Regional policy design: An analysis of relocation, efficiency and equity.

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Abstract

Despite substantial regional expenditures at both national and community level, European regional policies do not appear to deliver. The evidence suggests that neither efficiency gains nor reduced regional inequalities are attained. If there is any positive impact at all, then it is at the most a redistributional one. If transfers are mainly redistributional in nature, would policies based on non-distortionary financing be a better route to follow? We ask what are the alternatives to a distortionary regional policy forcing the delocation of activity. Are non-distortionary policies always more efficient than distortionary alternatives? We analyze these questions employing a new economic geography model, where we also take into account the importance of knowledge spillovers for productivity, industry location and policy. It is shown that the effectiveness of different regional policy depends on (i) intra-industry knowledge spillovers, (ii) inter-industry knowledge spillovers, and (iii) trade costs. Our analysis provides insight into what may be the reason for the lack of success of EU regional initiative.

JEL Classification: H2, O15, R12, R13, R3, R5

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1 Introduction

Are increased regional inequalities and increased geographical concentration of economic activity the flip side of the industrial restructuring following economic integration and technological progress? Both theory and empirical evidence may point in this direction (see e.g. Behrens, Gaigné, Ottaviano and Thisse, 2003, Boldrin and Canova, 2001, Braunerhjelm et al, 2002, and Martin, 1998 and 1999). Hence, the focus on regional policy in Europe appears to be justified and valid.

The objective of the European Commission, as set out in Article 130a of the Treaty on European Union, is to "promote harmonious development". It aims to achieve this by "reducing disparities between the levels of development of the various regions". Its approach to economic cohesion has a political justification "that wide disparities are intolerable in a community", but also an economic justification "[imbalances] indicate an under-utilization of human potential and a failure to take advantage of economic opportunities which would benefit the Union as a whole" (see e.g. European Commission, 1996). In other words, the Commission expects regional policy to reduce inequalities while at the same time increasing efficiency and overall social welfare in the Union.

However, while there may be a strong case for intervention, theoretical and empirical studies make one question the success of current and recent regional policy initiatives. EU spends around one third of its budget on regional support. But despite the vast sums they absorb, European regional policies do not appear to deliver: over the last two decades regional inequalities within member states have not narrowed, and by some measures they have even widened (see e.g. Braunerhjelm et al, 2000; and Puga, 2002). At the same time we also observe that manufacturing activity has become more concentrated across regions (see Midelfart-Knarvik and Overman, 2002).

As means of achieving its regional objectives, the EU has formulated policies to attract firms to poor, peripheral regions, for in this way to increase investment, employment and productivity in these areas. Recent empirical work by Midelfart-Knarvik and Overman (2002) suggests that in terms of affecting industrial location, policy has indeed succeeded. Midelfart and Overman find that policy has played a role in mitigating the economic forces at work in determining industrial location in Europe over the last decade. But the direct impacts of regional expenditures appear to be counter to economic determinants, thereby causing the delocation of industrial activity. The outcome is then a pattern of industrial location away from that which economic forces alone would deliver, and this impedes an efficient allocation of resources.

It is alarming that despite the substantial resources that are spent on regional policy, the evidence suggests that neither efficiency gains nor reduced regional inequalities are attained.[1] On the contrary, so far what we observe are distortionary location effects and rising regional inequalities in terms of income and manufacturing distribution. The historical counterfactual "what would have

[1]This fact has triggered increased theoretical work related to regional policy design, see e.g. Dupont and Martin, 2003, and Forslid, 2003 for recent contributions.

happened without an active regional policy" is hard to construct. Could inequalities possibly have risen even more? However, according to Boldrin and Canova (2001), regional expenditure (Structural Funds) does not appear to have enhanced the productivity and capacity of the regions to which it is funneled. This leads us onto the question we want to address in this paper: if regional policies are mainly redistributional, are there policy initiatives that would be more efficient than those that are currently implemented? Hence, if we want to eliminate regional inequalities, how do we do this at the lowest possible cost?

Current initiatives set up to reduce regional inequalities rely on a distortionary financing scheme, as to a large extent they are based on the relocation of activity to the periphery. We ask if regional policy initatives that rely on direct income transfers financed over non-distortionary tax schemes would be more efficient, and if so, under what circumstances. Counter to what one might expect based on insight from traditional public finance theory, it turns out that non-distortionary alternatives are not always more efficient.

We also show that, when setting up a non-distortionary tax scheme to finance income transfers, there is a set of options. Again in contrast to what traditional public finance theory would tell us, a tax scheme that relies on the taxation of mobile factors only may – under certain circumstances – represent one such non-distortionary option.

In order to address this set of issues, we employ a new economic geography model. However, we use a model which relies not only on pecuniary externalities, as most economic geography models do. Our model also takes into account the role played by technological externalities for productivity, industry location and policy. Critics of the new economic geography have noted that technological externalities are in general absent from most models within this literature (see Neary, 2001), although there are exceptions such as Baldwin et al (2001) and Martin and Ottaviano (2001). Here we aim to meet this criticism by introducing one type of technological externalities, namely knowledge spillovers, in our model. Over the last decade a number of studies, among others Audretsch and Feldman (1996), have confirmed that knowledge spillovers are important, and that they are typically very localized. Especially relevant for our analysis of regional policy, is a study of knowledge spillovers within and across European regions by Bottazzi and Peri (2002). They find that knowledge spillovers are typically much stronger within than between regions, and stronger within industries than across industries. When setting up our model we draw on their insight.

We integrate technological externalities in the form of localized knowledge spillovers into a new economic geography framework, and allow for intra- as well as inter-industry knowledge spillovers arising from knowledge intensive activity. Our set-up allows us to explore how pecuniary externalities that characterize the new economic geography models interact with knowledge spillovers in determining the location of industry and optimal regional policy design.

The paper is organized as follows: In section 2 we present a new economic geography model incorporating localized intra- and inter-industry knowledge spillovers. In section 3 we characterize the asymmetric equilibrium supported by the model. This is taken to be the market outcome absent of policy intervention, and implies an uneven geographical distribution of economic activity between a core and the periphery. Section 4 investigates the impact of a set of regional policy initiatives according to their achievements in terms of equity and welfare. Section 5 concludes.

2 A model of industrial location

Our point of departure is an economic geography model which builds on Krugman (1990) and Forslid and Ottaviano (2003). The economy we consider consists of two regions; $i = 1, 2$. There are two types of factors of production: unskilled (L_{Ui}) and skilled labor (L_{Si}). Unskilled labor is immobile between regions, while skilled labor is regionally mobile. Each region has a fixed and equal amount of unskilled labor, $L_1^U = L_2^U = L^U$. Total supply of skilled labor in the economy equals $L_1^S + L_2^S = L_W^S$. Subscripts indicate region of employment. Production takes place in two sectors, A and B: Sector A is perfectly competitive and produces a homogenous good under constant returns to scale, and it only employs unskilled labor. Sector B is monopolistically competitive and produces differentiated goods employing both unskilled and skilled labor, and faces increasing returns to scale in production captured by a linear cost function. Skilled workers only enter into the fixed cost, while unskilled labor only enters the variable cost of production. Hence, fixed costs are typically thought to represent skill intensive activities like R&D, while variable costs represent unskill intensive activities such as assembly.

The economy is characterized by the prevalence of localized intra- as well as inter-industry knowledge spillovers. We do not analyze the micro foundations of the positive externalities, but just note that they are a type of technological externalities. The source of these spillovers is the knowledge intensive activity in sector B, and the spillovers work both within the sector B and between this sector and the sector A. However, as the spillovers are assumed local in nature, they only work within a region and not across regions. This implies that both sector A and sector B productivity in a given region i depend on the level of activity in sector B in this region. Since skilled labor is only employed by sector B, there is a one to one relationship between level of B activity and number of skilled workers in region i, and thus between productivity and stock of skilled labor in a region. In line with empirical evidence we further assume intra- to be stronger than inter-industry spillovers, see e.g. Bottazzi and Peri, 2002.

The combination of inter-regional mobile skilled labor, trade costs and increasing returns to scale gives rise to localized pecuniary externalities and self-reinforcing industrial agglomeration driven by demand and supply linkages (see e.g. Fujita, Krugman and Venables, 1999, for further discussion of the features of economic geography models).

Consumer preferences are given by the utility function

$$U = C_A^{1-\mu} C_B^{\mu}, \qquad 0 < \mu < 1. \tag{1}$$

where C_A and C_B denote consumption of goods from the sectors A and B, respectively, and μ is the expenditure share on B goods. The A-good is chosen as numeraire. It is costlessly traded across regions, and its market price, p_A, is thus equal to unity. Sector A uses only unskilled labor, while its productivity (φ_i) depends on the extent of localized inter-industry knowledge spillovers received from sector B activity. By choice of scale, unit labor requirement in the A-sector in the home country is one, which gives unskilled wages

$$\begin{gathered} w_i^U = \varphi_i = \varphi\left(L_i^S\right), \\ \textit{with} \;\; \varphi_i \geq 1, \quad \varphi(0) = 1, \quad \varphi_i' > 0, \qquad \varphi_i'' < 0. \end{gathered} \tag{2}$$

Demand for good A is assumed large enough to guarantee that sector A is active in both regions irrespectively of the location of other production sectors. In other words, we assume consumer preferences to be so that a single location alone cannot supply the total economy with A goods. This will be true when good A has a large weight in utility (μ small) and product variety is highly valued by consumers (σ is small), and implies that wages for unskilled labor are given across regions.

The consumption of goods from sector B is defined as an aggregate of n differentiated goods, $C_M \equiv \left[\sum_{k=1}^{n} c_k^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$ with $\sigma > 1$, where c_k represents consumption of each good. Each producer operates under increasing returns to scale at the level of the plant, and in line with Dixit and Stiglitz (1977) we assume that there is large group monopolistic competition between firms in the B sector. Thus, both the perceived elasticity of demand and the elasticity of substitution between any pair of differentiated goods are equal to σ.

A representative firm B in region i produces its output x_i using a fixed input of $\rho_i \alpha$ units of skilled labor and a marginal input of $\rho_i \beta$ units of unskilled labor who earns the wage w_i^S. The cost function reflects the presence of localized intra-industry knowledge spillovers (ρ_i), and is given by

$$\begin{gathered} TC_i = \rho_i \left(w_i^S \alpha + w_i^U \beta x_i\right), \\ \text{with} \;\; \rho_i = \rho\left(L_i^S\right), \;\; \rho(0) = 1, \quad \rho'\left(L_i^S\right) < 0, \qquad \rho''\left(L_i^S\right) > 0. \end{gathered} \tag{3}$$

All producers have access to the same technology, so prices do not differ between firms in a given region. Since firms face a constant demand elasticity they set a constant markup $\frac{\sigma}{\sigma-1}$ over marginal costs, the *f.o.b.* price from region $i = h, f$, is given by

$$p_i = \frac{\sigma}{\sigma - 1} \beta \rho_i \varphi_i, \tag{4}$$

B goods are tradeable, but we assume Samuelson iceberg type transport costs, so that only $\frac{1}{\tau}$ of each unit shipped actually reaches its destination. This means that the *c.i.f.* price is τ times higher than the *f.o.b.* price of a locally produced good. Due to free entry there are zero profits in sector B. Using the zero profit condition in combination with the expression for price and the cost function, we have that

$$x_i = \frac{w_i^S \alpha (\sigma - 1)}{\beta \varphi_i} \tag{5}$$

in equilibrium. Choosing units so that $\beta = \frac{\sigma-1}{\sigma}$, we have producer prices $p_i = \rho_i \varphi_i$, and equilibrium quantities $x_i = w_i^S \sigma \alpha \varphi_i^{-1}$. As noted by Forslid and Ottaviano (2003) market structure and technology imply that monopolistic rents arise due to product differentiation and are absorbed by skilled labor's wages. Given the fixed input requirement of skilled labor in sector B, skilled labor market clearing implies that in equilibrium the number of type B firms in region i is determined by

$$n_i = \frac{L_i^S}{\alpha \rho_i}. \tag{6}$$

Taking the dual of C_M we find that the price index for good B is

$$Q_i = \left[n_i p_i^{1-\sigma} + n_j (\tau p_j)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \qquad i \neq j, \tag{7}$$

where n_i and n_j are the number of varieties produced in regions i and j, and total number of varieties in the economy equals $n = n_1 + n_2$. Accordingly, the consumer price index can be expressed as

$$P_i = p_A^{1-\mu} Q_i^{\mu} \qquad i = h, f. \tag{8}$$

Local disposable income in region i (Y_i) consists of unskilled and skilled earnings:

$$Y_i = w_i^S L_i^S + w_i^U L_i^U \tag{9}$$

We use Shepard's lemma to derive local (x_{ii}) and foreign (x_{ij}) demand for a variety of the B good produced in region i:

$$x_{ii} = p_i^{-\sigma} Q_i^{\sigma-1} \mu Y_i, \qquad x_{ij} = p_i^{-\sigma} Q_j^{\sigma-1} \tau^{1-\sigma} \mu Y_j, \qquad i \neq j. \tag{10}$$

Using (10) and the zero profit condition, the product market equilibrium in sector B takes the form

$$w_i^S \sigma \alpha \varphi_i^{-1} \geq p_i^{-\sigma} \left[Q_i^{\sigma-1} \mu Y_i + \tau^{1-\sigma} Q_j^{\sigma-1} \mu Y_j \right], \qquad n_i \geq 0, \qquad i \neq j. \tag{11}$$

Factor market clearing requires that the supply of unskilled labor (L_i^U) in equilibrium is equal to demand for unskilled labor in sector A and sector B so that $L_i^U = L_{Ai}^U + L_{Bi}^U$. Using Shephard's lemma on equation (3) to derive labor demand in sector B, and substituting for quantities and number of firms employing (5) and (6)we can rewrite the labor market clearing condition as

$$L_{Ai}^U = L_i^U - w_i^S (\sigma - 1) L_i^S \varphi_i^{-1}. \tag{12}$$

The spatial equilibrium is determined by (2), (4), (5), (6), (7), (9), and (11), (12) which gives equilibrium values of the endogenous variables p_i, x_i, n_i, Q_i, Y_i, w_i^S, w_i^U, and L_{Ai}^U.

The spatial structure of the economy is determined by the location decision of the skilled workers. Following Krugman (1991) we assume that workers are short sighted and choose location as to maximize their current indirect utility, $\mu^\mu (1-\mu)^{(1-\mu)} w_i^S P_i^{-1}$. Migration between regions 1 and 2 is thus governed by the current indirect utility differential

$$V = \mu^\mu (1-\mu)^{(1-\mu)} \left(\frac{w_1^S}{Q_1^\mu} - \frac{w_2^S}{Q_2^\mu} \right). \tag{13}$$

It follows that all interior equilibria, i.e. equilibria with a positive number of B firms in each region, require that $w_1^S/Q_1^\mu = w_2^S/Q_2^\mu$, while asymmetric equilibria with complete agglomeration of skilled workers and sector B in one region i are equilibria if and only if, $w_i^S/Q_i^\mu > w_j^S/Q_j^\mu$. An asymmetric equilibrium is always stable if it is an equilibrium.

3 The market outcome: A Core-periphery equilibrium

Our analysis focuses on the design of regional policy given a situation where the market outcome would be one characterized by a high degree of concentration of industrial activity in one region. We do this by using as our point of departure an asymmetric – so-called core-periphery – equilibrium where all skill intensive activity, i.e. sector B, is concentrated in one region, say region 1. We shall refer to this region as the core (C) and to region 2 as the periphery (P). Expressed formally, this implies that number of B firms in the two regions are respectively

$$n_C = \frac{L_W^S}{\alpha \rho_C},\ n_P = 0, \tag{14}$$

where the subscript C depicts core region variables and the subscript P periphery variables. It follows that manufacturing production only takes place in the core, that unskilled wages in the periphery are equal to unity ($w_P^U = \varphi_P = 1$), and that equilibrium quantity of each produced variety is

$$x_C = \frac{\mu \sigma \alpha (\varphi_C + 1) L^U}{(\sigma - \mu) \varphi_C L_W^S}. \tag{15}$$

All skilled workers reside in the core and earn wages

$$w_C^S = \frac{\mu(\varphi_C + 1) L^U}{(\sigma - \mu) L_W^S}. \tag{16}$$

We assume that $(\varphi_C + 1)/\varphi_C > (\sigma - \mu) L_W^S/\mu L^U$, i.e. $w_C^S > w_U^S = \varphi_C$, which – in line with empirical evidence – means that skilled workers earn a higher wage than unskilled workers. This holds as longs as inter-industry spillovers are not too high, the expenditure share on B goods is not too low, and the substitutability of varieties produced in sector B is relatively low.

Income in the two regions is respectively

$$Y_C = \frac{\sigma\varphi_C + \mu}{\sigma - \mu} L^U,\ Y_P = L^U, \tag{17}$$

and consumers face price indices

$$Q_C = \left(\frac{L_W^S}{\alpha\rho_C}\right)^{\frac{1}{1-\sigma}} \varphi_C \rho_C, \qquad Q_P = \tau Q_C. \tag{18}$$

For a core-periphery equilibrium to exist and be stable, it follows from the migration rule explained above, that real earnings in the core must exceed real earnings in the periphery. Using (13) and (18) this gives the stability (sustainability) condition

$$\frac{w_C^S}{w_P^S} > \frac{1}{\tau^\mu}. \tag{19}$$

which must hold for the core-periphery pattern to be a stable equilibrium. Substituting for $L_1^S = L_W^S$ and $L_2^S = 0$ we rewrite (19) as

$$\sigma(\varphi_C + 1)\varphi_C^{1-\sigma}\left(\frac{\rho_P}{\rho_C}\right)^{\sigma} \tau^{\mu+1-\sigma} - (\sigma\varphi_C + \mu)\tau^{2(1-\sigma)} - \sigma + \mu > 0. \tag{20}$$

Our analysis rests on the condition that parameter values characterizing the state of technology and the economy are within the range supporting the sustainability of the core-periphery equilibrium depicted by condition (20).

The market outcome entails regional inequalities as unskilled workers in the periphery have real earnings that are clearly below those of unskilled workers in the core. The gap in real earnings will depend on the magnitude of inter-industry spillovers and trade costs, and is given by:

$$\frac{w_C^U/Q_C}{w_P^U/Q_P} = \varphi_C \tau. \tag{21}$$

For an illustration of (21), see Figure 1.

{Figure 1}

4 Regional policies

Our aim is to evaluate a set of regional policy initiatives according to their impact on regional inequalities, the welfare of different groups of labor, as well as on social welfare of the economy as a whole. We seek to answer the following question: given that we want to reduce regional inequalities, how do we do this at the lowest possible cost – i.e. in the most efficient way?

First, we consider the impact of a regional policy that aims at reducing regional inequalities by forcing an allocation of industry different from the one that market forces would deliver. Such a policy provides a simplified – but useful – portray of current European regional policies, which to a large extent have aimed, and aim, at attracting firms to poor peripheral locations.[2]

Second, we examine the impact of regional policies where one seeks to eliminate regional inequalities through direct income transfers based on non-distortionary transfer schemes. We explore two possible tax schemes as basis for a non-distortionary financing: (i) a national general tax scheme, and (ii) a tax on the mobile and agglomeration specific factor, i.e. skilled labor.

We compare how the different regional policies affect welfare of individual groups and social welfare of the economy as a whole. We discuss what type of policy that is most efficient under what circumstances.

Our point of departure is a core-periphery equilibrium and a government with the objective to eliminate regional inequalities, so as to ensure that unskilled workers in the periphery get the same real earnings as the unskilled workers in the core, i.e. $w_C^U/Q_C^\mu = w_P^U/Q_P^\mu$.

Regional policies are, however, often rather unclear with respect to their objectives. These will in general always be about reducing regional income inequalities to allow for horizontal equity. Additionally, they may be about reducing personal income inequalities, to obtain vertical equity. While the former implies closing the gap in real earnings across regions for unskilled workers, the latter implies reducing the gap in real earnings between unskilled and skilled labor. Here we assume that the objective of the government is limited to providing horizontal equity. As we shall see however, the policies we consider do differ in their effect on vertical equity.

4.1 Policy I: Relocation of activities to the periphery

We first consider how inducing relocation of economic activity can allow for regional inequalities to be eliminated, i.e. $w_C^U/Q_C^\mu = w_P^U/Q_P^\mu$. Since regions are assumed to be identical along all dimensions, this objective can only be met if an equal distribution of sector B activity across the two regions is achieved. In order to enable a policy evaluation, we solve the model for such a symmetric equilibrium and let the equilibrium values be denoted by a subscript S.

[2] The EU conducts a policy of relocation spending large amounts on direct and indirect subsidies. These types of additional costs related to the delocation of activity are not included in our welfare assessment. This should however, be kept in mind when the different policy interventions are compared.

Number of firms in the two regions is given by

$$n_S = \ n_S = \frac{L_W^S}{2\alpha\rho_S}, \tag{22}$$

with $\rho_S = \rho\left(\frac{L_W^S}{2}\right)$. From (3) it follows that $\rho_S > \rho_C$, and that due to localized intra-industry knowledge spillovers total number of firms in the economy is smaller under a symmetric equilibrium than under an asymmetric equilibrium. As for equilibrium quantity of each produced variety and wages for skilled workers these are given by

$$x_S = \frac{2\mu\sigma\alpha L^U}{(\sigma-\mu)\, L_W^S}. \tag{23}$$

$$w_S^S = \frac{2\mu\varphi_S L^U}{(\sigma-\mu)\, L_W^S}. \tag{24}$$

respectively with $\varphi_S = \varphi\left(\frac{L_W^S}{2}\right)$. Income in each of the two regions under the symmetric equilibrium is

$$Y_S = \frac{\sigma\varphi_S}{\sigma-\mu} L^U. \tag{25}$$

We observe that total income in the economy is higher under the symmetric equilibrium than under the asymmetric equilibrium, cf. (17) and (25). This is due to the existence of inter-industry knowledge spillovers. It implies that the distribution of sector B activity across regions affects total income of the economy, and is then higher under the symmetric than under the asymmetric equilibrium. In the absense of inter-industry spillovers, total income would be unaffected by the localization of sector B activity. Because of this income effect, we also have that quantities and skilled wages are higher under the symmetric than under the asymmetric equilibrium, $x_S > x_C$ and $w_S^S > w_C^S$.

Consumers face price indices

$$Q_S = \left(\left(1+\tau^{1-\sigma}\right)\frac{L_W^S}{2\alpha\rho_S}\right)^{\frac{1}{1-\sigma}} \varphi_S\rho_S. \tag{26}$$

In the absence of inter-industry spillovers, $Q_C < Q_S$, cf. (18), due to intra-industry spillovers. But the presence of inter-industry spillovers serves to drive up unskilled wages, and in turn prices on B goods, so that the magnitude of Q_S relative to Q_C is not unambiguous, but dependent on parameter values, and particularly dependent on intra- relative to inter-industry spillovers. From (18) and (26) it follows that $Q_C < Q_S$ holds if

$$\underbrace{\left(\frac{\rho_S}{\rho_C}\right)^{\frac{1}{1-\sigma}}}_{Intra-effect}\underbrace{\left(\frac{2}{1+\tau^{1-\sigma}}\right)^{\frac{1}{1-\sigma}}}_{TC-effect}\underbrace{\frac{\varphi_C\rho_C}{\varphi_S\rho_S}}_{\Pr ice-effect} < 1. \tag{27}$$

The term denoted *Intra-effect* is always less than unity, and reflects the fact that with intra-industry spillovers a core-periphery equilibrium allows for a greater total number of varieties than what is the case in a symmetric equilibrium. In the presence of positive trade costs the second term, denoted *TC-effect,* will also be less than unity. But as for the term denoted *Price-effect*, which depicts the price on B goods under a core-periphery equilibrium relative to that under a symmetric equilibrium, this may be less than or greater than unity depending on the magnitude of intra- versus inter-industry spillovers. As noted above, our analysis is based on the assumption that intra-industry knowledge spillovers are stronger than inter-industry knowledge spillovers. Formally, this means that $\varphi_C \rho_C \leq \varphi_S \rho_S$, and implies that $Q_C < Q_S$ will always hold.

Our welfare assessment is based on a comparison of real earnings for the three groups of inhabitants of the economy – the skilled workers in the core (V_C^S) , the unskilled workers in the core (V_C^U) , and the unskilled workers in the periphery (V_P^U) – and on the sum of their real earnings as a measure of total social welfare.

We proceed by examining how real earnings change as government intervention moves us from the market equilibrium that is characterized by industrial agglomeration in one region, to one with equal distribution of activity between the two regions. Formally expressed we have that changes in welfare are given by:

$$\Delta V_C^S = \frac{w_S^S}{P^S} - \frac{w_C^S}{P^C} = \frac{\mu L^U}{(\sigma-\mu) L_W^S} \left[\underbrace{\frac{1}{Q_S^\mu} \left(2\varphi_S - (\varphi_C+1)\right)}_{IE>0} \underbrace{- \left(\varphi_C+1\right) \left(\frac{1}{Q_C^\mu} - \frac{1}{Q_S^\mu} \right)}_{PE<0} \right] \tag{28}$$

$$\Delta V_C^U = \frac{w_S^U}{P^S} - \frac{w_C^U}{P^C} = \underbrace{\frac{1}{Q_S^\mu} \left(\varphi_S - \varphi_C\right)}_{IE<0} \underbrace{- \varphi_C \left(\frac{1}{Q_C^\mu} - \frac{1}{Q_S^\mu} \right)}_{PE<0} < 0 \tag{29}$$

$$\Delta V_P^U = \frac{w_S^U}{P^S} - \frac{w_P^U}{P^P} = \underbrace{\frac{1}{Q_S^\mu} \left(\varphi_S - 1\right)}_{IE>0} \underbrace{+ \left(\frac{1}{Q_S^\mu} - \frac{1}{Q_P^\mu} \right)}_{PE \lesseqgtr 0} \tag{30}$$

It is possible to split the impact of policy intervention on real earnings into two types of effects: an income effect (IE) and a price effect (PE). In the absence of inter-industry spillovers, this effect is zero for all three groups. In this case the location of sector B activity neither affects wages in sector A nor total income of the economy, cf. the discussion above. But with positive inter-industry spillovers, policy intervention entails a positive income effect for skilled workers in the core and unskilled workers in the periphery, but a negative income effect for unskilled workers in the core.

The term PE depicts the price effect, and is negative for skilled and unskilled workers in the core, while ambiguous for unskilled workers in the periphery. It is negative for the inhabitants of the core, because (i) trade costs now have to be paid on one half of the B goods consumed, and (ii) a reduced number of varieties are now being offered. The PE effect reflects that policy intervention prevents the exploitation of positive externalities. Whether the inhabitants of the periphery experience a net gain or net loss from the policy initiative depends on the magnitude of trade costs relative to the reduction in number of varieties.

Figures 2, 3 and 4 provide graphical illustrations of the welfare assessment for the individual groups of inhabitants. They are drawn for three cases:

(i) *Zero knowledge spillovers*: no knowledge spillovers;

(ii) *Relatively strong intra-industry knowledge spillovers*: intra-industry knowledge spillovers are strong relative to inter-industry spillovers;

(iii) *Relatively weak intra-industry knowledge spillovers:* intra-industry knowledge spillovers exceed inter-industry spillovers but less so than in case (ii).

{Figures 2,3,4}

The diagrams communicate the effect of trade costs and inter- and intra-industry knowledge spillovers on the impact of policy interventions. The gains that unskilled workers in the periphery may enjoy, and the losses skilled workers and unskilled workers in the core experience, are higher the higher are trade costs. In the absence of localized spillovers both gains and losses approach zero as trade costs go to zero as location ceases to matter (Figure 2). However, with localized spillovers we see that the location of activity never ceases to matter for productivity and, hence, nor for efficiency and social welfare. As a consequence, policy intervention causing relocation has a negative impact on real earnings of skilled and unskilled labor in the core. The reduction in earnings is, in fact, most significant for the unskilled in the core, since relocation of sector B activity to the other region affects both their nominal as well as their real earnings negatively: the moving of sector B activity means that spillovers affecting their productivity and wages are lost, at the same time as a share of their B goods consumption now has to be imported from the other region (see Figures 3 and 4). As for unskilled workers in the periphery they will typically gain from relocation if trade costs are high and inter-industry spillovers significant relative to intra-industry spillovers. But for low trade costs and relatively high intra-industry spillovers they may actually lose because of the regional policy initiative (see Figures 3 and 4).

Net change in social welfare for the economy as a whole is given by

$$\left(\sum V\right)^{Policy1} - \left(\sum V\right)^{Market} \tag{31}$$
$$= \Delta V_C^S L_W^S + \Delta V_C^U L^U + \Delta V_P^U L^U$$
$$= \frac{2\sigma L^U \varphi_S}{(\sigma - \mu) Q_S^\mu} - \frac{\mu L^U (\varphi_C + 1)}{(\sigma - \mu) Q_C^\mu} - \frac{(\varphi_C + 1) L^U}{Q_C^\mu} - \frac{L^U}{Q_C^\mu \tau^\mu}$$

The difference in impact on social welfare of the economy caused by a policy inducing relocation consequently also depends on the prevalence and magnitude of localized inter- and intra-industry spillovers, as can be seen from Figure 5 . For any given level of trade costs, the net loss to the economy due to a relocation policy will be greater the more significant are intra-industry knowledge spillovers, but smaller the more significant are inter-industry externalities. Irrespective of the magnitude and nature of knowledge spillovers, we also see that the impact of relocation is a non-monotonic function of trade cost. This follows from what is a general feature of new economic geography models, namely that the forces for – and the rents from – agglomeration are greatest for an intermediate level of trade costs, see e.g. Fujita, Krugman and Venables (1999).

{Figure 5}

Our modelling of a policy of relocation allows for an illustration of what has been pointed out to be a potential disadvantage of European regional policies: While seeking cohesion they may impede economies from realizing the gains from regional specialization and agglomeration enabled by advancing technologies and labor mobility (see in particular Sapir et al, 2003). But the analysis also makes clear, that by inducing relocation the EU may enhance inter-industry spillovers and thus productivity and earnings in poor peripheral regions.

Important to note is that the numerical simulations used for the welfare assessment are based on – and drawn for – parameter values that support an asymmetric market equilibrium.[3] For the chosen set of parameter values the market equilibrium with agglomeration is always superior to the dispersed equilibrium induced by policy interventions in terms of total social welfare. [4]

[3]See the appendix for parameter values.

[4]It should be noted though, that for high trade cost there may be parameter spaces for which the agglomeration is sustainable, but where there are multiple equilibria, and where dispersion of activity would typically provide higher social welfare. Ottaviano and Thisse, 1999, also address the optimality of an asymmetric versus a symmetric equilibrium, but do so using another model of monpolistic competition than the one used in most of the existing litterature on economic geography, namely the Dixit-Stiglitz model, which is also employed here. They find that for an intermediate range of trade costs, the market yields agglomeration although dispersion is superior. On the other hand, Norman and Venables (2001) find that the market always produces too little agglomeration. A review of existing results as well as our own, thus makes it very clear that the optimality of agglomeration as such very much depends on specific assumptions underlying the chosen model. This implies that one should be careful presenting unambiguous and general conclusions on the optimality of spatial structures.

4.2 Policy II: Direct income transfers to the periphery financed by a national tax

The second type of policy we consider is one which ensures horizontal equity in terms of $w_C^U/Q_C^\mu = w_P^U/Q_P^\mu$ using direct income transfers financed over a non-distortive tax scheme. The income subsidy (s) to the unskilled workers in the periphery is funded by a national income tax (t). Given the objective of the government, the policy initiative therefore has to provide

$$\frac{(1-t)\,\varphi_C}{P^C} = \frac{(1-t)\,(1+s)}{P^P}. \tag{32}$$

From (32) it follows that such a transfer scheme implies a subsidy equal to

$$s = \varphi_C \tau^\mu - 1. \tag{33}$$

The budget condition underlying such a policy initiative is given by

$$sL^U = t\left(w_C^S L_W^S + \varphi_C L^U + (1+s)\,L^U\right), \tag{34}$$

from which we derive the equilibrium tax rate

$$t = \frac{(\varphi_C \tau^\mu - 1)\,(\sigma-\mu)}{\varphi_C\sigma + \mu + (\sigma-\mu)\,\varphi_C\tau^\mu}. \tag{35}$$

Direct transfers to inhabitants of the periphery imply reduced real earnings for skilled workers (V_C^S) and unskilled workers (V_C^U) in the core region, due to the tax burden put on them in order to subsidize consumers in the periphery. On the other hand they entail increased real earnings for unskilled workers (V_P^U) in the periphery. Unlike a policy based on relocation of activity, a policy of direct income transfers has only an income effect, but no price effect. Formally expressed we have:

$$\begin{aligned}\Delta V_C^S &= \frac{(1-t)w_C^S}{P^C} - \frac{w_C^S}{P^C} \\ &= -\frac{\mu L^U}{(\sigma-\mu)\,L_W^S}\frac{1}{Q_C^\mu}\left(\varphi_C+1\right)\frac{(\varphi_C\tau^\mu-1)\,(\sigma-\mu)}{\varphi_C\sigma+\mu+(\sigma-\mu)\,\varphi_C\tau^\mu} < 0\end{aligned} \tag{36}$$

$$\Delta V_C^U = \frac{(1-t)\varphi_C}{P^C} - \frac{\varphi_C}{P^C} = -\frac{\varphi_C}{Q_C^\mu}\frac{(\varphi_C\tau^\mu-1)\,(\sigma-\mu)}{\varphi_C\sigma+\mu+(\sigma-\mu)\,\varphi_C\tau^\mu} < 0 \tag{37}$$

$$\begin{aligned}\Delta V_P^U &= \frac{(1-t)(1+s)}{P^P} - \frac{1}{P^P} \\ &= \frac{1}{\tau^\mu Q_C^\mu}\left((\varphi_C\tau^\mu-1) - \varphi_C\tau^\mu\frac{(\varphi_C\tau^\mu-1)\,(\sigma-\mu)}{\varphi_C\sigma+\mu+(\sigma-\mu)\,\varphi_C\tau^\mu}\right) > 0\end{aligned} \tag{38}$$

Net change in social welfare for the economy as a whole is consequently given by

$$
\begin{aligned}
&\left(\sum V\right)^{Policy2} - \left(\sum V\right)^{Market} \\
&= \Delta V_C^S L_W^S + \Delta V_C^U L^U + \Delta V_P^U L^U \\
&= -\frac{L^U\left(\tau^{\mu}-1\right)\left(\mu+\varphi_C\sigma\right)\left(\varphi_C\tau^{\mu}-1\right)}{Q_C^{\mu}\left(\varphi_C\sigma+\mu+\left(\sigma-\mu\right)\varphi_C\tau^{\mu}\right)} < 0,
\end{aligned}
\tag{39}
$$

and is always negative. The impact of a regional policy based on direct income transfers is illustrated graphically in Figure 6. We see that policy intervention implies a welfare loss, but this decreases monotonically in trade costs, for eventually to vanish for zero trade costs, at which point equilibrium subsidies equal zero.

{Figure 6}

Due to the fact that the tax scheme that funds the subsidies to the periphery is levied economy wide, the location of economic activity is not affected by the policy intervention, and nor is thus the stability of asymmetric market equilibrium affected by the policy intervention. In other words, the financing of the policy initiative is non-distortionary.

We want to compare the change in social welfare induced by this latter policy initiative with that induced by the policy forcing relocation discussed in the previous section. We find that the differential impact of the former on social welfare is given by

$$
\begin{aligned}
&\Delta\left(\sum V\right)^{PolicyIIversusMarket} - \Delta\left(\sum V\right)^{PolicyIversusMarket} \\
&= \frac{\sigma L^U}{\left(\sigma-\mu\right)}\left[\frac{\left(\varphi_C+1\right)\left(1-t\right)}{Q_C^{\mu}} - \frac{2\varphi_S}{Q_S^{\mu}}\right] \lesseqgtr 0
\end{aligned}
\tag{40}
$$

and is conveyed graphically in Figure 7. The differential impact on social welfare is a non-monotonic function of trade costs. Counter to what we would expect based on insight from traditional public finance theory, a distortionary policy may actually prove more efficient than a policy that is based on a non-distortive financing. Eliminating regional inequalities through relocation of activity instead of through direct income transfers, will typically be more efficient if trade costs are high, intra-industry spillovers relatively insignificant, and inter-industry spillovers relatively significant.

{Figure 7}

However, as trade costs decline and the magnitude of the subsidy needed to abolish regional inequalities diminishes, the relative efficiency of a direct transfer policy increases, for then to reach a maximum for an intermediate to low level of trade cost. The non-monotonic patterns follow from the important feature of the model that the agglomeration rents produced by localized pecuniary externalities, are hump shaped in trade costs. The efficiency loss from a distortionary relative to a non-distortionary financed policy is thus most significant for the level of trade costs at which agglomeration rents peak.

Figure 7 illustrates that increased intra-industry knowledge spillovers amplify the relative efficiency gain related to the choice of a regional policy of direct income subsidies over a regional policy of relocation, while increased inter-industry knowledge spillovers work in the other direction.

4.3 Policy III: Direct income transfers to the periphery financed by a tax on the industrial agglomeration

The third type of regional policy we consider, is also a direct income transfer to the periphery, but this time financed via a tax on the mobile, agglomeration specific factor only. The location decision of the mobile factor – skilled labor – determines the spatial structure of the economy and is responsible for the emergence of the industrial agglomeration in the core. A basic insight from the public finance literature is that an optimal tax scheme is one that avoids taxing mobile factors, and instead levies taxes on immobile factors, as the former is distortionary in nature while the latter is not (see e.g., Gordon, 1986, Frenkel, Razin and Sadka, 1991, and Bucovetsky and Wilson, 1991). In order to minimize the efficiency loss related to the acquiring of funds for transfers, one would thus reckon that a tax on the industrial agglomeration to fund transfers to the periphery would be a less preferred alternative.

However, recent contributions to the tax literature which merge insights from the new economic geography theory with public finance theory, have shown that the agglomeration rents generated by an industrial agglomeration affect the tax elasticity of the factors employed by the agglomeration (see Baldwin et al, 2003, Kind et al, 2000, and Ludema and Wooton, 2000). In particular, it has been found that the existence of agglomeration rents implies that the mobile factors of an industrial agglomeration will be tax inelastic up to a certain threshold. Up to this threshold, a government may use taxes to extract rents from the agglomeration without affecting the sustainability of the agglomeration, i.e. without being distortionary and causing the delocation of activity.

Introducing an economy wide income tax to fund subsidies to the periphery may be reckoned as difficult in political terms, since it levies a significant tax burden also on low income groups, i.e. the unskilled labor in the core. In order to lighten this burden, a tax on the high income group may appear as an attractive alternative. Moreover, a tax on skilled labor only implies that while achieving the goal of horizontal equity, the government is in addition also able to reduce personal income inequalities and thereby improve vertical equity.

The government introduces a income subsidy to the periphery that allows for real earnings of unskilled labor in the periphery to be equal to those of unskilled labor in the core, i.e.

$$\frac{\varphi_C}{P^C} = \frac{(1+s)}{P^P}, \tag{41}$$

and let it be financed by a tax on the skilled labor employed by the agglomeration.[5]

As long as this scheme does not affect the sustainability of the industrial agglomeration, it will neither affect prices, equilibrium quantities and number of firms, nor wages before tax. As before, the objective function of the government implies a subsidy $s = \varphi_C \tau^\mu - 1$. The government's budget condition is now given by $tw_C^S L_W^S = sL^U$, so that the equilibrium tax rate equals

$$t = \frac{(\sigma - \mu)(\varphi_C \tau^\mu - 1)}{\mu(\varphi_C + 1)}. \tag{42}$$

In terms of changes in real earnings induced by the policy intervention, we have that:

$$\begin{aligned} \Delta V_C^S &= \frac{w_C^S}{P^C} - \frac{(1-t)w_C^S}{P^C} \qquad (43) \\ &= -\frac{\mu L^U}{(\sigma-\mu) L_W^S} \frac{1}{Q_C^\mu} (\varphi_C + 1) \frac{(\sigma-\mu)(\varphi_C \tau^\mu - 1)}{\mu(\varphi_C + 1)} < 0 \end{aligned}$$

$$\Delta V_C^U = 0 \tag{44}$$

$$\Delta V_P^U = \frac{1+s}{P^P} - \frac{1}{P^P} = \frac{(\varphi_C \tau^\mu - 1)}{Q_P^\mu} > 0 \tag{45}$$

Compared to the economy-wide-funded transfer policy examined in the previous section, we see that the increase in real earnings received by unskilled in the periphery is in this case more substantial (cf. (38) and (45)). The reduction in welfare experienced by the skilled workers in the core is on the other hand greater (cf. (36) and (43)). As unskilled in the core are not affected by a tax on the mobile factors of the agglomeration, they are better off than they would have been with the formerly considered regional policy.

The enlarged loss in net real earnings experienced by skilled labor in the core is due to the fact that (i) they have to carry the burden of funding the transfer scheme alone, and (ii) net sum of transfers to the periphery is higher. The net sum is higher because net real earnings of unskilled workers in the core are

[5] We note that the working of such a scheme is identical to one where one levies a tax on parts of firms' cost, namely those linked to the agglomeration specific factor – skilled labour.

higher as they do not have to pay taxes, and this in turn means that horizontal equity implies greater transfers.

Net change in welfare for the economy as a whole is given by

$$\left(\sum V\right)^{Policy3} - \left(\sum V\right)^{Market} = \frac{\left(\varphi_C \tau^{\mu} - 1\right) L^U}{Q_C^{\mu}} \left(\frac{1}{\tau^{\mu}} - 1\right) < 0. \tag{46}$$

Figure 8 allows us to compare the welfare effects on the three different regional policies initiatives I-III. It is drawn for relatively strong intra-industry knowledge spillovers. The main message is that policy III is always inferior to policy II in terms of total social welfare. This can also be seen by comparing (39) and (46). The reason is simply that in the latter case there is a greater transfer to the periphery, and in turn a more significant loss in total welfare, as consumption here incurs vasteful trade cost.

{Figure 8}

But unlike the tax scheme employed to fund transfers to the periphery examined in the previous section, a tax levied on the mobile factors of the agglomeration may affect the stability of the industrial agglomeration. In contrast to an economy wide tax, the latter tax scheme may distort the allocation of economic activity. In order to investigate this further, we derive the condition for the industrial agglomeration to exist and be stable in the case with a tax on the mobile factor of the agglomeration. As skilled workers are confronted with a tax in the core region, they will stay in the core as long as $(1-t)w_C^S/Q_C^{\mu} > w_P^S/Q_P^{\mu}$. This implies that the asymmetric equilibrium remains stable as long as

$$(1-t)\,\sigma\left(\varphi_C + 1\right)\varphi_C^{1-\sigma}\left(\frac{\rho_P}{\rho_C}\right)^{\sigma}\tau^{\mu+1-\sigma} - \left(\sigma\varphi_C + \mu\right)\tau^{2(1-\sigma)} - \sigma + \mu > 0. \tag{47}$$

For a tax on skilled labor in the core not to have any distortionary effects, and thus not to induce delocation of industrial activity, it follows from (47) that a tax rate cannot exceed the threshold level t^*:

$$t < t^* = \frac{\sigma\left(\varphi_C + 1\right)\varphi_C^{1-\sigma}\left(\frac{\rho_P}{\rho_C}\right)^{\sigma}\tau^{\mu+1-\sigma} - \left(\sigma\varphi_C + \mu\right)\tau^{2(1-\sigma)} - \sigma + \mu}{\left(\varphi_C + 1\right)\varphi_C^{1-\sigma}\left(\frac{\rho_P}{\rho_C}\right)^{\sigma}\tau^{\mu+1-\sigma}} \tag{48}$$

Figure 9 provides a graphical illustration of the tax scheme that would have to be levied in order to attain regional equity in terms of real earnings for unskilled labor as per (42), and of the tax rate that would be consistent with sustaining the industrial agglomeration in the core. With respect to the former, we see that an equity providing tax rate is obviously an increasing function of trade costs, since the higher the trade costs the greater the gap in real earnings that has to be closed by the tax. As for the latter, we see that an agglomeration sustaining tax rate is typically hump shaped in trade costs, reflecting the fact that the rents from agglomeration peak at an intermediate level of trade costs.

The intersection of the two curves in Figure 9 gives the trade cost level below which a tax scheme merely based on the taxation of skilled mobile labor allows for inter-regional equality without affecting the sustainability of the industrial agglomeration. From (48) and Figure 9 it can be seen that, the more significant the localized intra-industry knowledge spillovers (measured by ρ_P/ρ_C), the higher is ceteris paribus the tax rate that is consistent with sustaining of the agglomeration. Graphically, enhanced spillovers imply an upward shift in the hump shaped curve. Comparative static on (48) further reveals that the threshold level t^* is increasing in market linkages (μ) and decreasing in elasticity of substitution (σ). On the other hand, the greater are inter-industry spillovers, the lower the tax rate that allows for the agglomeration to be sustained.

{Figure 9}

The graphical illustration and the inequality in (48) inform us about the extent to which taxation of the mobile factors to which the rents from the industrial agglomeration accrue, can be used as a means to funding a regional transfer scheme. We see that this depends on degree and type of knowledge spillovers, market linkages, trade costs and elasticity of substitution – the latter measuring degree of product market competition. For high trade cost, relatively insignificant intra-industry spillovers and relatively significant inter-industry spillovers, funding a regional policy initiative purely by taxing the industrial agglomeration in the core may indeed not be an alternative at all. But for significant intra-industry spillovers, weak inter-industry spillovers, and lower trade cost there may indeed be scope for such a policy.

This means that under certain circumstances a government has the option to introduce a regional policy that not only allows for horizontal equity, but also allows it to reduce the gap between low- and high-income groups. Hence, the tax scheme allows for a more even distribution of agglomeration rents across the economy and improves vertical equity.

5 Concluding remarks

In this paper we have addressed questions related to optimal regional policy design. Our analysis shows that optimal design of regional policy depends on level of trade costs, and degree of pecuniary externalities, magnitude of localized inter- and intra-industry knowledge spillovers, and degree of product market competition.

We have compared a distortionary regional policy forcing relocation of activity with regional policy based on direct income transfer financed over non-distortionary tax schemes. We find that the relocation alternative is least attractive for intermediate trade costs and high intra-industry knowledge spillovers.

But for high trade cost, insignificant intra-industry knowledge spillovers and relatively more significant inter-industry spillovers this type of policy may actually be more efficient.

Furthermore, if a government aims at designing a regional policy that not only eliminates regional inequalities but also reduces personal inequalities, taxing the industrial agglomeration in the core region may be an attractive alternative. However, it will only be a feasible alternative when there are high intra-industry relative to inter-industry spillovers and trade costs are relatively low.

Can the analysis above teach us anything about why EU regional policy has not been more of a success? It probably can. The EU has designed a regional policy whose success actually relies on the prevalence of inter-industry positive externalities. When it appears not to have delivered according to expectations, this may indeed be about the magnitude of inter- relative to intra-industry externalities. If the latter type of positive externalities is more prevalent than the former type, a policy inducing the relocation of activity will do more harm in terms of impeding the exploitation of localized intra-industry externalities than it will do good in terms of allowing for more inter-industry spillovers.

Empirical analysis, see e.g. Bottazzi and Peri (2002), suggests that knowledge spillovers in the EU may indeed be much more important in an intra-industry context than in an inter-industry context. If so, then regional inequalities would potentially have been more efficiently eliminated through direct income transfer to the EU periphery. Such a transfer could be based on general tax schemes. But as integration proceeds, and trade barriers fall, a transfer scheme could also be funded by taxing of the industrial agglomeration in the EU core, which would contribute not only to increased horizontal equity, but also to increased vertical equity.

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6 Appendix

Functions and Parameter values used for simulations:
$\rho_i = \left(1 + L_i^S\right)^{-\varepsilon}$, $\varphi_i = \left(1 + L_i^S\right)^{\xi}$
$\sigma = 3$, $\mu = 0.5$, $L^U = 6$, $L_W^S = 2$

Figure 1:

Zero knowledge spillovers: $\varepsilon = \xi = 0$
Weak inter-industry spillovers: $\varepsilon = 0.4, \xi = 0.1$
Strong inter-industry spillovers: $\varepsilon = 0.4, \xi = 0.2$

Figures 2-9:
Zero knowledge spillovers: $\varepsilon = \xi = 0$
Relatively weak intra-industry spillovers: $\varepsilon = 0.2, \xi = 0.1$
Relatively strong intra-industry spillovers: $\varepsilon = 0.4, \xi = 0.1$

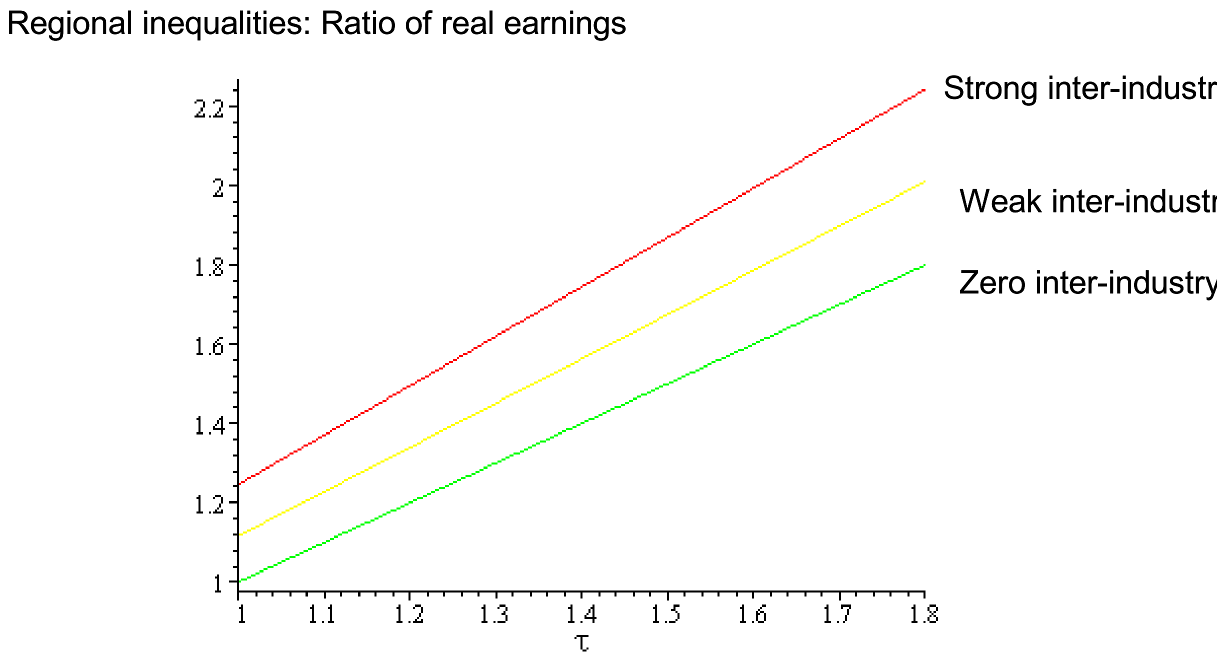

Figure 1: Regional inequalities as function of trade cost and inter-industry spillovers

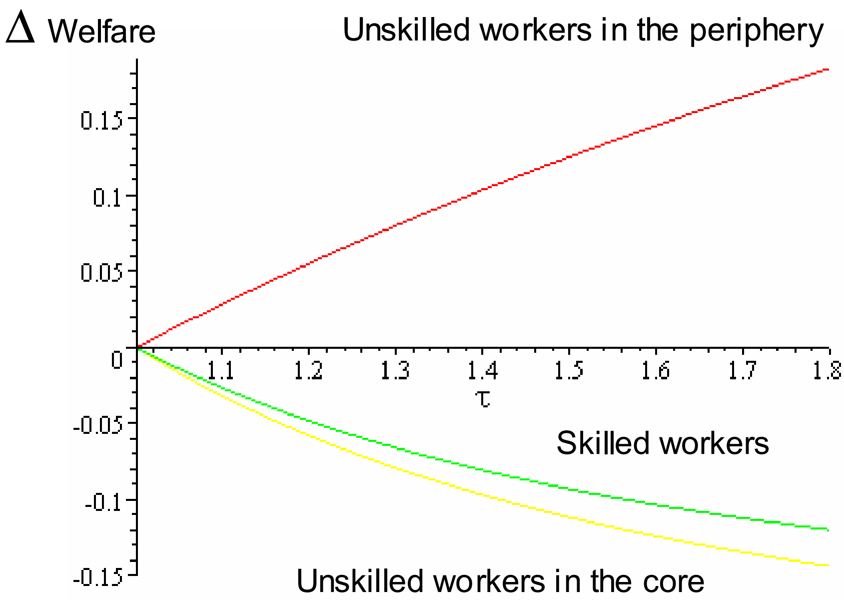

Figure 2: A regional policy of relocation: Impact on real earnings; case (i): Zero knowledge spillovers

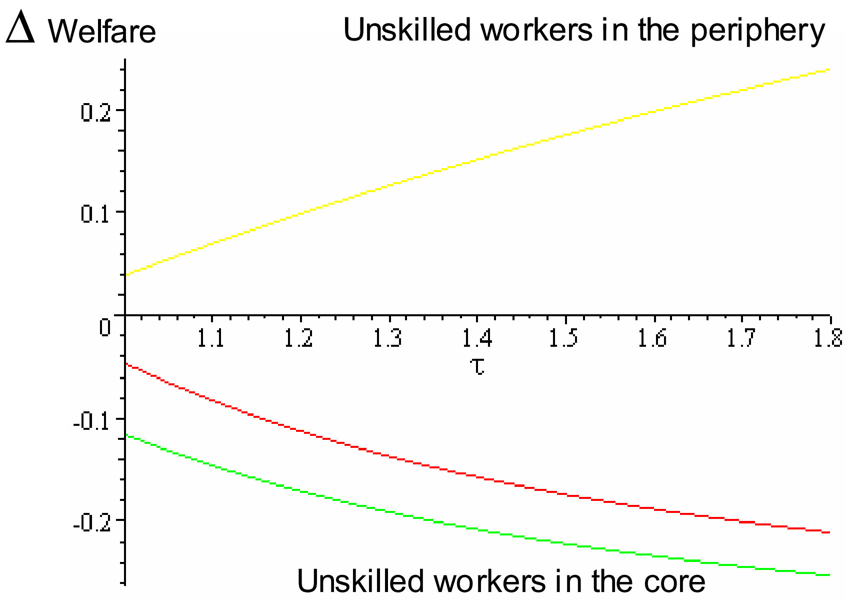

Figure 3: A regional policy of relocation: Impact on real earnings; case (ii): Relatively weak intra-industry knowledge spillovers

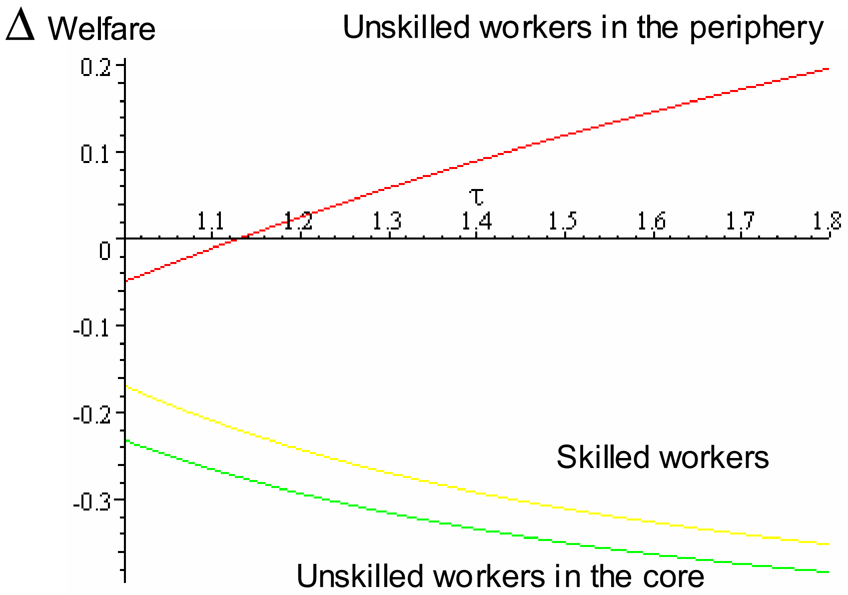

Figure 4: A regional policy of relocation: Impact on real earnings; case (i): Relatively strong intra-industry knowledge spillovers

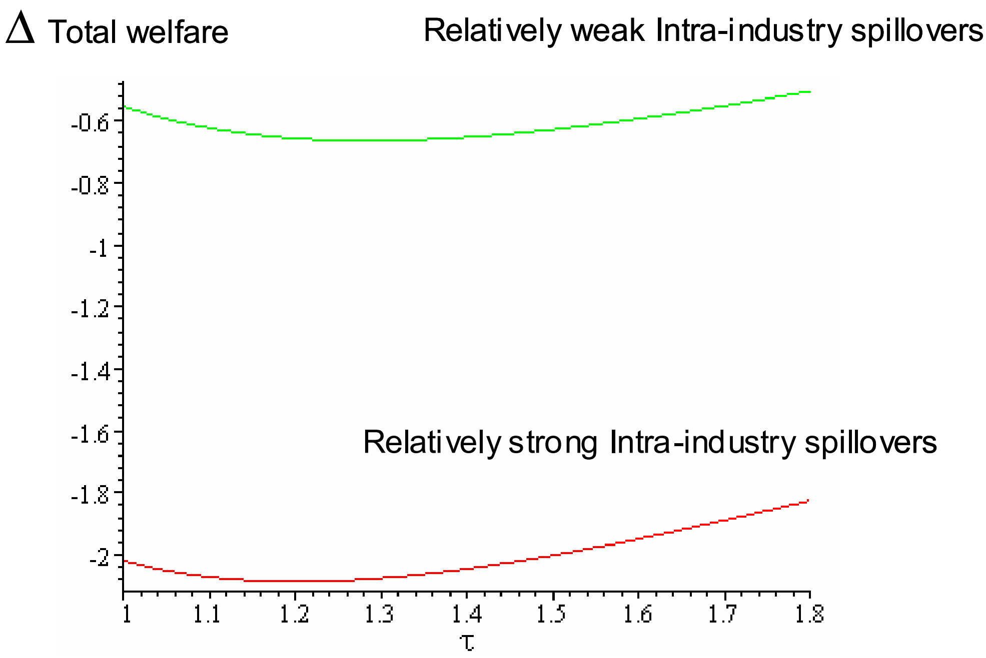

Figure 5: A regional policy of relocation: Impact on total welfare

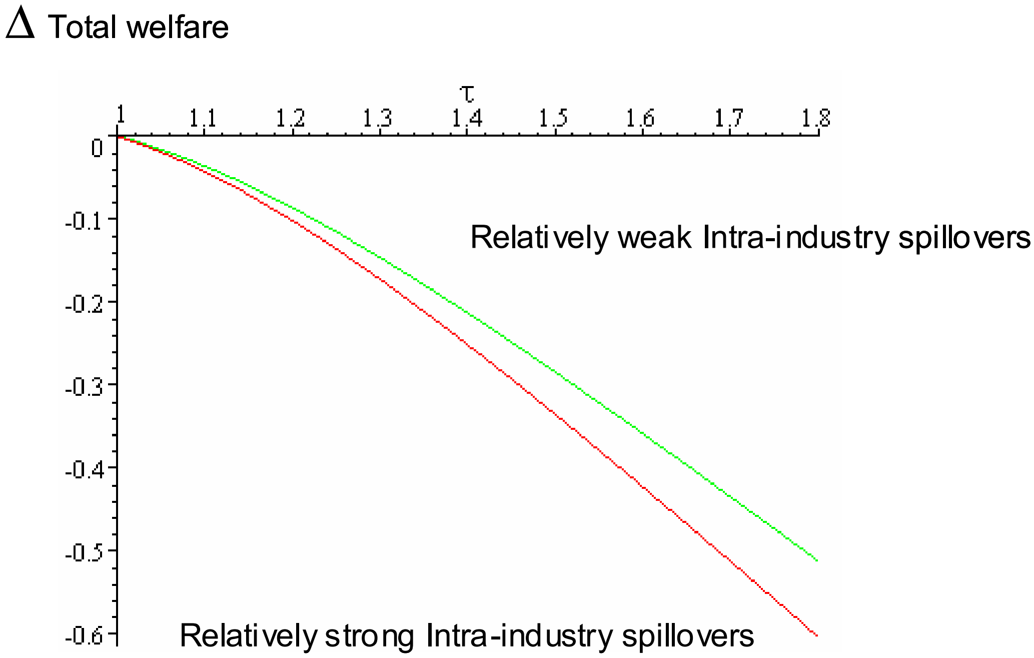

Figure 6: A regional policy of direct income subsidies: Impact on total welfare

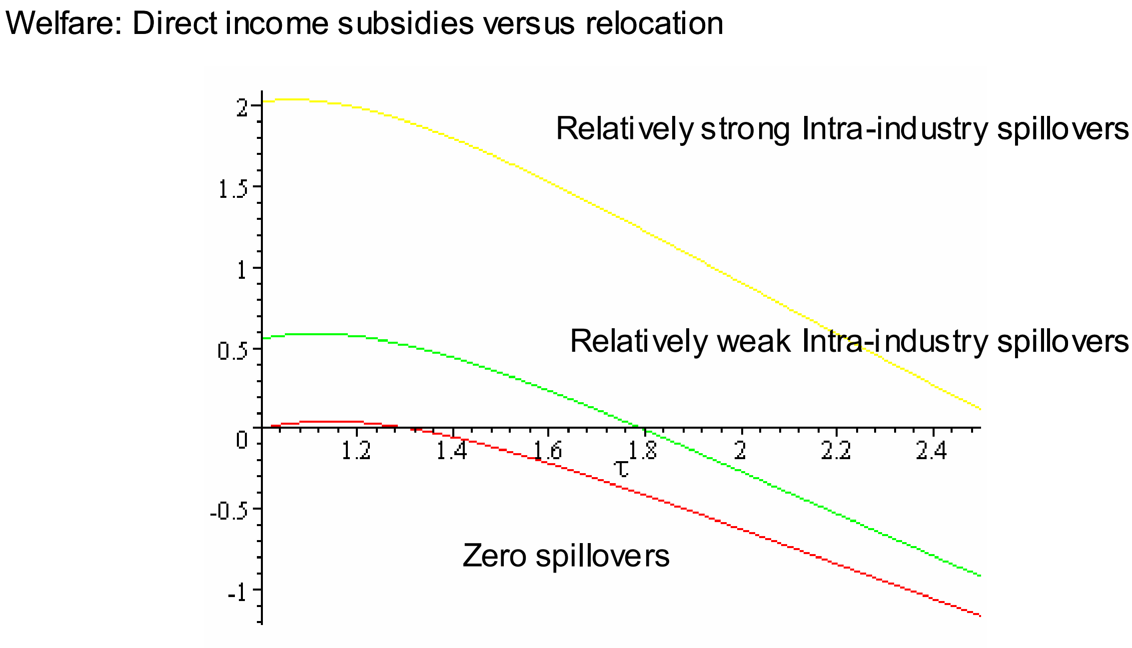

Figure 7: Comparison of regional policies: Impact on total welfare

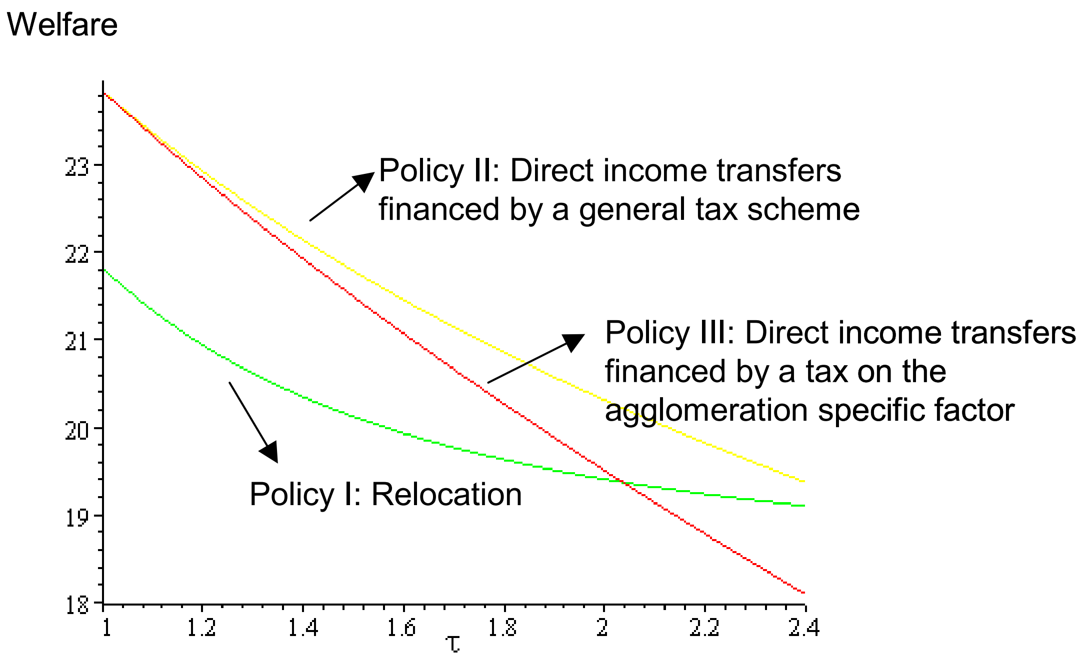

Figure 8: Regional policy I-III: Comparison of the impact on social welfare

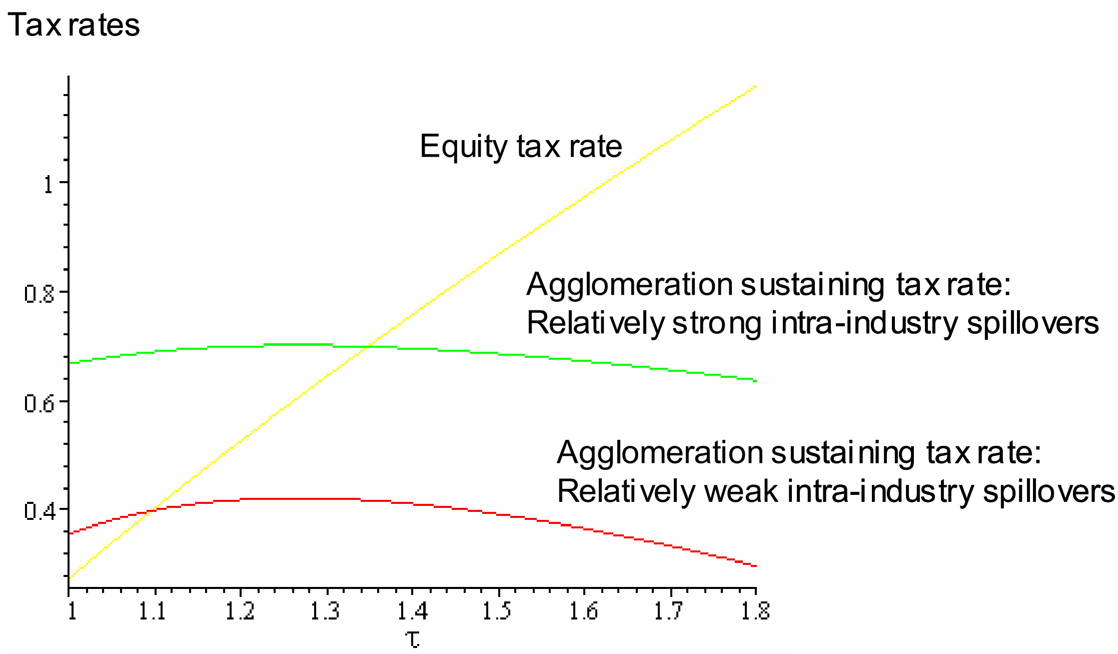

Figure 9: A regional policy based on taxation of the industrial agglomeration: Equity versus agglomeration sustaining tax rates