital expenditures as a percentage of GDP provide useful information. These data can be obtained by multiplying the corresponding data from Tables 2A and 2B. For instance for Germany and Portugal in 1997 capital expenditures as a percentage of GDP are 1.3% and 5.2%, respectively. Here too, there are marked cross-country differences but again there is no evidence of a race to the bottom.

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In recent years benchmarking has been a popular method among EU-policymakers to compare the relative locational (dis)advantages of the various EU-countries and regions for the mobile factors of production (notably capital). In the introduction we already referred to the recent Lisbon criteria. If we take the region of North-West Europe as an example, the Dutch Ministry of Economic Affairs has identified the following regions as having the most attractive location characteristics. Table 2C is only meant to indicate that the alleged attractiveness could be the result of (past) regional public spending.

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Source: World Bank 2000, CD-Rom
Table 2C lists just a few reasons why some of the regions in these countries are found to be preferred locations, but it suggests that location decisions can be effected by regional government spending and not only by the levels of taxation. This last point also comes across from an UNCTAD survey on location and foreign direct investment (UNCTAD, 1996). Large companies like Samsung or Mercedes-Benz stated that, apart from taxes and subsidies, the social and economic infrastructure (transport) are key determinants for their location decision. In order to show this last point formally we now turn to our model.

3. The Model
In this section we present the model which is an extension of Forslid (1999). The main extension is a more elaborate modelling of the government sector since we also include government spending effects and pay attention to the efficiency of government production. The reason to use the Forslid model is twofold. First, in the discussion of tax competition the main issue is that mobile and immobile factors of production in the manufacturing sector react differently to taxation. Below we will call the immobile factor, labor and the mobile factor, (human) capital. At least in the European context this corresponds to the fact that labor is less mobile than capital.
The ability to distinguish between mobile and immobile factors is also why Baldwin and Krugman (2000) and Andersson and Forslid (1999) take the Forslid-model as their starting point in their analysis of tax competition and economic integration. A second reason to use the Forslid model is that it can be solved analytically and, contrary to standard models of geographical economics, some analytical results can be derived. This second point will be used in section 5.

There are two regions \( j = 1,2 \). Each region has \( L_j \) workers and \( K_j \) of (human) capital. Each agent is either a worker or a capital owner, where capital can be thought of as human or knowledge capital. All agents are assumed to have the same preferences. Workers are geographically immobile, whereas capital is mobile. Each agent has the following utility function, depending on consumption of manufactures \( M \) (a composite of \( n \) different varieties \( c_i \)), consumption of food \( F \), and consumption of public services \( Z \).

\[
U = M^\delta F^{(1-\delta)} Z^\theta
\]

where \( 0 < \delta < 1 \); \( 0 \leq \theta \leq 1 \)

\[
M = \left( \sum_{i=1}^{n} c_i^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}
\]

where \( M \) is the CES aggregate of manufacturing varieties; \( \sigma > 1 \) is the elasticity of substitution between varieties.

The production of food, which is freely traded at zero transport costs, takes place under constant returns to scale and requires only workers. A suitable choice of units ensures that one unit of labor produces one unit of food. Labor is used in food production and in the manufacturing sector but in the latter it is only part of the variable cost of production. Using food as a numeraire and assuming free trade implies that its price and hence the wage can be set equal to one. This means that we only have to determine the return on human capital.

\(^5\) The main point here is to include a mobile and an immobile factor of production. The labelling of these two factors (unskilled versus skilled labor or labor versus capital) is not material as long as the mobile factor (be it skilled labor or capital) spends its income in the region where it is used for production; see in particular Forslid (1999, p.11) for a discussion of the importance of this assumption.
Firms in the manufacturing industry use labor and capital to produce a variety of manufactures under increasing returns to scale. The fixed cost component requires $\alpha_j(.)$ units of capital and the variable cost component requires $\beta_j(.)$ units of labor. The fixed cost component is assumed to represent the knowledge intensive part of the manufacturing production process like R&D, marketing and management, etc. The production of manufactures benefits from the availability of public goods $Z_j$ in region $j$. This distinguishes our model from Baldwin and Krugman (2000) and Andersson and Forslid (1999). The former do not analyze public spending separately, taxes are returned to the factors of production in non-distortionary lump-sum manner while the latter include public goods in the utility function (as in equation (1) above) but do also not consider the effects of public goods on the cost of production. We take this into account as follows:

$$\alpha_j(Z_j) = f_j(Z_j); \quad \beta_j(Z_j) = f_j(Z_j)\frac{\sigma - 1}{\sigma}; \quad \text{with } f_j(0) = 1, f_j' \leq 0$$

By choice of units we have chosen the specification of the fixed cost of production, $\alpha$, and variable costs of production, $\beta$, as a function of $Z$ such that the notation can be simplified considerably. The quality aspect of public goods comes to the fore by making the parameters region-specific, this is a simple way of distinguishing between more and less useful public goods.

Let $r_j$ be the return to capital in region $j$, then the costs of producing $x$ units of a manufacturing variety in region $j$ are equal to

$$\alpha_j(Z_j)r_j + \beta_j(Z_j)x$$

Note that the use of public services in manufactures does not influence the amount of public services available to consumers. Furthermore, the return to capital can be looked upon as the operating profit of a typical variety, capital gets paid what the firm earns net of payments to labor (Baldwin and Krugman, 2000, p. 5).

The production of public goods requires (human) capital only, and is subject to variable returns to scale (constant or decreasing returns to scale). This is the second extension of our model, we assume that the production of public goods takes up net
resources. It captures the idea that government production competes with private production and relates to the discussion about the optimal size of the government sector. To emphasize this, we have assumed in equation (5) that government production is subject to variable returns to scale, that can be region-specific.

\[ Z_j = g_j(K_j^p); \quad \text{with} \quad g_j(0) = 0, \quad g_j' > 0, \quad g_j'' \leq 0 \]

where \( K_j^p \) is the amount of capital in the public goods sector in region \( j \). Market clearing for capital in region \( j \) \( (K_j = K_j^p + K_j^m) \) allows us to determine the number of varieties produced in region \( j \) (subject to the qualification of positive production etc.)

\[ n_j = (K_j - K_j^p) / \alpha_j(Z_j) \]

Equilibrium in the public sector requires that the public spending is fully paid by taxes:

\[ r_j K_j^p = t_j Y_j \]

where \( t_j \) is the uniform income tax rate and applies to both labor and capital.\(^6\) Given the sectoral distribution of capital and the return on capital, choosing a level of public goods determines the tax rate and vice versa. In addition we assume that capital employed in the public sector earns the same return as in the private sector. As such, this reflects the notion that the public sector has to compete with the private sector for factors of production.

Standard monopolistic competition mark-up pricing gives (see equation (3)):

\[ p_j = \frac{\sigma}{\sigma - 1} \beta_j(Z_j) = f_j(Z_j) \]

---

\(^6\) Differentiating between labor and capital income taxation raises the complication why to tax the mobile factor at all, see also Sinn (2002).
This pricing rule applies for locally produced and sold goods. Two observations with respect to this pricing rule can be made. First, due to the production structure (equation (4)), the price \( p_j \) does not depend on wages (Forslid, 1999). Secondly, we cannot choose units such that \( p_j = 1 \) because \( \beta \) is a function of \( Z \). However, once we know \( Z \) the price is also fixed.

Free entry and exit in the manufacturing sector ensures that profits are zero which implies that the equilibrium output per firm equals:

\[
(9) \quad x_j = \frac{(\sigma - 1)}{\beta_j(Z)} \alpha_j(Z_j) r_j = \sigma r_j
\]

Furthermore, using our normalization of wages, the income in region \( j \) is equal to

\[
(10) \quad Y_j = r_j K_j + L_j
\]

As in standard in geographical economics models we use iceberg transport costs \( T \) (= the number of goods shipped to ensure that 1 unit arrives). These costs imply that the price charged in the other region is \( T \) times as higher than the mill price. It is convenient to define \( \phi \equiv T^{1-\sigma} \), which ranges between 0 and 1; \( \phi = 0 \) represents autarky and \( \phi = 1 \) free trade.

The manufacturing sector market clearing condition is given by

\[
(11) \quad p_j x_j = \frac{p_j^{1-\sigma} \delta Y_j}{P_j^{1-\sigma}} + \frac{\phi p_k^{1-\sigma} \delta Y_k}{P_k^{1-\sigma}}
\]

where \( P_j \) is the price index for manufactures in region \( j \):

\[
(12) \quad P_j = \left( p_j^{1-\sigma} n_j + \phi p_k^{1-\sigma} n_k \right)^{1/(1-\sigma)}
\]

The left-hand side of equation (11) gives equilibrium (value of) output per firm and the right-hand side the associated demand.

Using (8), (9), (11), and (12) gives:
\[
(13) \quad r_1 = \left( \frac{1}{f_1} \right) \left[ \frac{f_1^{1-\sigma} \delta Y_1}{n_1 f_1^{1-\sigma} + \phi n_2 f_2^{1-\sigma}} + \frac{\phi f_2^{1-\sigma} \delta Y_2}{n_2 f_2^{1-\sigma} + \phi n_1 f_1^{1-\sigma}} \right]
\]
\[
(13') \quad r_2 = \left( \frac{1}{f_2} \right) \left[ \frac{f_2^{1-\sigma} \delta Y_2}{n_2 f_2^{1-\sigma} + \phi n_1 f_1^{1-\sigma}} + \frac{\phi f_1^{1-\sigma} \delta Y_1}{n_1 f_1^{1-\sigma} + \phi n_2 f_2^{1-\sigma}} \right]
\]

Using the income equations gives:
\[
(13'') \quad r_1 = \left( \frac{1}{f_1} \right) \left[ \frac{f_1^{1-\sigma} \delta (r_1 K_1 + L_1)}{n_1 f_1^{1-\sigma} + \phi n_2 f_2^{1-\sigma}} + \frac{\phi f_2^{1-\sigma} \delta (r_2 K_2 + L_2)}{n_2 f_2^{1-\sigma} + \phi n_1 f_1^{1-\sigma}} \right]
\]
\[
(13''') \quad r_2 = \left( \frac{1}{f_2} \right) \left[ \frac{f_2^{1-\sigma} \delta (r_2 K_2 + L_2)}{n_2 f_2^{1-\sigma} + \phi n_1 f_1^{1-\sigma}} + \frac{\phi f_1^{1-\sigma} \delta (r_1 K_1 + L_1)}{n_1 f_1^{1-\sigma} + \phi n_2 f_2^{1-\sigma}} \right]
\]

Equations (13'') are two linear equations in two unknowns, \( r_1 \) en \( r_2 \) which can be solved analytically (see the Appendix), to give \( r_1/r_2 \):
\[
\frac{r_1}{r_2} = \frac{f_2 \sigma \left\{ \phi n_1 \left[ 1 + \left( \frac{f_1}{f_2} \right)^{1-\sigma} \right] \right\} + n_2 \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^{\sigma-1} \right] + (\phi^2 - 1)(1 - \lambda) \delta}{f_1 \sigma \left\{ \phi n_2 \left[ 1 + \left( \frac{f_1}{f_2} \right)^{\sigma-1} \right] \right\} + n_1 \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^{1-\sigma} \right] + (\phi^2 - 1) \lambda \delta}
\]

In order to determine \( Z_n \), we let the government choose the share \( \kappa \) of capital to be employed in the public sector. Equation (5) shows that for any level of capital the choice of \( \kappa \) directly determines what share of capital is available for the production of \( Z \). Having thus determined \( Z \) we also know \( \alpha \) and \( \beta \). In the calculations we use the following functional forms for \( f_j \) and \( g_j \):
\[
f_j(Z_j) = e^{-\eta_j Z_j}; \quad g_j(L_j^p) = \left( L_j^p \right)^{\mu_j}
\]
Note that \( g \) determines \( n \). A higher \( \eta \) or higher \( Z \) implies that the costs of manufacturing production decreases. Furthermore, with respect to the production of public goods we choose between constant returns to scale, \( \mu = 1 \), or decreasing returns to scale, \( 0 < \mu < 1 \) in government production.

Now that we, through the introduction of \( \kappa \), have a decision rule as to how much of the human capital in a region will be employed in the government sector, the above
expression for \( r_1 / r_2 \) can be further simplified when we use

\[
K_1^p = \kappa_1 \lambda; \quad K_2^p = \kappa_2 (1 - \lambda),
\]

so that

\[
n_1 = \frac{(1 - \kappa_1) \lambda}{f_1}; \quad n_2 = \frac{(1 - \kappa_2) (1 - \lambda)}{f_2}
\]

we finally get:

\[
\frac{n_1}{n_2} = \frac{f_2 \left( \frac{(1 - \kappa_1) \lambda}{f_1} \left( 1 + \left( \frac{f_1}{f_2} \right)^{\sigma - 1} \right) + \frac{(1 - \kappa_2) (1 - \lambda)}{f_2} \left( 1 + \frac{f_1}{f_2} \right)^{\sigma - 1} \right) + (\phi^2 - 1)(1 - \lambda) \delta}{f_1 \sigma \left( \frac{(1 - \kappa_2) (1 - \lambda)}{f_2} \left( 1 + \left( \frac{f_1}{f_2} \right)^{\sigma - 1} \right) + \frac{(1 - \kappa_1) \lambda}{f_1} \left( 1 + \frac{f_1}{f_2} \right)^{\sigma - 1} \right) + (\phi^2 - 1) \lambda \delta}
\]

With \( f_1 = f_2 = 1 \) and \( \kappa_1 = \kappa_2 = 0 \), meaning the absence of a government sector, the expression for the equilibrium relative return on capital is exactly the same as the corresponding equilibrium equation in Forslid (1999).

To round up the discussion of our model, we have to include that in its location decision capital does not only take the factor rewards \( r_1 \) and \( r_2 \) into account but also the respective price levels, tax rates, and provision of public services. So, the incentive of capital to re-locate is determined by the following ratio \( \rho \) of indirect utilities or, as we will call it below, the ratio of welfare between regions 1 and 2:

\[
(14) \quad \rho = \left( \frac{(1 - t_1) n_1}{(1 - t_2) n_2} \right) \left( \frac{P_2}{P_1} \right)^\delta \left( \frac{Z_1}{Z_2} \right)^\theta
\]

This ratio is central in the calculations in next section. Apart from the case of complete agglomeration, capital has no incentive to re-locate as long as \( \rho = 1 \) and moves in the direction of the region with offers a higher indirect utility if \( \rho \neq 1 \). Equation (14) completes our discussion of the model and we now turn to the analysis.

\[
\text{The indirect utility of a capital owner in region } j \text{ equals } \left( \frac{\delta r_j}{P_j} \right)^\delta (1 - \delta) r_j^{1 - \delta} Z_j^\theta
\]
4. Results

4.1 Does government policy matter?

As a benchmark we first show that without the government sector our model entails the standard economic geography effects as shown by Krugman (1991) and Forslid (1999). This model has become known as the core model of geographical economics (Neary, 2001). In terms of our model no government sector essentially means that all capital is employed in the manufacturing sector, $\kappa_i = 0$. Figure 1 shows for our benchmark parameter values that economic integration (increasing values of $\phi$) results in the familiar anti-clockwise rotation of the equilibrium curve displaying the relative welfare or, more accurately in this case, the relative real return on capital as a function of capital in region 1, $K_1$: $K_1=0$ ($K_1=1$) implies that all capital is in region 2 (region 1). For low values of $\phi$ (here, $\phi=0.35$) there is a stable symmetric long run equilibrium and for higher values of $\phi$ (0.45 and 0.70 in Figure 1) the symmetric equilibrium becomes unstable and only complete agglomeration of capital is a stable equilibrium. Unless stated otherwise the benchmark parameter values are as shown by Table 3. The relative welfare is on the vertical axis and $K_1$ is on the horizontal axis. In section 4.1 we assume symmetric regions, meaning that the parameter values given by Table 3 are the same for both regions.

<table>
<thead>
<tr>
<th>$\delta$</th>
<th>$\sigma$</th>
<th>$\phi$</th>
<th>$\eta$</th>
<th>$\mu$</th>
<th>$\kappa$</th>
<th>$\theta$</th>
<th>$L_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>4</td>
<td>0.25</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Note that equation (14) does not apply in the no-government case. In this case $\rho$ represents the ratio of welfare without government and is straightforward to derive $\rho$ for this case, see also footnote 7.
For a symmetric equilibrium \((K_1=K_2=0.5)\) the relative real return on capital as defined by equation (14) is always one, for full agglomeration of capital the real return on capital is higher for the region \(i\) where \(K_i=1\). This creates an agglomeration rent and in principle, when taxation would be introduced, enables this region to apply a higher tax rate and as long as the after tax return on capital in the core exceeds the net return on capital in the periphery, the core region will avoid that capital moves out.

We now introduce the government sector. In order to ensure positive production of \(Z\) we have to take \(\kappa_i > 0\), meaning that a positive amount of capital is now employed in the public sector. Given that the base parameter values for \(\eta\) and \(\theta\) are positive (see Table 3), the production of \(Z\) has an impact on the costs of production and utility. The difference between our specification and that of Andersson and Forslid (1999) is that they assume that the production of a public good uses a part of the consumption basket as an input, which is then returned to consumers in the form of a public good. The net effect is that the production side is not affected by the introduction of public goods. However, by choice of their parameter values in the utility function even the consumption effect is not taken into account and their analysis thereby essentially concentrates on the distribution effect of taxes between and within regions. In our model the production of public goods uses capital (equation (5)) and as such also
influences the production side of the economy and thus redistributes resources between the sectors. This can be seen by inspecting equations (4) and (5), the production function of the manufacturing sector differs from that of the public sector notably because the latter is not subject to fixed costs. A different production structure between the manufacturing and public sector is needed to ensure that the production of public goods can be distinguished from that of manufacturing goods.

With the introduction of $Z$ we can now also look at the consequences for taxes. What is the main impact of introducing a government which uses resources like capital? Figure 2A shows the results for three cases with $\kappa_i=0$, $\kappa_i=0.1$ and $\kappa_i = 0.2$ (again all other parameter values are as shown in Table 3).

---

\[\text{Figure 2A, introducing the government sector}\]

---

\[\text{Also we think it makes more sense to tax the mobile factor (here, capital) when at least part of the tax revenues is used to produce public goods that benefit the mobile factor, instead of the situation (as in Andersson and Forslid’s model) where the mobile factor is taxed but the public goods are only consumed by (immobile) consumers.}\]
As can be seen from Figure 2A the symmetric equilibrium quickly becomes unstable once we allow for an increasing share of capital to be employed in the government sector. For $\kappa_i \geq 0.2$ only full agglomeration is a stable long run equilibrium. This means that the introduction of $Z$ clearly fosters agglomeration. In our model specification this conclusion holds for all intermediate values of $\phi$, hence it holds for almost any degree of economic integration save for $\phi=0$ or $\phi=1$. Compared to the no-government case of Figure 1 the introduction of $Z$ is clearly non-neutral. Figure 2B illustrates that that for region 1 and, given the symmetry between the two regions, as well as for region 2 its relative welfare is best served when a region attracts all capital and when also $\kappa_i$ is higher (note that for $K_i=0.5$, which is always an (un)stable equilibrium, the relative welfare is by definition 1).

Given the equilibrium solutions, the government budget constraint (equation (7)) gives the associated tax rate for each level of $Z$. Figure 2C illustrates that tax rates can differ between the larger and smaller region in a systematic way, such that the tax rate in the larger region is always higher. In particular for the case of $\kappa_i=0.2$, where $K_i=1$
(complete agglomeration) is the stable equilibrium, the tax rate in the core is positive and the zero tax rate in the periphery does not induce a re-location of capital. The reason being the agglomeration rent as emphasized by Baldwin and Krugman (2000). In Figure 2C the tax rates are on the vertical axis and the share of capital in region $K_i$ is again on the horizontal axis.

**Figure 2C, tax rates for $\kappa i=0.2$**

![Graph showing tax rates for $\kappa i=0.2$](image)

The conclusions based Figures 2A and 2C do not change qualitatively when we pick different values for $\kappa$ or by allowing $\kappa$ to differ between regions.\(^{10}\) The same is true for alternative values of $\theta$, the weight of public goods in the utility function, increasing this weight strongly stimulates agglomeration. With respect to $\eta$ a similar conclusion holds. The more public goods lower the costs of production of manufactures, see equations (3) and (4), the more the agglomeration tendencies as illustrated by Figure 2A are reinforced.

The important conclusion is that the introduction of the government sector matters and the precise way in which it effects equilibria crucially depends on the fact that the production structure of the government sector differs from that of the manufacturing sector. In our model releasing capital from the manufacturing sector, which reduces production of manufactures, has two effects. First the production of public goods does not incur fixed costs which makes the production of public goods in this sense less "wasteful" than manufactures production. Second, the released labor can be used more efficiently in the food sector for the same reason. The fact that labor and capital

\(^{10}\) When $\kappa_1 \neq \kappa_2$ the only effect is that the dispersed equilibrium is no longer at $K_i=0.5$.  

20
can be used more efficiently means that, compared to the no government case, the larger region offers a higher return on capital and this stimulates agglomeration.

Does this last conclusion also hold if the size of the government sector has a bearing on the efficiency of the production of $Z$ itself? Or in other words, what happens if $\mu_i$ is no longer one (which means constant returns to scale in government production)? If $\mu < 1$ this means that government production becomes subject to decreasing returns to scale so as to emphasize that an ever-increasing government sector leads to inefficiencies. Figure 3 illustrates for three different values of $\mu_i$, and for $\kappa_i=0.2$, the relevance of the scale effect in government production. With decreasing returns to scale the symmetric equilibrium ultimately becomes stable again, due to the weakening of agglomeration forces. With respect to taxation, with $K_1=K_2=0.5$ again becoming a stable equilibrium (despite that $\kappa_i=0.2$) by definition $t_1=t_2$. Hence a stable dispersed equilibrium is associated with spontaneous (not policy induced) tax harmonization, this is in sharp contrast with the conclusion based on Figure 2C for the case of agglomeration.

**Figure 3, varying the returns to scale parameter for $Z$-production**

---

11 Decreasing returns to scale with respect to capital in the production of $Z$ also implies that for small values of capital the marginal productivity can be higher than in the benchmark case with constant returns to scale with respect to capital. For regional differences in $\mu$ one has to be careful in comparing productivity differences because conclusions depend not only on the level of $K_i$ but also on the position of a region on its government production function.
The upshot of our analysis so far is that the introduction of the government sector has a decisive impact on the spatial distribution of economic activity, for better or worse. Until now we have maintained the symmetry assumption, in the next sub-section we allow both regions to differ with respect to their government sector.

4.2 Asymmetric governments

The discussion about tax or, more general, locational competition is ultimately based on the idea that it pays for national governments to behave differently, that is, to have lower taxes or better policies than other countries. From the perspective of geographical economics it has been shown that, in the absence of a coordinated policy of tax harmonization, tax competition need not to arise because of the existence of an agglomeration rent in core countries, a rent that can be taxed without re-location of the mobile factors (recall Figure 2C). We now use our geographical economics model to highlight the relevance of regional differences in the way $Z$ affects the economy. Because taxation is a means to an end we focus on the public spending financed by our income tax. In models in which government policy is the same thing as tax policy, governments are a negative force in the sense that taxation always decreases the net return to the (mobile) factors of production and the main issue than becomes simply if the after-tax returns interfere with pre-tax spatial equilibria. This sub-section is meant to show that through its production of public goods the locational effects of government polices become more subtle.

From section 4.1 we know that a region with more public goods (higher $\kappa$) which are more productive in lowering the costs of manufacturing production (higher $\eta$) and has a more efficient production of $Z$ itself (non-decreasing returns to scale captured by $\mu$) will attract the mobile factor of production, capital. Agglomeration thus results if the other region lags behind in these respects. Complications arise when the differences between the government sectors of the two regions do not differ in such a systematic manner. We show this for two examples both of which are characterized by region 1 having a larger government sector ($\kappa_1 > \kappa_2$) but by allowing for the possibility that in region 1 the $Z$-production may have a smaller impact on the cost of production or it may be characterized by less efficient government production.
Figure 4 depicts the case where the public goods sector in region 1 is larger but each Z in region 1 has less impact on the cost of manufacturing production (we maintain that $\mu_1=1$). For $\eta_1=0.2$, $\eta_2=0.5$, $\kappa_1=0.4$ and $\kappa_2=0.2$ we see that this leads to strong agglomeration. By subsequently only reducing $\eta_1$ to zero we get a different outcome, since there are now three dispersed equilibria, the middle-one being stable. So now, despite the fact region 1 still deploys a larger share of its human capital in the Z-sector, Z-production in region no longer (with $\eta_1=0$) contributes to lower costs of manufacturing production and this improves the prospects for the initial periphery (region 2), as Figure 4 shows.

![Figure 4 Asymmetric Government effectiveness, $\eta_1 < \eta_2$](image)

Finally, in Figure 5 we basically perform the same experiment but now by changing $\mu$ instead of $\eta$. For $\eta_1=\eta_2=0.3$, $\kappa_1=0.3$ and $\kappa_2=0.25$ we change the scale parameter in the government production function from $\mu_1=\mu_2=0.9$ to $\mu_1=\mu_2=0.2$. It is again clear that these kind of changes can have far-reaching implications. This decrease of $\mu$ not only changes the position of the dispersed equilibrium but also its stability: the dispersed equilibrium becomes unstable. The dispersed equilibria are not symmetric because $\kappa_1>\kappa_2$. For a high value of $\mu$ this means that small changes in $K$ around the
dispersed equilibrium have opposite effects on the relative indirect utilities then for a small value of $\mu$. This is caused by the differences in the marginal productivity of capital in the public sector.

Differentiating $\mu$ between regions (for instance because one region succeeds in producing $Z$ more efficiently) also reveals that the positioning of (stable) dispersed equilibria can change significantly (not shown here). In particular, when comparing equilibria the initially smaller region attracts more capital if it succeeds in increasing the efficiency of its production of public goods.

**Figure 5 Inefficient Governments, changing $\mu$**

The main conclusion that arises from the two examples underlying Figures 4 and 5 is that in our model the balance between spreading and agglomeration depends strongly on the functioning of the government sector and on the differences between the two regions in this respect. The implicit but important implication is that governments may determine the fate of their country with respect to its attractiveness to mobile production factors. Of course, these are just two simulation examples. One of the advantages of the Forslid model is that it is solvable and that is why we finally turn to the question if more general conclusions can be reached for the stability of equilibria when important parameters like $\kappa$ or $\phi$ are changed.
5. Analytical results

A main reason to use and extend the model developed by Forslid (1999) is that the manufacturing sector uses both, a mobile and an immobile production factor. The issue of locational competition is best illustrated in such a model. However the model also allows us to derive some analytical results, and the outcomes of the simulations presented in section 4 can also be illustrated by analyzing the model formally.

First it is instructive to look more closely at the symmetric equilibrium. From equation (A2) in the appendix that is to say from equilibrium condition for \( r_1/r_2 \) which is given at the end of section 3, and by now using that for the symmetric equilibrium \( \lambda = 1-\lambda = 0.5, \ f_1 = f_2 = f, \ h_1 = h_2 = h \) and \( n_1 = n_2 = n, \ \kappa_1 = \kappa_2 = \kappa \), the rental rate, \( r_1 = r_2 \) reduces in the symmetric equilibrium to

\[
\frac{(1+\phi)h}{2\sigma f - (1+\phi)h},
\]

where

\[
h = \frac{\delta}{(1+\phi)n}
\]

Since \( n = \frac{(1-\kappa)}{2\alpha} = \frac{(1-\kappa)}{2f(g(\kappa/2))} \) we have:

\[
\left. r_1 \right|_{\lambda = 0.5} = \left. r_2 \right|_{\lambda = 0.5} \equiv r = \frac{\delta}{\sigma (1-\kappa) - \delta}
\]

such that: \( Y_1 = Y_2 \equiv Y = \frac{r}{2} + \frac{1}{2} = \frac{\sigma (1-\kappa)}{2[\sigma (1-\kappa) - \delta]} \) and \( t_1 = t_2 \equiv t = \frac{\kappa r}{2Y} = \frac{\kappa \delta}{(1-\kappa)\sigma} \)

These results allow us to calculate the impact of changes of policy parameters on the endogenous variables of the model. The results are summarized in Table 4.
Table 4 Analysis of Symmetric Equilibrium

<table>
<thead>
<tr>
<th>Endogenous variable in</th>
<th>Impact of rise in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetric equilibrium</td>
<td>( \sigma )  ( \delta )  ( \kappa )  ( \phi )  ( \mu )  ( \eta )</td>
</tr>
<tr>
<td>( R = \frac{\delta}{\sigma(1-\kappa) - \delta} )</td>
<td>-  +  +  0  0  0</td>
</tr>
<tr>
<td>( Y = \frac{\sigma(1-\kappa)}{2[\sigma(1-\kappa) - \delta]} )</td>
<td>-  +  +  0  0  0</td>
</tr>
<tr>
<td>( p = f(Z) = e^{-\eta Z} )</td>
<td>0  0  -  0  -  -</td>
</tr>
<tr>
<td>( n = \frac{(1-\kappa)}{2 f(g(\kappa/2))} )</td>
<td>0  0  ?  0  +  +</td>
</tr>
<tr>
<td>( Z = g(\kappa/2) = (\kappa/2)^\mu )</td>
<td>0  0  +  0  +  0</td>
</tr>
<tr>
<td>( t = \frac{\kappa \delta}{(1-\kappa)\sigma} )</td>
<td>-  +  +  0  0  0</td>
</tr>
</tbody>
</table>

It is helpful, although somewhat arbitrary, to divide the parameters into two groups. Those parameters that can be found in all economic geography models, the elasticity of substitution, \( \sigma \), the share of manufacturing production in total income, \( \delta \), and the freeness of trade, \( \phi \). And those that are central in our model, the amount of capital devoted to the production of public goods, \( \kappa \), the efficiency of the government sector, \( \mu \), and the effect of government spending on production costs, \( \eta \).

With respect to the first group the effects are standard. More or less costly trade has no effect on the nominal variables of the model, it does not lead to a redistribution of production factors in the economy or between countries (it does make international trade more or less expensive and effects real income). An increase in the elasticity of substitution increases competition between varieties and thus reduces the rental rate of capital and thus reduces income. If the weight of manufactures is increased this by itself raises the (relative) rental rate and thus also income.

More interesting are the effects of changes in the parameters that distinguish our model from standard economic geography models. Increasing the amount of resources devoted to the government sector (a higher \( \kappa \)) has a positive effect on \( Z \), and this
increases the efficiency of the economy, and thus raises the rental rate of capital and income. However, because the government has to pay competitive returns on capital rate and the production of Z has increased, the tax rate has to be increased too. So enlarging the government sector is a mixed blessing. Increasing the efficiency of the economy through an increase of η, is beneficial for the economy but shows up in a rather peculiar way, by an increase in the number of varieties, which by itself reduces the price index and increases welfare (not shown here). Increasing the efficiency of the government sector also has a positive effect on the number of varieties, because less production factors are wasted in the production of Z.

The conclusion is that the introduction of the government sector has ambiguous effects, but the origin and direction of all effects can be traced back to the respective causes and, stronger still, Table 4 shows that our government sector has an impact on the endogenous variables. Table 4 it gives an intuitive and qualitative understanding of some of the results of the graphs in section 4 (but note that symmetry does not hold in all of our simulation examples). In figure 4, for instance, a higher η indeed increases welfare for the country with the largest government sector (largest κ), and in figure 5 reducing the inefficiency of the government sector increases welfare the most in the country with the largest government sector (largest κ). Table 4 indicates that government spending matters for the equilibria. The next logical step is to find out how the stability of the symmetric equilibria change with respect to changes in the policy parameters mentioned in Table 4. This break analysis will be included in the next version of the paper.
6. Summary and Conclusions
Recent advances in the theory of trade and location have shown that increasing economic integration does not lead to a race to the bottom with respect to taxation. This important result challenges the standard views about tax competition but the treatment of the government sector is still rather rudimentary. The emphasis is almost exclusively on taxes and its distributional consequences. This is rather one-sided because taxes are a means to an end and public spending can also be used as an instrument of locational competition. Countries try to increase their attractiveness as a location by investing in location-specific infrastructure. When the effects of agglomeration are thought to be important tax and spending policies represent two opposing forces. All other things remaining the same, higher taxes stimulate spreading even though the existence of an agglomeration rent may prevent the spreading from actually taking place. Similarly, an increase in public spending stimulates agglomeration if this spending enhances the attractiveness of the location for the mobile factors of production. But all things do not remain the same in the sense that higher taxes typically also imply higher public spending and vice versa. Also, the extent to which a larger government sector (meaning higher public spending and taxes) really leads to a better quality of the country's infrastructure is an issue that has troubled policy-makers for a long time.

In the present paper we extend the recent work by Baldwin and Krugman (2000) and Andersson and Forslid (1999) in two ways. First, we allow for public spending to affect the cost of production and this has an impact on the location decisions of firms and workers. Second, we also take into account that the production of public goods takes up resources which cannot be used in the production of the manufacturing (private) sector and that countries may differ in the efficiency of the provision of public goods.

The main contribution of this paper is that it takes as its starting point the interdependency between taxes and spending. By changing the relative size, direction or efficiency of its production of public goods governments can change the equilibrium between agglomerating and spreading forces. Ultimately this means that by restricting locational competition to tax competition, one neglects that through their provision of public goods governments also determine (positively or negatively)
the attractiveness of its country as a location for footloose economic activity. This is true for both core and peripheral countries. This last conclusion is important for it indicates that, depending on its relative position with respect to the production of public goods, a periphery can (also) become a core (and vice versa)! For core countries it may not be enough, in contrast with Baldwin and Krugman (2000), to limit their tax differential with peripheral countries in order to prevent their mobile factors of production from leaving the country, they must also take the manner in which tax revenues are spent into account.
Appendix, Solving the Model for $r_1$ and $r_2$

(13') can be written as

\[ r_1 = a_1 r_1 + a_{12} r_2 + d_1 \]
\[ r_2 = a_2 r_2 + a_{22} r_2 + d_2 \]

The solution of which is

\[
\begin{bmatrix}
  r_1 \\
  r_2
\end{bmatrix} = \frac{1}{(1-a_{11})(1-a_{22}) - a_{12}a_{21}} \begin{bmatrix}
(1-a_{22})d_1 + a_{12}d_2 \\
 a_{22}d_1 + (1-a_{11})d_2
\end{bmatrix}
\]

where

\[
a_{11} = \left( \frac{1}{f_j} \right) h_j K_1 \quad a_{12} = \left( \frac{1}{f_j} \right) \phi h_2 K_2
\]
\[
a_{21} = \left( \frac{1}{f_j} \right) \phi h_1 K_1 \quad a_{22} = \left( \frac{1}{f_j} \right) h_2 K_2
\]
\[
d_1 = \left( \frac{1}{f_j} \right) (h_1 L_1 + \phi h_2 L_2) \quad d_2 = \left( \frac{1}{f_j} \right) (\phi h_1 L_1 + h_2 L_2)
\]

with

\[
h_j = \frac{f_j^{1-\sigma} \delta}{n_j f_j^{1-\sigma} + \lambda f_j^{1-\sigma}}
\]

For $K = 1$ and $K_1 = \lambda$; $L_1 = L_2 = 1/2$, we have

\[
a_{11} = \left( \frac{1}{f_j} \right) h_1 \lambda \quad a_{12} = \left( \frac{1}{f_j} \right) \phi h_2 (1-\lambda) \quad a_{21} = \left( \frac{1}{f_j} \right) \phi h_1 \lambda
\]
\[
a_{22} = \left( \frac{1}{f_j} \right) h_2 (1-\lambda) \quad d_1 = \left( \frac{1}{2f_j} \right) (h_1 + \phi h_2) \quad d_2 = \left( \frac{1}{2f_j} \right) (\phi h_1 + h_2)
\]

The derivation of $r_1$ is now straightforward

\[
r_1 = \frac{1 - h_2 (1-\lambda)}{2\sigma f_j} \left( h_1 + \phi h_2 \right) + \frac{\phi h_2 (1-\lambda)(h_2 + \phi h_1)}{2\sigma^2 f_j f_2}
\]
\[
\left( \frac{1 - h_1 \lambda}{\sigma f_1} \right) \left( \frac{1 - h_2 (1-\lambda)}{\sigma f_2} \right) + \frac{\phi h_2 h_1 \lambda (1-\lambda)}{\sigma^2 f_j f_2}
\]

and similarly for $r_2$. 
using the definitions of $h_1$ and $h_2$ gives

$\frac{1}{h_j} \equiv \frac{n_j f_j^\beta - \phi n_k f_k^\beta}{f_j^\beta \delta} = n_j + \phi n_k (f_k / f_j)^\beta$  

(A1) \[ \frac{r_1}{r_2} = \frac{f_2 \sigma \left\{ \phi n_1 \left[ 1 + \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] + n_2 \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] \right\} + (\phi^2 - 1)(1 - \lambda) \delta}{f_1 \sigma \left\{ \phi n_2 \left[ 1 + \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] + n_1 \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] \right\} + (\phi^2 - 1) \lambda \delta} \]

now using: $K_1^p = \kappa_1 \lambda; \quad K_2^p = \kappa_2 (1 - \lambda), \; \text{so}$

$n_1 = \frac{(1 - \kappa_1) \lambda}{f_1}; \quad n_2 = \frac{(1 - \kappa_2)(1 - \lambda)}{f_2}$

we get:

(A2) \[ \frac{r_1}{r_2} = \frac{f_2 \sigma \left\{ \phi \left( \frac{1 - \kappa_1}{f_1} \right) \left[ 1 + \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] + \left( \frac{1 - \kappa_2}{f_2} \right)(1 - \lambda) \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] \right\} + (\phi^2 - 1)(1 - \lambda) \delta}{f_1 \sigma \left\{ \phi \left( \frac{1 - \kappa_2}{f_2} \right)(1 - \lambda) \left[ 1 + \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] + \left( \frac{1 - \kappa_1}{f_1} \right) \lambda \left[ 1 + \phi^2 \left( \frac{f_1}{f_2} \right)^\beta - 1 \right] \right\} + (\phi^2 - 1) \lambda \delta} \]
References

Andersson, F. and R. Forslid, (1999), Tax Competition and Economic Geography, 


Taxation in Europe, Trends and Trade-Offs, Sdu Uitgevers, The Hague

Dutch Ministry of Economic Affairs, (1999), Nota Ruimtelijk Economisch Beleid 
(Report on Location Policy), The Hague.

Forslid, R., (1999), Agglomeration with Human and Physical Capital: An Analytically 

Neary, J.P., (2001), Of Hype and Hyperbolas: Introducing the New Economic 

Sinn, H-W., (1990), Tax Harmonization and Tax Competition in Europe, European 

Cambridge Mass.

UNCTAD, 1996, Incentives and Foreign Direct Investment, United Nations, New 
York.