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

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Abstract

Despite substantial regional expenditure at both national and community level, European regional policies do not appear to deliver. Evidence suggests that neither efficiency gains nor reduced regional inequalities result. If there is any positive impact at all, then it is at 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 consider the alternatives to a distortionary regional policy that forces the delocation of activities. Are non-distortionary policies always relatively more efficient than distortionary ones? We analyse these questions employing a new economic geography model, which also takes into account the importance of knowledge spillovers for productivity, industry location and policy. We show that the effectiveness of different regional policies depends on (i) intra-industry knowledge spillovers, (ii) inter-industry knowledge spillovers and (iii) trade costs. Our analysis suggests that the European approach to the elimination of regional inequalities may, relatively, be the more costly alternative.

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1. Introduction

Are increased regional inequalities and an increased geographical concentration of economic activity the flipside of the industrial restructuring that follows economic
integration and technological progress? Both theory and empirical evidence point in this direction (see, e.g., Behrens et al., 2003; Boldrin and Canova, 2001; Braunerhjelm et al., 2000; Martin, 1998, 1999), so the significant focus on regional policy in Europe would appear to be justified and valid.

The regional 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 that would benefit the Union as a whole” (see, e.g., European Commission, 1996). So the Commission expects regional policy initiatives 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 lead one to question the success of current and recent regional policy initiatives. The EU spends around a third of its budget on regional support. In addition to this, governments in Europe allocate a substantial share of their state aid to peripheral regions.1 But despite the resources they absorb, European regional policies do not appear to deliver—in terms of either reduced inequalities or increased efficiency:

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; Puga, 2002). At the same time, we also observe that manufacturing activity has become more concentrated across regions (see, e.g., Midelfart-Knarvik and Overman, 2002).

As regards efficiency, regional policy appears to have had a negative rather than a positive impact. Midelfart-Knarvik and Overman (2002) have studied EU initiatives established to attract firms to poor, peripheral regions in order to increase investment, employment and productivity there. Their findings indicate that in terms of affecting industrial location, the policy has indeed succeeded. But the direct impact of regional expenditure appears to run counter to economic determinants, causing a delocation of industrial activity: i.e. a pattern of industrial location different from what economic forces alone would deliver. The result is an inefficient allocation of resources. Boldrin and Canova (2001) have analysed the impact of regional expenditure on productivity and capacity, and their findings are disappointing: Regional expenditure does not appear to have enhanced the productivity and capacity of the regions into which it was channelled.

It is alarming to find that despite devoting considerable resources to regional policy, the evidence would suggest that neither efficiency gains nor reduced regional inequalities have resulted.2 If they have had any impact at all, regional initiatives must have been purely redistributional, impeding moves towards enhanced inequality or maintaining status quo. This leads us onto the question we want to address in this paper: If regional policies are mainly redistributional, are there any other policy initiatives that would be more efficient? In other words, if we want to eliminate regional inequalities, how do we do this at the lowest possible welfare cost?

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1See, e.g., Commission of the European Communities (2001).

2This fact has triggered increased theoretical work related to regional policy design: See, e.g., Dupont and Martin (2003) and Forslid (2003) for recent contributions.
A number of the regional initiatives set up by the EU and national European governments rely on distortionary financing schemes, which seek to reduce regional inequalities by encouraging relocation of activity to the periphery. We ask if regional policy initiatives relying on direct income transfers financed over non-distortionary tax schemes would be more efficient (incurring a smaller welfare loss), and, if so, under what circumstances? As opposed to what one might expect based on insight from traditional public finance theory, it turns out that non-distortionary policies are not always cheaper.

Moreover, we emphasize that there is a set of optional non-distortionary tax schemes. Again in contrast to what might be predicted by traditional public finance theory (see, e.g., Gordon, 1986; Frenkel et al., 1991; Bucovetsky and Wilson, 1991) predicts, a tax scheme that relies on the taxation of mobile factors only, may represent one such non-distortionary option.

The analysis is conducted employing a new economic geography model whereby we explicitly take into account the role played by proximity to other economic agents for each individual agent’s productivity and income. Our model not only incorporates pecuniary externalities, as most economic geography models do, but also considers the role played by technological externalities in the form of knowledge spillovers for productivity, industry location and policy. Over the last decade a number of studies (see, e.g., 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 than across industries. When setting up our model we draw on their insights.

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 interact with knowledge spillovers in determining the location of industry and optimal regional policy design.

This paper is organized as follows. In Section 2 we present a new economic geography model. In Section 3 we characterize the core-periphery equilibrium supported by the model. This is taken to be the market outcome without policy intervention and results in an uneven geographical distribution of economic activity between a core and the periphery, giving rise to regional income inequalities. Section 4 investigates the impact of a set of regional policy initiatives according to their achievements in terms of equity and welfare, and finally assesses the impact of societal values—reflected through different welfare criteria—on the evaluation of regional policies. Section 5 concludes.

2. A model of industrial location

Our point of departure is an economic geography model which builds on Krugman (1991) and Forslid and Ottaviano (2003). The economy we consider consists of two

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3Critics 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.

4Other studies pointing to the prevalence of localized positive externalities in Europe are e.g., Ciccone (2002) and Combes et al. (2004).
regions: \( i = 1, 2 \). There are two types of factors of production: Unskilled (\( L^U_i \)) and skilled labour (\( L^S_i \)), the subscript denoting region of residence. Unskilled labour is immobile between regions, while skilled labour is regionally mobile. This is in line with empirical studies suggesting that skilled labour is indeed more mobile than unskilled labour (see, e.g., Shields and Shields, 1989)—possibly because education generates human capital which is easily transferable to another region and eases the search for work (see, e.g., Ottaviano and Thisse, 2002).

Each region has a fixed and equal amount of unskilled labour, \( L^U_1 = L^U_2 = L^U \). The total supply of skilled labour in the economy is equal to the sum of skilled labour across the two regions: \( L^S_1 + L^S_2 = L^S \), subscripts denoting 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 labour. Sector \( B \) is monopolistically competitive and produces differentiated goods employing both unskilled and skilled labour, and faces increasing returns to scale in production captured by an affine cost function. Skilled workers only enter into the fixed cost, while unskilled labour only enters into the variable cost of production. Hence fixed costs are typically thought to represent skill-intensive activities such as R&D, while variable costs represent unskilled-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 analyse the micro-foundations of the spillovers, 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 sector \( B \) and between this sector and the sector \( A \). However, as the spillovers are assumed to be local in nature, they work only within a region and not across regions. This implies that both sector \( A \) and sector \( B \) productivity in a given region \( i \) depends on the level of sector \( B \) activity in this region. Since skilled labour is employed only by sector \( B \), there is a one-to-one relationship between the level of sector \( B \) activity and the number of skilled workers in region \( i \), and thus between productivity and the pool of skilled labour in a region. In line with empirical evidence we assume intra-industry spillovers to be stronger than inter-industry spillovers (see, e.g., Bottazzi and Peri, 2002).

The combination of inter-regional mobile skilled labour, trade costs and increasing returns to scale gives rise to localized pecuniary externalities and self-reinforcing industrial agglomeration driven by demand and supply linkages.

Consumer preferences are given by the utility function

\[
U = C_A^{1-\mu} C_B^\mu, \quad 0 < \mu < 1, \tag{1}
\]

where \( C_A \) and \( C_B \) denote consumption of goods from the sectors \( A \) and \( B \), respectively, and \( \mu \) 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 labour, while its productivity (\( \varphi_A \)) depends on the extent of localized inter-industry knowledge spillovers received from sector \( B \) activity. By choice of scale, unit labour requirement in sector \( A \) in the home country is \( 1/\varphi_A \), which (because \( p_A = 1 \)) gives

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5See Duranton and Puga (2004) for an analysis and discussion of the micro-foundations of externalities that give rise to agglomeration forces.
unskilled wages

\[ w^U_i = \varphi_i = \varphi(L_i^S), \]

with \( \varphi_i \geq 1, \ \varphi(0) = 1, \ \varphi'_i > 0, \ \varphi''_i < 0. \) \hfill (2)

Demand for good \( A \) is assumed to be so high that production in sector \( A \) must take place in both regions. The assumption of incomplete specialization implies that wages for unskilled labour are given and reflect cross-region variation in labour productivity.\(^6\)

The consumption of goods from sector \( B \) is defined as an aggregate of \( n \) differentiated goods, \( C_M \equiv \left[ \int_{k=0}^{n_m+n_x} c_k (\sigma-1)/(\sigma) \right]^{\sigma/(\sigma-1)} \) 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 is equal to \( \sigma \).

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

\[ TC_i = \rho_i(w_i^S x + w_i^U \beta x_i), \]

and is the same irrespective of the market served. \( B \) goods are tradable, but we assume Samuelson iceberg type transport costs, described by the parameter \( \tau > 1 \). This implies that only \( 1/\tau \) of each unit shipped actually reaches its destination, and means that the \( c.i.f. \) price is \( \tau \) 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

\[ p_i = \frac{\sigma}{\sigma - 1} \beta \rho_i \varphi_i, \]

in equilibrium. Choosing units so that \( \beta = (\sigma - 1)/\sigma \), we get producer prices \( p_i = \rho_i \varphi_i \), and equilibrium quantities \( x_i = w_i^S \sigma \varphi_i^{-1} \). 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 labour’s wages. Given the fixed input requirement of skilled labour in sector \( B \), skilled labour market clearing implies that in equilibrium the number of

\(^6\)The condition for incomplete specialization is \((1 - \rho)(Y_1 + Y_2) > L_i^U\), where \( Y_i \) denotes local disposable income in region \( i \). This condition will hold if good \( A \) has a large weight in utility (\( \mu \) small) and product variety is highly valued by consumers (\( \sigma \) is small).

Because of intra- and inter-industry spillovers, income and total expenditure on \( A \) goods will depend on the distribution of skilled workers across locations in equilibrium. The simulations presented later are all based on parameter values that supports an equilibrium of incomplete specialization.
type B firms in region \(i\) is determined by
\[
n_i = \frac{L_i^S}{\alpha p_i}.
\] (6)

Taking the dual of \(C_M\) we find that the price index for good B is
\[
Q_i = [n_i p_i^{-\sigma} + m_i (\tau p_j)^{1-\sigma}]^{1/(1-\sigma)}, \quad i \neq j,
\] (7)

where \(n_i\) and \(m_i\) 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
\[
P_i = p_i^{1-\mu} Q_i^\mu, \quad i = h, f.
\] (8)

Local disposable income in region \(i\) \((Y_i)\) consists of unskilled and skilled earnings
\[
Y_i = w_i^S L_i^S + w_i^U L_i^U.
\] (9)

Local \((x_{ii})\) and foreign \((x_{ij})\) demand for a variety of the B good produced in region \(i\) is given by
\[
x_{ii} = p_i^{-\sigma} Q_i^{\sigma-1} \mu Y_i, \quad x_{ij} = p_i^{-\sigma} Q_j^{\sigma-1} \tau^{1-\sigma} \mu Y_j, \quad i \neq j.
\] (10)

Using (10) and the zero profit condition, the product market equilibrium in sector \(B\) takes the form
\[
w_i^S \sigma \phi_i^{-1} \geq p_i^{-\sigma} [Q_i^{\sigma-1} \mu Y_i + \tau^{1-\sigma} Q_j^{\sigma-1} \mu Y_j], \quad n_i \geq 0, \quad i \neq j.
\] (11)

Factor market clearing requires that the supply of unskilled labour \((L_i^U)\) in equilibrium is equal to demand for unskilled labour in sector \(A\) \((L_{iA}^U)\) and sector \(B\) \((L_{iB}^U)\), so that \(L_i^U = L_{iA}^U + L_{iB}^U\). Using Shephard’s lemma on Eq. (3) to derive labour demand in sector \(B\), and substituting for quantities and number of firms employing (5) and (6) we can rewrite the labour market clearing condition as
\[
L_{iA}^U = L_i^U - w_i^S (\sigma - 1) L_i^S \phi_i^{-1}.
\] (12)

The market equilibrium is determined by (2), (4)–(7), (9), (11), and (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 \(L_{iA}^U\).

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

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

The concept of stability is the following: If we move a small mass of skilled labour from one region to another, and the post-shock indirect utility is lower in the “receiving” than in the “sending” region, the skilled workers would prefer to move back. The original
equilibrium is thus restored. The equilibrium is in this case said to be stable. If the post-shock indirect utility in the “receiving” region is higher, the equilibrium is unstable.

3. A core-periphery equilibrium

Our analysis focuses on the design of regional policy given a situation where the market outcome is characterized by a high degree of concentration of industrial activity in one region. Hence, our point of departure is an agglomerated—so-called core-periphery—equilibrium where all skill intensive activity—i.e. sector B activity—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 the number of B firms in the two regions are, respectively,

\[ n_C = \frac{L_S^C}{\sigma \rho_C}, \quad n_P = 0, \] 

(14)

where the subscript C depicts core region variables and the subscript P periphery variables. Since all manufacturing production takes place in the core, unskilled wages in the periphery are equal to unity, \( w_U^P = \phi_P = 1 \), while the unskilled in the core receive \( w_U^C = \phi_C \).

All skilled workers reside in the core and earn wages

\[ w_S^C = \frac{\mu(\phi_C + 1)L_U}{(\sigma - \mu)L_S^C}. \] 

(15)

We assume that \( (\phi_C + 1)/\phi_C > (\sigma - \mu)L_S^C/\mu L_U \), i.e. \( w_S^C > w_U^C = \phi_C \), 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 great, the expenditure share on B goods is not too low, the substitutability of varieties produced in sector B is relatively low, and the stock of unskilled labour is not “too small” relative to the stock of skilled labour.

Equilibrium quantity of each produced variety is

\[ x_C = \frac{\mu \sigma x (\phi_C + 1)L_U}{(\sigma - \mu)\phi_C L_S^C}. \] 

(16)

Since \( \sigma > 1 \) and \( 0 < \mu < 1 \), \( x_C > 0 \) will always be true. Income in the two regions is, respectively,

\[ Y_C = \frac{\sigma \phi_C + \mu}{\sigma - \mu} L_U, \quad Y_P = L_U, \] 

(17)

and consumers face price indices

\[ Q_C = \left( \frac{L_S^C}{\sigma \rho_C} \right)^{1/(1-\sigma)} \phi_C \rho_C, \quad Q_P = \tau Q_C. \] 

(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

\[ \frac{w_S^C}{w_S^P} > \frac{1}{\tau^{\mu}}, \] 

(19)
$w_C^S$ is the wage paid to the skilled in the core, while $w_P^S$ denotes the wage that a skilled worker would receive if he moved to the periphery, and is given by

$$w_P^S = \varphi_C^{-1} \left( \frac{\rho_C}{\rho_P} \right) \sigma \left( \mu L_u^{S} \sigma L_w^{S} \right) \left[ \tau^{\sigma-1} + \tau^{1-\sigma} \frac{\mu}{\sigma - \mu} (1 + \varphi_C) + \tau^{1-\sigma} \varphi_C \right]. \quad (20)$$

Substituting for $L_1^S = L_w^S$, $L_2^S = 0$, and $w_P^S$, we rewrite (19) as

$$\sigma (\varphi_C + 1) \varphi_C^{1-\sigma} \left( \frac{\rho_P}{\rho_C} \right) \sigma \tau^{\mu+1-\sigma} - (\sigma \varphi_C + \mu) \tau^{2(1-\sigma)} - \sigma + \mu > 0. \quad (21)$$

We see that (21) in general holds if $\tau$ is low enough and inter-industry spillovers are not too dominant relative to intra-industry spillovers. Compared to the standard new economic geography models (see Fujita et al., 1999), the inter-industry spillovers add an extra dispersion force to the model, while the intra-industry spillovers add a further agglomeration force.7

Our policy analysis rests on the condition that parameter values are within the range supporting the sustainability of the core–periphery equilibrium depicted by condition (21).

3.1. Efficiency and equity

Baldwin et al. (2003) show that the market outcome in the type of new economic geography model employed here is always Pareto efficient, in the sense that no change in the spatial allocation of industry can produce a welfare gain for one group without harming another group.

However, the core–periphery outcome generates regional inequalities. It follows from (17) and (18), that both real and nominal income per capita is indeed higher in the core than in the periphery. In line with empirical evidence on the sources of regional income disparities in Europe (see, e.g., Ciccone, 2002; Duranton and Monastiriotis, 2002; Rice and Venables, 2003) we see that the reason for divergence in nominal income is a combination of three factors: (i) the skill premium; (ii) the concentration of skilled labour in the core; and (iii) the intra- and inter-industry spillovers determined by population (activity) density.

The greater the inter-industry spillovers, the lower the wage of the unskilled in the periphery relative to that in the core. The gap in the real earnings of the unskilled across regions is even higher than the one in nominal earnings, since the nominal wage gap is further magnified by trade cost

$$\frac{w_C^U}{Q_C} = \varphi_C \tau. \quad (22)$$

While the core–periphery equilibrium is Pareto efficient, it does not allow for horizontal equity. What remains is the question of whether a planner with a utilitarian social welfare function can improve on the decentralized equilibrium. Baldwin et al. (2003) provide a

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7Inter-industry spillovers reduce the labour requirement in sector A and increase unskilled wages. Since unskilled workers are also used in the production of B goods, inter-industry spillovers and higher wages obviously have a negative impact on profitability in sector B. Due to inter-industry spillovers, unskilled workers will be more expensive to employ in the core than in the periphery, so inter-industry spillovers serve as a dispersion force.
detailed welfare analysis of the type of economic geography model employed here. They show that if the stock of immobile, unskilled labour in the economy is small enough, the core–periphery is always efficient as a market outcome. But if the stock of unskilled labour is relatively large, there will be a parameter space that supports agglomeration under the free market and dispersion under the planner.

The model employed here differs only slightly from the one in Baldwin et al. Its additional features include intra- and inter-industry spillovers. Therefore, the principal results on efficiency derived by Baldwin et al. also apply here. As the analysis below shows (see Section 4.1), intra-industry spillovers have the effect of diminishing the parameter space that supports agglomeration under the free market and dispersion under the planner. Inter-industry spillovers have the opposite effects and enhance this parameter space.

4. Regional policies

Our aim is to evaluate a set of regional policy initiatives according to their impact on regional inequalities, on the welfare of different groups of labour, 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?

First, we consider the impact of a regional policy that aims at reducing regional inequalities by forcing an allocation of industry that is different from the one that market forces would deliver. Such an approach provides a simplified—but useful—picture of current European regional policies, which to a large extent aim at attracting firms to poor peripheral locations.

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 the 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 labour. We compare the ways different regional policies affect the welfare of individual groups, equity and social welfare of the economy as a whole. We discuss what type of policy is least costly under what circumstances.

8Other welfare analyses of new economic geography models are given by Charlot et al. (2003) and Ottaviano and Thisse (2002). Charlot et al. provide a thorough welfare analysis of the Krugman (1991) model, emphasizing the importance of societal values, while Ottaviano and Thisse (2002) address the optimality of an equilibrium with agglomeration versus one with dispersion using a model with quasi-linear preferences.

9The EU and national European governments have a policy of relocation, spending large amounts on direct and indirect subsidies. These 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 evaluated.

10An alternative approach to the reduction of regional inequalities would be to encourage the migration of unskilled workers from the periphery to the core. This would in general appear to be the most efficient way of abolishing regional inequalities. We have, however, chosen not to discuss this policy option. There are two reasons why. First, the “migration alternative” appears unpalatable from a social (and thus political) perspective. Second, our policy analysis is very much motivated by the European situation. One of the key characteristics of Europe is indeed the lack of labor mobility—a recurrent concern of economists and policy-makers. Moreover, empirical analyses moreover show that the mobility is lower for unskilled than for skilled workers.

To conclude, abolishing regional inequalities by inducing the migration of unskilled workers seems neither a socially palatable nor a feasible alternative.
The welfare indicator we adopt is a utilitarian social welfare function, implying that social welfare is measured as the simple sum of real earnings (indirect utilities) over all individuals. However, the evaluation of regional policies may be affected by societal values and choice of social welfare function, and this we eventually discuss in Section 4.4.

Our point of departure is a core–periphery equilibrium. The government’s objective is 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. \( \frac{w_{U}}{Q_{C}} = \frac{w_{U}}{Q_{P}} \).

It follows that the government’s objective is limited to providing horizontal equity. However, we show that through choice of policy it may also reduce personal inequalities and thereby increase vertical equity across different groups of labour—a point, to which we will return later.

4.1. Policy I: Moving activities to the periphery

We first consider how forcing relocation of economic activity can allow for regional inequalities to be eliminated: i.e. to achieve \( \frac{w_{U}}{Q_{C}} = \frac{w_{U}}{Q_{P}} \). Since regions are assumed to be identical along all dimensions, this objective can be met only 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 dispersed (symmetric) equilibrium and let the equilibrium values be denoted by a subscript \( D \).

The number of firms in the two regions is given by

\[
n_{D} = \frac{L_{W}}{2 \mu \rho_{D}},
\]

with \( \rho_{D} = \rho(L_{W}^{S}/2) \). From (3) it follows that \( \rho_{D} > \rho_{C} \), and that due to localized intra-industry knowledge spillovers the total number of firms in the economy is smaller under a dispersed equilibrium than under an agglomerated equilibrium. As for equilibrium quantities of each produced variety and wages for skilled workers these are given by

\[
x_{D} = \frac{2 \mu \sigma x L_{U}}{(\sigma - \mu)L_{W}^{S}},
\]

\[
w_{D}^{S} = \frac{2 \mu \varphi_{D} L_{U}}{(\sigma - \mu)L_{W}^{S}},
\]

respectively, with \( \varphi_{D} = \varphi(L_{W}^{S}/2) \). Income in each of the two regions under the dispersed equilibrium is

\[
Y_{D} = \frac{\sigma \varphi_{D} L_{U}}{\sigma - \mu}.
\]

We observe that total nominal income in the economy is higher in the dispersed equilibrium than in the agglomerated equilibrium, see (17) and (26). This is due to the existence of inter-industry knowledge spillovers. It implies that the distribution of sector \( B \) activity

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\[11\text{Total nominal income is always higher in a dispersed than in an agglomerated equilibrium, since } 2Y_{D} > Y_{P} + Y_{C}, \text{ as longs as } L_{P}^{S} > 1. \text{ This follows from the fact that } 2\varphi_{P} > \varphi_{C} + 1 \text{ because } \varphi() \text{ is concave. However, this is not true for total real income, which is affected by the magnitude of both inter- and intra-industry spillovers. If inter-industry spillovers are weak and intra-industry spillovers are strong, the core–periphery allocation of firms will typically lead to higher income than a dispersed allocation of firms.} \]
across regions affects total income of the economy, and is then higher under the dispersed than under the agglomerated equilibrium. In the absence of inter-industry spillovers, total income would be unaffected by the localization of sector $B$ activity. Because of the income effect, it is also the case quantities and skilled wages are higher under the dispersed than under the agglomerated equilibrium, $x_D > x_C$ and $w^S_D > w^S_C$.

Consumers face price indices

$$Q_D = \left(\frac{(1 + \tau^{1-\sigma})L^S_W}{2z\rho_D}\right)^{1/(1-\sigma)} \varphi_D \rho_D.$$  \hspace{1cm} (27)

In the absence of inter-industry spillovers, $Q_C < Q_D$, see (18). But the presence of inter-industry spillovers serves to drive up unskilled wages, and in turn prices on $B$ goods. From (18) and (27) it follows that $Q_C < Q_D$ will only be true if

$$\left(\frac{\rho_D}{\rho_C}\right)^{1/(1-\sigma)} \left(\frac{2}{1 + \tau^{1-\sigma}}\right)^{1/(1-\sigma)} \frac{\varphi_C \rho_C}{\varphi_D \rho_D} < 1.$$ \hspace{1cm} (28)

What we have called the 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 is the case in a dispersed equilibrium. In the presence of positive trade costs what we have called the TC-effect, will also be less than unity. But as for the price-index-effect, which depicts the price on $B$ goods under a core–periphery equilibrium relative to that under a dispersed equilibrium, this may be less than or greater than unity depending on the magnitude of intra- versus inter-industry spillovers. Our analysis is based on the assumption that intra-industry knowledge spillovers are stronger than inter-industry knowledge spillovers. Formally, this means that $\varphi_C \rho_C < \varphi_D \rho_D$, and implies that $Q_C < Q_D$ will always hold.

Our welfare assessment is based on a comparison of real earnings for the three economic groups—the skilled workers in the core ($V^S_C$), the unskilled workers in the core ($V^U_C$) and the unskilled workers in the periphery ($V^U_P$)—and on the sum of their real earnings as a measure of total social welfare.

We go on to examine how real earnings change as government intervention takes us from the market equilibrium, which is characterized by industrial agglomeration in a single region, to one with equal distribution of activity between the two regions. Formally expressed, the changes in welfare are

$$\Delta V^S_C = \frac{w^S_D}{P_D} \frac{w^S_C}{P_C} = \frac{\mu L^U}{(\sigma - \mu)L^S} \left[ \frac{1}{Q_D^\mu} (2\varphi_D - (\varphi_D + 1)) - \varphi_C (1 - \frac{Q_C}{Q_D}) \right]_{IE > 0} \frac{1}{Q_D^\mu} - \frac{1}{Q_C^\mu} \right]_{PE < 0},$$ \hspace{1cm} (29)

$$\Delta V^U_C = \frac{w^U_S}{P_S} \frac{w^U_C}{P_C} = \frac{\mu L^U}{Q_D^\mu} (\varphi_D - \varphi_C) - \varphi_C \left( \frac{1}{Q_C^\mu} - \frac{1}{Q_D^\mu} \right) < 0, \quad IE < 0 \quad PE < 0$$ \hspace{1cm} (30)
It is possible to view the effects of policy intervention on real earnings as two types: An income effect \((IE)\) and a price-index effect \((PE)\). In the absence of inter-industry spillovers, the income effect is zero for all three groups. In this case the location of sector \(B\) activity affects neither wages in sector \(A\) nor total income of the economy, see the discussion above. However, with positive inter-industry spillovers, policy intervention has a positive income effect on skilled workers in the core and unskilled workers in the periphery, but a negative income effect on unskilled workers in the core.

The price-index effect 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 sector \(B\) goods consumed and (ii) a reduced number of varieties is now being offered, reflecting the fact that policy intervention prevents the exploitation of positive externalities. Whether the inhabitants of the periphery experience a positive or a negative price-index effect depends on the magnitude of trade costs relative to the reduction in number of varieties.

Figs. 1–3 show welfare assessments for the individual groups of inhabitants in three cases: (i) zero knowledge spillovers, (ii) relatively weak intra-industry knowledge spillovers, (iii) relatively strong intra-industry knowledge spillovers.\(^{12}\)

They illustrate 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 greater the higher the 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 (Fig. 1).

\(^{12}\)All figures given in this paper are based on numerical simulations employing parameter values supporting a core–periphery equilibrium. See the appendix for parameter values.
However, with localized spillovers we see that the location of activity never ceases to matter for productivity and, therefore for welfare. As a consequence, policy intervention causing relocation has a negative impact on real earnings of skilled and unskilled labour in the core even for zero trade costs (see Fig. 1 as compared to Figs. 2 and 3).

With intra-industry spillovers, the reduction in earnings is, in fact, most significant for the unskilled in the core, since the 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 sector B goods now has to be imported from the other region (see Figs. 2 and 3).

As for unskilled workers in the periphery they will typically gain from relocation if trade costs are high and inter-industry spillovers significantly relative to intra-industry spillovers.
But with low trade costs and relatively high intra-industry spillovers they may actually lose as a result of regional policy intervention (see Fig. 3). Why? If trade costs are high the cost savings that unskilled workers in the periphery enjoy due to the relocation of activity are accordingly high. If inter-industry spillovers are high, proximity to sector B activity matters substantially for productivity and wages in the A sector, and thus for unskilled wages. On the other hand, relocation impedes the full exploitation of intra-industry spillovers: And if these are important, the welfare loss (reflected through fewer varieties and possibly higher prices) incurred by splitting up the industrial agglomeration may come to dominate the other forces at work, so that even the unskilled in the periphery are worse off, with a forced dispersion of activity rather than with agglomeration in the core.

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

$$\left( \sum V \right)^{\text{Policy}} - \left( \sum V \right)^{\text{Market}} = \Delta V^S_C L_W^S + \Delta V^U_C L^U + \Delta V^U_P L^U$$

$$= \frac{2 \sigma L^U \varphi_D}{(\sigma - \mu) Q^D} - \frac{\mu L^U (\varphi_C + 1)}{(\sigma - \mu) Q^C} - \frac{(\varphi_C + 1) L^U}{Q^C} - \frac{L^U}{Q^C \tau^U} \geq 0$$

and is illustrated in Fig. 4. For any given level of trade costs, the net loss to the economy due to a relocation policy will be greater the more significant the intra-industry knowledge spillovers, but smaller the more significant the 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 rents from agglomeration are greatest for an intermediate level of trade costs (see, e.g., Fujita et al., 1999).

From (32) and (21) it can, moreover, be derived that if the stock of mobile, skilled labour is large enough relative to the stock of immobile, unskilled labour, then there is a certain parameter space within which the free market supports agglomeration, while maximum

Fig. 4. A regional policy of relocation: Impact on total welfare.
social welfare is obtained with dispersion. Hence, a regional policy forcing dispersion of activity may not only achieve equity but also allow for efficiency gains: i.e. higher social welfare. This may typically be true for an intermediate level of trade costs, and weak intra-industry relative to inter-industry spillovers. The results are in line with those of Baldwin et al. (2003), which were discussed in Section 3.

Our analysis sheds some light on an unfortunate feature 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 our analysis also makes clear that by inducing relocation one may potentially enhance inter-industry spillovers, and thereby productivity and earnings in poor peripheral regions.

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

The second type of policy we consider is based on direct income transfers financed over a non-distortionary tax scheme. The income subsidy \((s)\) to unskilled workers in the periphery is funded by a national income tax \((t)\). Given the objective of the government, the policy initiative has to ensure

\[
\frac{(1-t)\varphi_C}{P_C} = \frac{(1-t)(1+s)}{P_{P}}. \tag{33}
\]

From (33) it follows that such a transfer scheme implies a subsidy equal to

\[
s = \varphi_C \tau^\mu - 1. \tag{34}
\]

The budget condition underlying such a policy initiative is given by

\[
sL^U = t(w^S_L^S + \varphi_CL^U + (1+s)L^U), \tag{35}
\]

from which we derive the equilibrium tax rate

\[
t = \frac{(\varphi_C \tau^\mu - 1)(\sigma - \mu)}{\sigma \varphi_C + \mu + (\sigma - \mu) \tau^\mu \varphi_C}. \tag{36}
\]

Direct transfers to inhabitants of the periphery imply reduced earnings for both skilled \((V^S_C)\) and unskilled workers \((V^U_C)\) in the core region, and increased earnings for unskilled workers \((V^U_P)\) in the periphery. Unlike a policy based on relocation of activity, a policy of direct income transfers has only an income effect and no price-index effect. Formally expressed we have

\[
\Delta V^S_C = \frac{(1-t)w^S_C}{P_C} w^S_C = -\frac{\mu L^U}{(\sigma - \mu)L^S_W} \frac{1}{Q^\mu_C} (\varphi_C + 1) \frac{(\tau^\mu \varphi_C - 1)(\sigma - \mu)}{\sigma \varphi_C + \mu + \tau^\mu (\sigma - \mu) \varphi_C} < 0, \tag{37}
\]

\[
\Delta V^U_C = \frac{(1-t)\varphi_C}{P_P} - \frac{\varphi_C}{P_P} = -\frac{\varphi_C}{Q^\mu_C} \frac{(\tau^\mu \varphi_C - 1)(\sigma - \mu)}{\sigma \varphi_C + \mu + \tau^\mu (\sigma - \mu) \varphi_C} < 0, \tag{38}
\]
\[
\Delta V^U_p = \frac{(1 - t)(1 + s)}{P_p} - \frac{1}{P_p} = \frac{\tau^\mu \phi_C - 1}{\tau^\mu Q^\mu_C} - \frac{\phi_C}{Q^\mu_C} \frac{\phi_C^\mu - 1}{\sigma \phi_C + \mu + \tau^\mu (\sigma - \mu) \phi_C} > 0.
\]

(39)

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

\[
\left( \sum V \right)_{\text{Policy}^2} - \left( \sum V \right)_{\text{Market}} = \Delta V^S_C L^S_W + \Delta V^U_C L^U + \Delta V^P_C L^U = -\frac{L^U (\tau^\mu - 1)(\mu + \phi_C \sigma)(\phi_C^\mu - 1)}{Q^\mu C (\phi_C \sigma + \mu + (\sigma - \mu) \phi_C^\mu)} \leq 0,
\]

(40)

and is always negative as long as trade costs are positive.\(^1\) Policy intervention implies a welfare loss, but from (40) it follows that this loss decreases monotonically in trade costs, eventually to vanish for zero trade costs. Still, we observe that a regional policy based on direct income transfers will never improve the social welfare of the economy (see (40)) relative to market outcome. In contrast, a policy forcing dispersion of activity—as analysed in the preceding section—may under certain circumstances actually not only allow for equity to be achieved but also foster increased efficiency.

Due to the fact that the tax scheme that funds the income transfers to the periphery is levied economy-wide, the location of economic activity is not affected by the policy intervention, and so neither is the stability of the agglomerated market equilibrium.\(^2\) 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 a policy forcing relocation. The expression in (41) is positive if direct transfers deliver higher social welfare than relocation of activity, while it is negative if the opposite is true—i.e. if a distortionary policy is superior to a non-distortionary alternative:

\[
\Delta \left( \sum V \right)_{\text{Policy}^2 \text{versus Market}} - \Delta \left( \sum V \right)_{\text{Policy}^1 \text{versus Market}} = \frac{\sigma L^U}{(\sigma - \mu)} \left[ \frac{\phi_C + 1}{Q^\mu_C} (1 - t) - \frac{2 \phi_S}{Q^\mu_S} \right] \geq 0.
\]

(41)

This is shown in Fig. 5. 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 less costly than a policy based on non-distortionary financing. Fig. 5 shows that for low trade costs, direct income subsidies are typically more efficient than forcing the dispersion of activity. But for high trade costs we see that the opposite may be true. This means that eliminating regional inequalities through relocation of activity rather than direct income transfers will typically

\(^1\)It should be noted that (40) is always negative because of a feature of the model shared by most new economic geography models: i.e. taking one unit of value from the core and giving it to the periphery destroys value in real terms. Ottaviano and Thisse (2002) use a model with quasi-linear utility preferences in order to avoid this type of effect. The choice of social welfare function may, however, also affect the magnitude of this effect. We return to this in Section 4.4.

\(^2\)The non-distortionary impact of the tax scheme relies on the assumption of preferences being homothetic, on the limit to the transfer as depicted by (34) and on the assumption that mobile, skilled workers do not coordinate their choice of location.
be more efficient if trade costs are high, intra-industry spillovers relatively insignificant and inter-industry spillovers relatively significant.

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. The efficiency loss from a distortionary relative to a non-distortionary financed policy is most significant for intermediate to low trade costs at which point agglomeration rents peak.

Fig. 5 illustrates that increased intra-industry knowledge spillovers amplify the relative efficiency gain of a regional policy of direct income subsidies relative to 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 mobile skilled labour 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 et al., 1991; Bucovetsky and Wilson, 1991). In order to minimize the efficiency loss related to the acquisition of funds for transfers, one would thus assume 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; 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 difficult in political terms, since it also levies a significant net tax burden also on low-income groups: i.e. the unskilled labour in the core. In order to lighten this burden, a tax on the high-income group may appear an attractive alternative. Moreover, a tax on skilled labour only implies that while achieving the goal of horizontal equity, the government is in addition able to reduce personal income inequalities and thereby improve vertical equity.\(^{15}\)

So a subsidy is introduced to ensure equal unskilled real earnings across regions: i.e.

\[
\frac{q_C}{p} = \frac{(1 + s)}{p},
\]

which is financed by a tax on the skilled labour employed by the agglomeration.\(^{16}\)

As long as this scheme does not affect the sustainability of the industrial agglomeration, it will not affect prices, equilibrium quantities, number of firms or pre-tax wages. As before, the objective function of the government implies a subsidy \(s = \varphi_C \tau^u - 1\). The government’s budget condition is now given by \(tw^SL^S_W = sL^U\), so that the equilibrium tax rate equals

\[
t = \frac{(\sigma - \mu)(\varphi_C \tau^u - 1)}{\mu(\varphi_C + 1)}.
\]

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

\[
\Delta V^S_C = \frac{w^S_C}{p} - \frac{(1 - t)w^S_C}{p} = - \frac{\mu L^U}{(\sigma - \mu)L^S_W} \frac{1}{Q^u_C} \frac{1}{(\varphi_C + 1)} (\sigma - \mu)(\varphi_C \tau^u - 1) < 0,
\]

\[
\Delta V^U_C = 0,
\]

\[
\Delta V^U_p = \frac{1 + s}{p} - \frac{1}{p} = \frac{(\varphi_C \tau^u - 1)}{Q^u_p} > 0.
\]

 Compared to the economy-wide funded transfer policy examined in the previous section, the increase in real earnings received by the unskilled workers in the periphery is in this case more substantial (see (39) and (46)). The reduction in welfare experienced by the skilled workers in the core is, on the other hand, greater (cf. (37) and (44)). As the unskilled workers in the core are not affected by a tax on the mobile factor of the agglomeration, they are better off than they would have been with a regional policy based on an economy-wide tax.

\(^{15}\)Note that a tax on skilled labor represents a type of tax instrument that may be feasible and realistic when the active government is national but is less so when it is supra-national such as e.g. the EU Commission. The latter type typically has fewer tax instruments at hand. As regards the EU, this may, however, change in the future (although probably not in the near future).

\(^{16}\)We note that the working of such a scheme is identical to one where a tax is levied on parts of firms’ costs: Namely those linked to the agglomeration-specific factor—skilled labour.
Skilled labour in the core is worse off, because (i) the workers have to carry the burden of funding the transfer scheme alone and (ii) the net sum of transfers to the periphery is higher. The net sum is higher because the net real earnings of unskilled workers in the core are higher as they do not have to pay taxes, and horizontal equity consequently implies greater transfers.

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

$$\left( \sum V \right)_{\text{Policy}^3} - \left( \sum V \right)_{\text{Market}} = \left( \frac{\varphi_C \tau^u - 1}{Q_C^u} \right) \left( \frac{1}{\tau^u} - 1 \right) \leq 0. \quad (47)$$

Fig. 6 allows us to compare the welfare effects on the three different regional policy 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 (40) and (47). The reason is simply that in the latter case there is a greater transfer to the periphery, and a more significant loss in total welfare, as consumption here incurs wasteful trade costs.

However, a tax levied on the mobile factor of the agglomeration may affect the stability of the industrial agglomeration. So 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 of 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

$$(1 - t)^\sigma (\phi_C + 1) \phi_C^{1 - \sigma} \left( \frac{\rho_p}{\rho_C} \right)^\sigma \tau^{u+1-\sigma} - (\sigma \phi_C + \mu) \tau^{2(1-\sigma)} - \sigma + \mu > 0. \quad (48)$$

For a tax on skilled labour in the core not to have any distortionary effects by inducing delocation of industrial activity, it follows from (48) that a tax rate cannot exceed the
threshold level $t^*$:

$$t < t^* = \frac{\sigma(\varphi_C + 1)\varphi_C^{1-\sigma}(\rho_P/\rho_C)^{\sigma} \tau^{\mu+1-\sigma} - (\sigma\varphi_C + \mu)\tau^{2(1-\sigma)} - \sigma + \mu}{(\varphi_C + 1)\varphi_C^{1-\sigma}(\rho_P/\rho_C)^{\sigma} \tau^{\mu+1-\sigma}}.$$

Fig. 7 shows the tax that would allow for regional equity as per (43), and of the tax rate that would be consistent with sustaining the industrial agglomeration in the core (see (49)). 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. 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 Fig. 7 gives the trade cost level below which a tax scheme based merely on the taxation of skilled mobile labour allows for inter-regional equality without affecting the sustainability of the industrial agglomeration. From (49) and Fig. 7 it can be seen that the more significant the localized intra-industry knowledge spillovers (measured by $\rho_P/\rho_C$), the higher ceteris paribus, the tax rate consistent with sustaining the agglomeration. (Graphically, enhanced intra-industry spillovers imply an upward shift in the hump-shaped curve.) On the other hand, the greater the inter-industry spillovers, the lower the tax rate that allows for the agglomeration to be sustained. Comparative static on (49) further reveals that the threshold level $t^*$ is increasing in market linkages ($\mu$) and decreasing in elasticity of substitution ($\sigma$).

It follows from Fig. 7, that for high trade costs, 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 is no alternative. But for significant intra-industry spillovers, weak inter-industry spillovers and lower trade costs there may be scope for such a policy. Hence, under certain circumstances a government has
the option to introduce a regional policy that not only allows for horizontal equity but also lets it reduce the gap between low- and high-income groups.\footnote{The development of EU spending shows that increased integration (i.e. lower trade costs) has indeed allowed for the conduct of policy that promotes vertical equity. Baldwin and Wyplosz (2004) provide an overview of EU spending from 1958 to 2006. They demonstrate that the total EU budget has increased as the EU has become more integrated (i.e. trade costs have fallen). Most relevant in this context is the fact that not only the total budget but also the Cohesion funds have increased. Cohesion funds allow for transfers from the rich regions of the EU—characterized by agglomeration of industrial activity and a relatively skilled and high-income labour force—to the poor regions of the EU with little activity and typically a labour force that is unskilled and earns a low income. So, in practice, cohesion funds mean transfers not only from rich to poor \textit{regions}, but transfers from rich to poor \textit{people}.}

4.4. Evaluating regional policies: The impact of societal values

So far our welfare assessments of the alternative regional policies have been based on a utilitarian welfare criterion. However, the relative merits and costs of regional policies depend on societal values. Charlot et al. (2003) point out that the utilitarian criterion will tend to be biased towards agglomeration, in that it supports this configuration for the largest interval of trade cost.

In order to see how—and to what extent—the choice of welfare criterion may affect the comparison of regional policies, we follow Charlot et al. and apply the CES-family of social welfare functions, which are commonly used in public economics. Letting $V^S_i$ depict the real earnings (indirect utility) of a skilled worker in region $i$, $V^U_i$ the real earnings of an unskilled worker in region $i$ and $h$ the spatial allocation of activity (state of the economy), the welfare indicator is given by

$$W(h) = \begin{cases} 
\frac{1}{1-\eta} \left[ \sum_{i=1}^2 V^S_i(h)^{1-\eta} L^S_i + \sum_{i=1}^2 (V^U_i(h))^{1-\eta} L^U_i \right] & \text{for } \eta \neq 1, \\
\frac{1}{1-\eta} \left[ \sum_{i=1}^2 \ln V^S_i(h) L^S_i + \sum_{i=1}^2 \ln V^U_i(h) L^U_i \right] & \text{for } \eta = 1, 
\end{cases} \quad (50)$$

$\eta \geq 0$ measures the degree of aversion towards inequality, and as $\eta$ rises the bias towards the disadvantaged group increases. We see that for $\eta = 0$, the welfare function is identical to the utilitarian welfare indicator employed throughout Sections 4.1–4.3. Comparison of Figs. 6 and 8 illustrates how aversion to inequality affects the ranking of regional policies relative to each other as well as relative to the core-periphery equilibrium in terms of social welfare. Fig. 8 is drawn for the same parameter values as Fig. 6. But while the simulations underlying Fig. 6 are based on a utilitarian welfare criterion (i.e. $\eta = 0$), those underlying Fig. 8 are based on the assumption of some degree of aversion towards inequality, and use $\eta = 0.9$. Note that, as before, the figure is drawn for an interval of trade costs for which the free market supports the core–periphery equilibrium.

Comparing Figs. 6 and 8, we see that the change in welfare criterion may affect the ranking of the policy alternatives. The interval of trade costs within which a regional policy based on direct transfers is superior to a policy inducing relocation is greater with a utilitarian welfare approach than with a welfare function embodying an aversion towards inequality.

Moreover, for low trade costs, policy intervention may actually be superior to laissez-faire as a regional policy based on direct income transfers actually produces higher social...
welfare than the core–periphery equilibrium. Therefore with a welfare criterion other than utilitarian, direct transfers as means of regional policy may not only eliminate inequalities but also improve efficiency.

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 the level of trade costs and the degree of pecuniary externalities, magnitude of localized inter- and intra-industry knowledge spillovers and the elasticity of substitution. We emphasize that optimal policy design will, however, also be a function of the government’s underlying societal values.

We have compared the welfare costs of a distortionary regional policy forcing relocation of activity with a regional policy based on direct income transfer financed over non-distortionary tax schemes. We find that the relocation alternative is the most costly one for intermediate trade costs and high intra-industry knowledge spillovers. But for high trade costs, insignificant intra-industry knowledge spillovers and relatively more significant inter-industry spillovers the opposite is found to be true: A policy of relocation is actually less costly than one based on direct income transfers. For intermediate trade costs and relatively weak intra-industry spillovers, such a policy may even be welfare improving relative to the market outcome.

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 feasible when there are high intra-industry relative to inter-industry spillovers and trade costs are relatively low.

Finally, we examined the role played by different societal values—in particular the degree of aversion towards inequality—mirrored through different social welfare functions. If the government has a negative attitude towards inequality, not only may this affect the ranking of the alternative regional policies, but for low trade costs a regional
policy initiative based on direct transfers may deliver equity as well as higher social welfare than the market outcome.

What can this analysis teach us about European regional policies? We have shown that the relative welfare cost of regional policy initiatives depends on the magnitude of inter-relative to intra-industry externalities. If the latter type of positive externalities is more prevalent than the former, a policy inducing the relocation of activity will tend to be more costly than one based on direct income transfers. Empirical analysis (see, e.g., Bottazzi and Peri, 2002) suggests that regional knowledge spillovers in the EU may indeed be much more important in an intra-industry than an inter-industry context. If so, regional inequalities may be more efficiently eliminated through direct income transfer to the EU periphery than by inducing relocation.

Our analysis underscores the need for increased insight regarding the prevalence and relative importance of different types of externalities and the degree of integration (level of trade costs) when designing regional policy.

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Appendix

Functions and parameter values used for simulations:

\[ \rho_i = (1 + L_i^S)^{-\varepsilon}, \varphi_i = (1 + L_i^S)^{\xi} \]

\[ \sigma = 3, \mu = 0.5, L^U = 6, L^S_W = 2 \]

Figs. 1–5, 7:

Zero knowledge spillovers: \( \varepsilon = \xi = 0 \);
Relatively weak intra-industry spillovers: \( \varepsilon = 0.2, \xi = 0.1 \);
Relatively strong intra-industry spillovers: \( \varepsilon = 0.4, \xi = 0.1 \).

Figs. 6:

Relatively strong intra-industry spillovers: \( \varepsilon = 0.4, \xi = 0.1 \).

Figs. 8 and 9:

Relatively strong intra-industry spillovers: \( \varepsilon = 0.4, \xi = 0.1 \);
Relatively weak intra-industry spillovers: \( \varepsilon = 0.2, \xi = 0.1 \);
Zero aversion to inequality: \( \eta = 0 \);
Aversion to inequality: \( \eta = 0.9 \).
References


