Tax policies and their impact on the spatial distribution of economic activities and welfare

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Abstract

The paper discusses the effects of different tax systems to the spatial location of economic activities and welfare in the context of the footloose capital model known from the new economic geography literature. The tax revenues are assumed to be used for subsidising the profits in the smaller region. We show that the spatial distribution of firms depends on the level of subsidies, but does not depend directly on the level of taxes in case of uniform income or value added tax, or even if the incomes of different production factors – labour and capital – are taxed at different rates. Nevertheless, if there are differences in the tax rates across regions or the unit taxes at the goods are introduced, the location decision of the firms depends also on the difference in the tax rates in the two regions or the common unit tax rate. Also, there are indirect effects through the impact on the income shares of the regions. As for the welfare effects the results tend to be ambiguous.

JEL-Classification Numbers: R12, R13, R50.

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1. Introduction

Regional science has been a marginal field in economics. Only since the beginning of 1990s—since the papers of Paul Krugman (1991a, 1991b)—the interest in the theory of location of economic activities has risen. The lack of interest was largely caused by the impossibility to deal with the locational issues analytically, as circular causality—firms move to agglomerations as this enables more efficient production; as the number of firms in the agglomeration increases, additional motivation for the rest of the firms to move there is created—causes lots of complications. In explaining why cities emerge and economic activity tends to agglomerate, the existence of increasing returns has an important role. Until the model of imperfectly competitive economy by Dixit and Stiglitz (1977), it was not possible to include this aspect into mathematical economic models explicitly.

New economic geography (NEG) follows the lines of the new trade theories and new growth theories in assuming imperfect competition, increasing returns and applying usually the structure of economy proposed by Dixit and Stiglitz (1977). The modelling framework is general equilibrium, based on the optimization decisions of individual agents. The most important outcome of the NEG models is that even

regions that are initially identical in their factor endowments may end up having very different production structures.

The first NEG models were not analytically solvable (e.g. Krugman (1991a,b); also the models presented in the book by Fujita et al. (1999) who show the possibilities of using the NEG approach for discussing various issues in regional, international and urban economics), they relied in their conclusions and results instead on numerical examples. It was not possible to show explicitly how the regional distribution of economic activity depends on e.g. trade costs or the endowments of production factors and therefore it was also not possible to carry out an explicit policy analysis. In the second half of the 1990s also analytically solvable models like the so-called footloose capital model, footloose entrepreneur model and linear models were developed (for a detailed presentation of these models see e.g. Baldwin et al. (2003)). Based on these models, policy implications have been analyzed. Neary (2001) has suggested that the NEG can be most useful exactly for analyzing policy implications. Nevertheless, so far the analysis in this respect has been relatively moderate.

The purpose of the paper is to show how different taxing schemes might influence the location of economic activity and welfare. We do it in the context of the footloose capital model (Martin and Rogers 1995). We compare the effects of income and consumption taxes, with possibly asymmetric tax rates in the two regions or at different income sources.

First we give a short overview of the ideas behind the NEG models. After that the principles of policy analysis will be introduced. Then we present the effects on the distribution of economic activity and income inequality of introducing different tax schemes and a proportional profit subsidy into the footloose capital model. The final section concludes.

2. Basic models of the new economic geography

NEG models are not the only possible way to discuss the regional development and policy issues; nevertheless, they are the only models aiming directly to address regional economic issues relying explicitly on microfoundations. Nevertheless, during the last 15 years the NEG type models have become the basis for the analysis of the location of economic activity and the impact on regional development goals (see e.g. Baldwin et al. 2003).

The NEG literature started with Krugman's (1991b) paper. The NEG models use similar modelling techniques as the new growth theory or new trade theory, relying on the Dixit and Stiglitz (1977) type imperfectly competitive economy with increasing returns to scale in production. In the heart of the NEG models stands the interaction between centrifugal and centripetal forces, which creates the circular agglomeration process.

In the NEG models it is usually assumed that there are two sectors in the economy, one of which has increasing returns to scale due to some fixed input requirement (so-called manufacturing or modern sector) and the other with constant returns to scale (producing agricultural or traditional goods). There are also two production factors, these could be different types of labour, one of which is mobile

between the regions and needed in the modern sector and the other is immobile and can be employed only in the traditional sector (e.g. in Krugman 1991b); labour and capital as in Martin and Rogers (1995) (so-called footloose capital model), in which case labour is mobile between the sectors, but not between regions, the inter-regionally mobile factor is physical capital, but it moves without its owner; or labour and human capital (Forslid and Ottaviano 2003, so-called footloose entrepreneur model) with human capital being the factor mobile between the regions and labour having to stay in the region of origin, but being able to move from one sector to the other.

Most of the NEG models rely on the Dixit and Stiglitz (1977) model of monopolistically competitive economy, assume iceberg type trade costs and CES-type utility functions (e.g. Krugman 1991b, Martin and Rogers 1995, Venables 1996, Krugman and Venables 1995, Puga 1999, Forslid and Ottaviano 2003) and this is one reason why NEG models have been strongly criticized—they seem to rely on very specific assumptions. Nevertheless, Ottaviano et al. (2002) have shown that using quasi-linear quadratic utility functions and assuming that transport of a manufactured good needs to be covered with the good of the CRS sector gives qualitatively same results.

The main message of the NEG models is that regions which are originally identical might develop to have a completely different industrial structure. The main factor of interest is the share of modern firms in each region. Most of the models come to the result that for very high trade costs the symmetric outcome is the only stable equilibrium, but if the trade costs decrease, agglomeration in one of the regions will be the outcome of the market forces. Which region gets the so-called industrial core depends on "accidents" or expectations. The outcomes of the NEG models are discussed in the context of increasing integration of the regions (or decreasing trade costs between the regions).

Baldwin et al. (2003, pp. 34-36) distinguish seven key features of the core-periphery model.

• Home market effect and home market magnification: in answer to an exogenous change in the location of demand, the industry relocates more than proportionally to the enlarged region. The home market magnification means that the home market effect is the stronger the freer is trade between the regions.

• Circular causality: agglomeration forces are self-reinforcing—relocation of some industry motivates also other firms to relocate to the same region.

• Endogenous asymmetry: if the trade costs decrease progressively, the initially even distribution of economic activity (symmetric regions) will change to asymmetric distribution.

• Catastrophic agglomeration: there is a critical level of trade costs at which a very small reduction of them leads the symmetric regions to reorganize into core-periphery pattern, if a shock disturbs the symmetric equilibrium. At high trade costs such a small decrease would have no impact on the spatial distribution of industry.

• Locational hysteresis: for the intermediate trade costs where both the symmetric and agglomerated equilibriums are sustainable, if a shock induces a change in the spatial pattern of economic activity, the economy does not return to its initial

equilibrium if the shock is removed—a temporary shock has permanent consequences.

• Hump-shaped agglomeration rents: if the economy is organized as a core and a periphery, the mobile factor is usually not indifferent to location, as it would lose income by moving from the core to the periphery. These agglomeration rents first rise and then fall in answer to the proceeding reduction of trade costs, in the range of the trade costs where the full agglomeration outcome is sustainable.

• The overlap and self-fulfilling expectations: there exists a range of trade costs where both the symmetric and core-periphery outcomes are locally stable long run equilibria. If there is a change in expectations about which equilibrium will be the outcome in the future, a jump between the symmetric outcome and a full agglomeration outcome is possible.

Not all of these features are valid for the footloose capital model applied for policy analysis in the current paper, especially in case of perfectly symmetric regions—in that case the model never comes to the core-periphery equilibrium, if the market forces are let to act on their own. Nevertheless, at any case it displays the home market effect and home-market magnification, and hump-shaped agglomeration rents.

3. Policy in the models of new economic geography

Ottaviano (2003), when discussing the key policy implications of the NEG models, mentions that policies not directly aimed to influence regional economic activity patterns might nevertheless have an effect on these. There have been several trials to introduce policy measures and analyze their effects in the NEG models (see e.g. Baldwin et al. 2003), with attention on different issues like for example tax competition, political economy, infrastructure policies or regional subsidies.

The current paper is most tightly in the lines of Dupont and Martin (2006). They discuss the location and welfare effects of capital and employment subsidies, financed by a local or a global income tax. In the current paper we analyze analogously the subsidy to profits, but assume another kinds of tax systems. First the case of different tax rates on labour and capital incomes are discussed, then we introduce regionally different value added taxes, which an also be interpreted as regionally different income taxes—offering as such a generalisation for the local and global financing of the subsidy—-and after that we discuss the effect of unit taxes. The analysis is based on the footloose capital model.

3.1. The footloose capital model

The footloose capital model uses the following assumptions.[1]

The economy consists of two regions, region *A* and region *B*. There are two sectors in the economy, the traditional sector (indexed by *T*) producing a homogeneous good and the modern (or manufacturing) sector (index *M*), producing

[1] We follow here the notation of Dupont & Martin (2006).

n^w varieties. There are also two production factors, labour and capital. Labour is immobile between regions, whereas capital can flow freely between them. It is assumed that the capital moves without its owners, therefore the capital income is repatriated.

The consumers consume both modern and traditional goods and their utility is given by

$$U = C_M^{\mu} C_T^{1-\mu}, \quad C_M = \left(\int_{i=1}^{n^w} c_i^{1-1/\sigma} \, \mathrm{d}i \right)^{1/(1-1/\sigma)}, \quad 0 < \mu < 1 < \sigma, \tag{1}$$

where C_T is the consumption of the traditional goods and C_M is the CES index of the modern varieties, with c_i being the demand for the variety i and σ the elasticity of substitution. μ is the share of expenditures spent on the modern goods.

The homogeneous good is produced with a constant returns to scale technology, using labour as the only input. Its units are chosen such that the amount of output is equal to the labour input. As the result of this assumption, the wages are equal to the price of the traditional good, which is chosen to be the numeraire: $p_T = w_T = 1$. The homogeneous good is traded without costs across the regions and therefore also the prices of the homogeneous good and the wages have to be equal in the two regions.[2]

Production in the modern sector incurs increasing returns to scale: there is some fixed cost in producing each variety. This has to be covered with capital input, which requires return p. The units of capital are chosen such that the capital input needed for producing a variety is equal to unity. This implies that the total number of varieties is equal to the world stock of capital: $n^w = K^w$. The variable cost is associated with labour input: a_M units of labour are needed per a unit of output. As the labour can move freely between the sectors, the wages in both sectors equalize. Using these assumptions, the total cost function of a manufacturing firm is

$$TC = p + a_M x, \tag{2}$$

where x is the output of a typical modern firm.

Due to the scale effects each variety is produced exactly by one firm and it is assumed that each firm produces only one variety. The trade of modern goods from one region to the other is costly. It is assumed that the trade costs are so-called iceberg-type: in order to supply x units of the modern good in the other region, tx units have to be shipped, with $t > 1$.

In the equilibrium the region A's aggregate demand for the homogeneous good is $C_T = (1 - \mu)E$, where E is the disposable income in region A. The region A's demand for each manufacturing variety is given by

$$c_j = \frac{p_j^{-\sigma} \mu E}{\int_{i=0}^{n^w} p_i^{1-\sigma} \, \mathrm{d}i}, \quad E = pK + L. \tag{3}$$

Here there is no taxation assumed. If income taxes are added into the model, the equation for expenditure changes and the expenditure entering other equations is

[2] We also have to assume that none of the regions is large enough to satisfy alone the aggregate demand for the traditional good.

disposable income. In case of a value added tax, the prices should be interpreted as after-tax prices (consumer prices).

Under Dixit-Stiglitz monopolistic competition and the assumed utility function the firms set the prices of modern goods at a constant mark-up over the marginal cost: $p = a_M / (1\text{-}1/s)$. The units of the modern good are chosen such that $a_M = s / (s - 1)$. The foreign prices have to cover also transportation costs, therefore $p^* = t\,p$. Moreover, the Dixit-Stiglitz monopolistic competition implies that the operating profit of a manufacturing firm is the value of sales divided by the elasticity of substitution: $p = p\,x / s$. Using the demand function and the monopolistic prices, the equilibrium profits can be written as

$$\begin{aligned} p &= b\frac{E^w}{K^w}\left[\frac{s_E}{s_n + f(1-s_n)} + \frac{f(1-s_E)}{f\,s_n + 1 - s_n}\right], \\ p^* &= b\frac{E^w}{K^w}\left[\frac{f\,s_E}{s_n + f(1-s_n)} + \frac{1-s_E}{f\,s_n + 1 - s_n}\right], \quad b \equiv \frac{m}{s} < 1;\ f \equiv t^{1-s}, \end{aligned} \tag{4}$$

where s_n is the region A's share of industry and s_E the region A's share of expenditure. E^w and K^w are the national expenditure and national capital, respectively.[3] For the general equilibrium the following conditions have to be fulfilled in case of the footloose capital model without policy:

$$s_E = (1-b)s_L + b\,s_K, \tag{5}$$

$$p = p^* = b\frac{E^w}{K^w}, \tag{6}$$

$$s_n = \frac{1}{2} + \left(\frac{1+f}{1-f}\right)\left(s_E - \frac{1}{2}\right). \tag{7}$$

It is assumed that the location of firms is given in the short run, thus, the equation for the equality of profits in both regions (equation 6) and the equation for the share of firms in region A (equation 7), both determined form the condition for the equality of profits in the two regions, have to be fulfilled only in the long run. The equation for the region A's share of expenditures (5)—derived from the definition of the share of expenditure—has to be valid always, both in the short and the long run.

The firms (capital) move from one region to the other whenever the nominal profits in the other region are higher than in the initial region. The price level does not matter as the capital income is repatriated.

3.2. Introducing policy into the footloose capital model

In order to introduce policy into the footloose capital model, some equilibrium conditions have to be added. Policy measures mean redistribution of money—money is collected from some economic agents and given to some others. This introduces distortions into the economy. We assume first that the government budget must be

[3] Usually in the NEG literature the subscript *w* refers to the world, but in the current context we interpret the world as consisting of one country.

balanced: the whole tax revenue is paid out as subsidies. Second, it has to be guaranteed that factor markets stay in equilibrium after introducing policy. This is no problem for the case of capital as the assumption that the number of firms depends on the amount of available capital is set already in the basic model. For the labour market the equilibrium condition is given by equation (8):

$$L^w = E^w(1-b), \quad \text{with} \quad E^w = L^w + p\,K^w, \tag{8}$$

where the condition that the profits (including subsidies) have to be equal in the two regions has been employed. If income taxes are introduced, the national expenditure has to be replaced by the country's disposable income.

4 Policy analysis

4.1 Subsidizing profits with revenues with different tax on labour and capital income

If the profits in region *B* are subsidized—also like in Dupont and Martin (2006), who assume uniform income taxation—it has to be that $p = (1 + z^*)\,p^*$. Using this condition, the profit equations (4), and taking the region *A*'s expenditure share as given, it is possible to solve for the share of firms operating in the region *A*:

$$s_n = \frac{s_E(1-f^2) - f(1+z^* - f)}{(1-f)\left[1+z^* - f - z^* s_E(1+f)\right]}. \tag{9}$$

This is same as in Dupont and Martin (2006) for a given distribution of expenditures (s_E).

On the taxation side, we assume that the labour and capital incomes are possibly taxed at different rates, $1 - t_L = ?\,(1 - t_K)$, where t_L and t_K are the labour and capital income tax rates, respectively, and *?* is the factor determining their relation. Labour is taxed with a lower tax rate than capital if $? > 1$. From this follows that the economy-wide disposable income is

$$E_d^w = (1-t_K)(r\,L^w + p\,K^w). \tag{10}$$

This means that the government's budget constraint is

$$t_K(r\,L^w + p\,K^w) + L^w(1-r) = \frac{z^*}{1+z^*}(1-s_n)p\,K^w. \tag{11}$$

The expenditure share of region A is now

$$s_E = \frac{r\,s_L L^w + p\,s_K K^w}{r\,L^w + p\,K^w}, \tag{12}$$

where s_L and s_K are the region *A*'s share of labour and capital owners, respectively. The labour market equilibrium condition is

$$L^w = (1-t_K)(r\,L^w + p\,K^w)(1-b). \tag{13}$$

This equation says that if the income is taxed, then the pre-tax profits have to rise in order to maintain the labour market equilibrium.

The equilibrium profit stays as in Dupont and Martin (2006):

$$p = (1+z^*)p^* = b\frac{E_d^w}{K^w}\frac{\left[1+z^*-f-z^* s_E (1+f)\right](1+z^*)(1-f)}{\left[1-f(1+z^*)\right](1+z^*-f)}, \qquad (14)$$

given the country's after-tax expenditure E_d^w and region *A*'s expenditure share s_E.

We assume that the rate of subsidy z^* is predetermined, as well as the relation between labour and capital income tax (*?*). Thus, we can to solve for the tax rate on capital income from the resource constraint (equation (13)), given the after-subsidy profits:

$$t_K = 1 - \frac{L^w}{(1-b)(r\,L^w + p\,K^w)}. \qquad (15)$$

From the government budget constraint, equation (11), the equilibrium level of after-subsidy profits is found, using also the result for the capital income tax rate from equation (15):

$$p = \frac{b}{1-b}\frac{L^w}{K^w}\frac{(1+z^*)}{(1+s_n z^*)}. \qquad (16)$$

The equilibrium capital income tax rate is therefore

$$t_K = 1 - \frac{(1+s_n z^*)}{b(1+z^*) + (1-b)(1+s_n z^*)\,r}. \qquad (17)$$

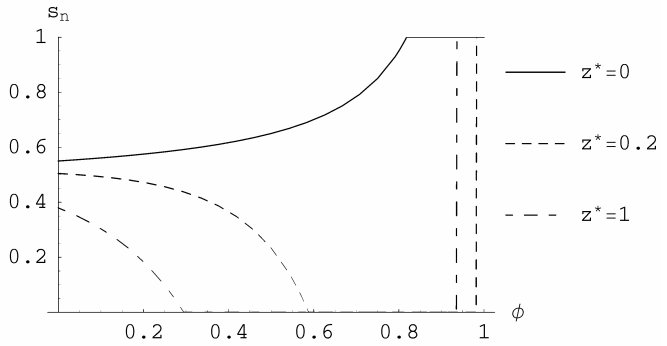
Using the equations (16) and (17), and substituting these into the definition of the region *A*'s share of expenditure, equation (12), we get its expenditure share under such a tax system as

$$s_E - \frac{1}{2} = s_L - \frac{1}{2} + \frac{b(1+z^*)(s_K - s_L)}{b(1+z^*) + (1-b)(1+s_n z^*)\,r}. \qquad (18)$$

Combining this equation with equation (9) gives the equilibrium geography (the shares of the number of modern firms) of the economy and the expenditure shares of the regions. The effects of subsidies are shown at Figure 1. The share of firms in region *A* does not depend on the taxes, given the share of expenditures. Using the profit subsidies can be effective in relocating the increasing returns to scale industry from the larger region to the smaller one and the effect gets stronger if trade costs decrease.

The results are in principle the same as in Dupont and Martin (2006): the subsidies enable the government to influence the location of the modern firms. Differences are in the welfare effects of the different groups of economic agents. If the capital owners are taxed more heavily than the workers, the tax burden is carried more by the capital owners, so that even capital owners living in the subsidized region might not gain in the terms of utility, but the workers living in the same region might win. The workers living in the larger, not subsidized region still certainly face a loss in welfare.

Figure 1. The share of firms in the larger region (s_n) in case of proportional profit subsidies (z^*) in the smaller region and different taxes on capital and labour income



The figure is based on equation (9). Assumption: the larger region's share of expenditures $s_E = 0.55$.

4.2 Subsidizing profits with revenues from regionally varying value added taxes

In order to analyse the welfare effects of regionally asymmetric taxation, we assume that the value added tax can be different on goods sold in different regions.[4] We assume no arbitrage: it is not possible to bring the goods from the lower-tax-region and to sell these without paying the higher tax in the other region. The relation between the taxes in the two regions is determined by the equation $1 + t^* = ?(1 + t)$.

The VAT creates distortions in the goods market: the consumer and producer prices are not equal any more. The modern firms continue to set the prices according to the monopolistic pricing rule and in the traditional goods sector the firms still ask for their goods the marginal cost, but the consumers face prices that are higher. This affects the profits that the firms can earn as the consumers reduce their demand for a given income. Thus, the profit equations (4) have to be replaced by

$$p = b\frac{E^w}{K^w(1+t)}\left[\frac{s_E}{s_n + f(1-s_n)} + \frac{f(1-s_E)}{g(f s_n + 1 - s_n)}\right],$$
$$p^* = b\frac{E^w}{K^w(1+t)}\left[\frac{f s_E}{s_n + f(1-s_n)} + \frac{1-s_E}{g(f s_n + 1 - s_n)}\right]. \qquad (19)$$

The share of firms in region A that equalizes the after-subsidy profits (found from the condition that $p = (1 + z^*)\, p^*$) is now

$$s_n = \frac{s_E g - (1+z^*)(1 - s_E(1-g))f + (1-s_E)f^2}{(1-f)(1+z^* - f - s_E(z^* + (1-g)(1-f) + z^* g f))}. \qquad (20)$$

Thus, given the share of expenditures, the share of firms in region A depends also on the ratio of tax rates in the two regions.

The effect of the changes in the ratio of the VAT in the two regions (*?*) is shown at Figure 2. If the taxes are a lot higher in the subsidized region (local

[4] This assumption is in fact identical to assuming regionally differing income tax, analogously to the case of a uniform value added tax on all goods and in both regions: the effects are identical to these of an uniform income tax with $1 - t^{inc} = 1 / (1 + t^{VAT})$.

financing or mainly local financing), the subsidy might not be sufficient to attract firms: the local demand-diminishing effect of taxes can dominate the attractiveness of the subsidies for low trade freeness (of course, this also depends on the size of the subsidy; on the figure the subsidy is chosen that low that the interaction with the higher tax there creates rather a subsidy for the larger region in case of low trade freeness). Thus, local financing of the subsidies might not result only in the decreased welfare of the residents of the smaller (subsidized) region, but might also push some firms to move out of the region. Nevertheless, if the taxes are more similar in the regions or the taxes are even lower in the smaller region or the trade is freer, the subsidies manage to attract the modern firms to the smaller region. Lower taxes in a region work as an income subsidy to the people residing there, increasing the share of expenditures in the lower-taxed region and making it as such a more attractive location for firms.

Figure 2. The share of firms in the larger region (s_n) in case of proportional profit subsidies (z^*) in the smaller region and regionally varying value added tax.

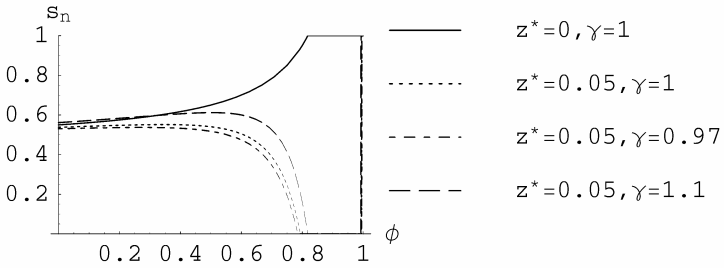


Figure is based on equation (20). Assumption: the larger region's share of expenditures $s_E = 0.55$.

The equations for the total national and regional expenditure stay as in the basic footloose capital model. Thus, the total national expenditure and the expenditure in region *A* are

$$E^w = L^w + p\ K^w \tag{21}$$

and

$$E = s_L L^w + p\ s_K K^w, \tag{22}$$

respectively.

The resource market equilibrium condition is now

$$L^w = (1-b)\frac{E^w}{1+t}\left(s_E + \frac{1-s_E}{g}\right) \tag{23}$$

and the government budget constraint is

$$z^*(1-s_n)p^* K^w = \frac{t}{1+t} s_E E^w + \frac{t^*}{1+t^*}(1-s_E)E^w. \tag{24}$$

The profits and taxes keeping the resource market in the equilibrium are given by equations (25) and (26), respectively:

$$p = \frac{b}{1-b}\frac{L^w}{K^w}\frac{(1+z^*)}{(1+s_n z^*)}, \tag{25}$$

$$t = \frac{(1-s_E)(1-g) + \dfrac{(1-s_n)z^* b(1-s_E(1-g))}{1+s_n z^*}}{g}. \tag{26}$$

Thus, the profits are the same as under the other tax systems, given the subsidy and the regional distribution of industry.

The income inequality or the equilibrium share of expenditures in region *A* is

$$s_E - \frac{1}{2} = s_L - \frac{1}{2} + \frac{b(1+z^*)(s_K - s_L)}{1+(b+(1-b)s_n)z^*}. \tag{27}$$

This is the same expression as in the case of uniform income taxation. Regionally different VAT does not influence the shares of expenditures.[5]

The welfare effects in the case of regionally different taxes depend of course on weather the subsidized region is less or more heavily taxed than the other region. If the taxes are lower in the subsidized region, one can say that the clear winners would be the capital owners living there. Possibly also the workers residing in the subsidized region could win. The clear losers under this system would be the workers living in the higher-tax region. If the taxes in the subsidized region are higher than in the other region, the welfare effects are more complicated.

4.3 Subsidizing profits with revenues from a unit tax

With unit taxes the pricing behaviour of the firms changes. They do not price any more at the monopolistic price, but take also the unit tax into account. The producer prices at home and foreign market are now

$$p = \frac{T + a_M s}{s - 1} \quad \text{and} \tag{28}$$

$$p^* = \frac{T + a_M s t}{s - 1}, \tag{29}$$

respectively, where *T* is the unit tax.

The operating profits can be written now

$$p = b\frac{E^w}{K^w}\left[\frac{s_E}{s_n + \Theta(1-s_n)} + \frac{\Theta(1-s_E)}{\Theta s_n + 1 - s_n}\right], \tag{30}$$

$$p^* = b\frac{E^w}{K^w}\left[\frac{\Theta s_E}{s_n + \Theta(1-s_n)} + \frac{1-s_E}{\Theta s_n + 1 - s_n}\right], \tag{31}$$

where $\Theta = \left(\dfrac{T + a_M t}{T + a_M}\right)^{1-s}$.

[5] If the model were written in terms of regionally different income tax instead of value added tax, it would be otherwise, of course, as at that case we would work with after-tax expenditures and after-tax expenditure shares. Here the taxes are included in the total expenditures.

These expressions remind very closely those of the usual profit equations (equations (4)), with the difference that the expression T replaces f. The same is true for the equilibrium distribution of manufacturing firms with subsidies (as in Dupont and Martin (2006)):

$$s_n = \frac{s_E(1-\Theta^2) - \Theta(1+z^* - \Theta)}{(1-\Theta)\left[1+z^* - \Theta - z^* s_E(1+\Theta)\right]}. \qquad (32)$$

It is interesting to note that contrary to the proportional taxes analysed before, the unit taxes enter explicitly the equation for the regional distribution of firms (through the term T), in the other cases the tax influenced the share of firms in each region only through its impact on the distribution of expenditures. The unit tax has an analogous impact on the firm shares as trade freeness: with the profit subsidies, more firms locate to the smaller region if the unit tax is higher or the trade is freer (see Figure 3). This results from the observation that with higher unit taxes the relative difference of the price indexes in the two regions decreases, which means that the difference in the demand for the goods produced in any region also decreases. Therefore, the larger home market effect diminishes and the subsidies play an important role in making the location decision.

Figure 3. The share of firms in the larger region (s_n) in case of proportional profit subsidies (z^*) in the smaller region and unit tax (T).

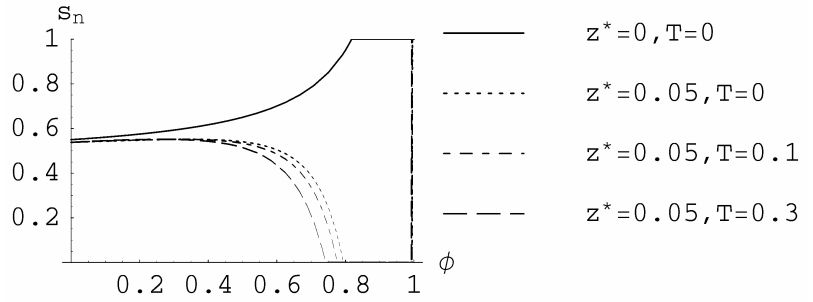


Figure is based on the equation (32). Assumptions: $s_E = 0.55$, $a_M = 1$, $s = 6$.

Even though it is possible to find the expressions for the labour market equilibrium condition and government budget constraint, they are complicated enough for being unrevealing and not enabling to solve for the general equilibrium values of the unit tax rate and profits. For the same reason it is difficult to say anything about the welfare effects.

5 Conclusions

In the paper it was shown that combining taxes and subsidies enables to influence the spatial pattern of economic activity. The footloose capital model known from the literature of new economic geography was used as the basis of the analysis. It was assumed that the government subsidizes the profits of firms locating in the

smaller region, while the money necessary for paying the subsidies is collected as the income tax, which is possibly different for labour and capital income, as the value added tax that is different in the two regions, or as a unit tax.

From the policy measures the subsidies are more important in influencing the location decisions of the modern firms, though through the taxes the income distribution across regions changes. Smaller subsidies are necessary for attracting firms to locate to the smaller region if the trade is freer as then it is not so important to locate close to the larger market - the home market effect decreases if trade costs decrease.

There are four groups of economic agents in the economy: workers residing in the smaller region, workers residing in the larger region, capital owners residing in the smaller region and capital owners residing in the larger region. Each of these groups is affected differently by the implemented policy, with the tax structure having a very important role. The welfare analysis has not presented explicitly in the paper, but some first results of analysis suggest that one should rather rely on the relative utilities of the different groups of economic agents in the economy (relative to the other groups) than on the absolute measures.

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