

Agglomeration economies and the regional policy choices of countries*

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Abstract

This paper investigates the effects of agglomeration economies on the regional policy choices of countries.

The analysis uses a 2-country-4-region model with agglomeration economies, an immobile production factor and a mobile one, allowing the study of international capital and profit flows; moreover, different assumptions on bilateral transport costs allow to obtain results in different spatial settings.

Countries are allowed to allocate their policy efforts towards either domestic region, or a combination of the two, pursuing equity, efficiency, or a welfare function which weights both objectives.

The paper shows that concurrent and often conflicting interests co-exist, between regions and between owners of mobile production factors vs. owners of mobile ones.

Trade-offs arise especially when agglomeration economies are strong, but their emergence is also linked to two other important control variables which can affect the results: (i) the spatial settings of the economy, in particular the existence of peripheral regions, and (ii) the differences of territorial characteristics between the regions of which a country is composed or, as it is increasingly defined, the territorial capital of the regions, whose effects can be exogenously introduced in the model.

Also investigated are the international effects of regional policy, through the effects of the policy decisions of one country on the equity and the efficiency of the other one.

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1 Introduction

The European economic landscape has experienced a process of growing integration, due to the expansion of the European Union and the deepening of integration inside it. At the same time, countries and regions have been put under increasing pressure by international competition, since new competitors on a global arena have arrived and are expanding their product range beyond traditional productions.

The recent economic crisis has made the international competition problems worse, and also for this reason, it is becoming increasingly difficult to run and justify policies aimed at reducing spatial disparities within countries on a mere equity ground but the EU and its member countries are looking again at regional “cohesion” policies¹ as a mean to also become more competitive in a globalized world (EU Commission, 2007, 2008).

Regions have hence become not simple parts of the national economies, but actors whose effectiveness in competition determines the welfare of the whole country. In fact, increasing attention has been paid in the literature to aspects such as the presence of agglomeration economies (Rosenthal and Strange, 2001; Ciccone, 2002; Rosenthal and Strange, 2004), innovation spillovers (Audretsch and Feldman, 1995, 2004; Varga and Schalk, 2004; Maier and Sedlacek, 2005), knowledge networks (Fisher, 2001), social and territorial capital (Putnam, 1993; Camagni, 2009).

Because of these theoretical advancements, there is increasing attention to indigenous regional characteristics as key factors of national development, and, consequently, regional policies are no longer the same for all regions at the same level of development but are intensifying their degree of adaptation to the different structures of regions, with a process of “customization”.

Also mainstream economic theory shows a renewed interest in spatial aspects, first induced by the works of Krugman (1991), and soon followed by a large number of extensions (as signalled by the books by Fujita et al., 1999; Fujita and Thisse, 2002). However, most literature focused on the origin and consequences of agglomeration, whereas only a more recent strand has regional policies as its main investigation topic (Martin, 1998; Puga, 2002; Baldwin et al., 2003; Ottaviano, 2003).

Even more limited are the contributions which investigate explicitly the consequences of the initial differences between the regions of which a country is composed, something which would be called “territorial” specificities in an

¹By *regional policy*, we mean in this paper any policy which aims at changing the spatial distribution of economic activities within countries. Consistently with the tradition of regional science (e.g. Richardson, 1979; Vanhove, 1999) we assume that regional policy can have either a spatial equity or an economic efficiency objective, or both. The term regional policy is hence used here in a broader meaning than just development policies for lagging regions, since here the focus is broader and also includes policies to improve national competitiveness by better allocating economic activities within the country.

heterodox framework. In fact, if on the one side it is very interesting from a theoretical and a policy point of view to analyze the origin of clusters and agglomerations starting from an homogeneous situation, it is on the other side important to notice that regions are indeed very different and the creation of agglomerations in one of them is often also linked to stronger indigenous characteristics. Without neglecting the role of self-reinforcing mechanisms, it is therefore interesting to observe what role play “territorial” characteristics in presence of these mechanisms.

Another aspect is even less investigated: in a world which is economically integrated (to a certain extent, at least), the effects of regional policies in one country may spread to other countries as well. If the regional policies are designed to help countries and regions to compete internationally, they will bring effects on other countries and regions as well. However, in the literature, most models only analyze the intra-national effects of regional policies or the inter-national effects of integration.

But, if regional policies are largely determined at an international level, as is the case of the EU cohesion policy, there will be different concurring interests by international stakeholders also in determining how the commitments of this policy are to be distributed within nations, in terms of which regions and which type of policies. In fact, the European Union has passed from a model in which the allocation was purely national to a model in which, after the bargaining at national level, there is also a bargaining on the assignation of funds to the individual regions (Bachtler et al., 2006; Bachtler and Mendez, 2007), a model which would prevent, for example, some countries from using cohesion policy in order to boost national competitiveness by investing in their national champions.

To analyze the effects of domestic regional policies on the foreign regions (or of foreign regional policies on domestic regions), there is the need for 2-country-3-region or 2-country-4-region models, which are still little diffused².

This paper hence introduces a new 2-country-4-region model in order to analyze the effects of the regional policies of one country on another country, under different assumptions on the strength of agglomeration economies and on the territorial characteristics of regions which compose the two countries.

More specifically, we are here concerned with the effects on citizen’s economic welfare, distinguishing between types of agents and regions, and will show which effects do regional policies in one country exert on the other country in terms of welfare and spatial equity³. In particular, it will be shown that these effect depend on (1) the strength of agglomeration eco-

²Among the exceptions are: Paluzie (2001), Baldwin et al. (2003, Ch.17), and Fratesi (2008).

³The term equity in this paper will always refer to the spatial equity, i.e. to the differences of welfare between regions, leaving the issue of inter-personal equity for another interesting and flourishing but little related literature.

nomies, (2) the indigenous (exogenous) differences between the regions, i.e. the territorial characteristics and (3) the spatial settings, i.e. the geographical shape and the possible existence of peripheral regions, so also answering the question “will a different spatial configuration bring different results on the optimal policy choice of countries?” and in particular, “will the income maximizing regional policy be the same if the strongest region is bordering the other country or vice-versa?”

The remaining of the paper is organized as follows: Section 2 sets up the model; Section 3 extends the model to represent regional policies; Section 4 studies the domestic and international effects of regional policies in the limit case in which the two countries are fully integrated (i.e. when transport costs are nil); Section 6 analyzes systematically the effects entailed by regional differences under different assumptions on the strength of agglomeration economies and on the spatial setting; Section 7 concludes the paper.

2 The model

In this section a general equilibrium model is presented for the analysis of regional policies in a multi-country setting. This model does not involve growth and labour mobility, for this reason it is apt to represent short and medium run situations in which only capital can move (and is in fact assumed to be perfectly mobile).

The model features 2 countries, A and B , each composed of two regions, 1 and 2 belonging to A and 3 and 4 belonging to B . The regions can be characterized by different sizes and also by different assumed productivities. In this way, the model is able to take into account some of the endogenous regional specificities which in an heterodox literature would be called as territorial characteristics or “territorial capital” (Camagni, 2009).

The national governments (see section 3.1) can support the production in their countries and regions by allocating a public production support between the regions. The purpose is to study the interaction of country behaviors and, consequently, when the regional policies in one country can induce effects in the other. A movement of public production factor from one domestic region to the other domestic one, in fact, has the direct effect of advantaging the latter region, but has also effects on the national aggregate production and also, through the international markets for goods and capital, on the welfare of the other country (see section 3.2).

2.1 The demand side of the model

In this model, the presence of economies of agglomeration is taken for granted and assumed. In fact, the interest of the paper lies in their effect, and the different effects that are generated by their strength. The genesis

of agglomeration economies, which is the study theme of a wide theoretical and empirical literature (Rosenthal and Strange, 2004), goes beyond the scope of this paper. More specifically, the interest of this paper lies in what effects bring the economies of agglomeration to policies in the common case in which these economies of agglomeration exist.

The demand side of the model has, similarly to Fratesi (2008), a functional form inspired to the quality ladders literature (Grossman and Helpman, 1991) where to the standard love for variety hypothesis an index is added to account for agglomeration economies. In particular, the model will represent economies of agglomeration on the production side, with a structure that, instead of making more productive in terms of quantities produced the firms where more economic activity is concentrated, assumes that the firms benefit from the presence of other firms by producing goods that are superior in quality, and this is perceived by the consumers in their utility function.

This model works hence better in those cases in which there are local technological spillovers and/or industrial atmosphere, which both allow firms to produce goods of superior quality taking advantage of the co-location of other firms.

Differently from Fratesi (2008), to be able to study the effects of integration, transport costs are explicitly taken into account with a coefficient which is the usual iceberg transport cost one (see McCann, 2005). The utility function of any consumer living in region i (any of four regions) is therefore:

$$U_i = \left[\sum_0^{N_1} (N_1^\gamma x_{1i} t_{1i})^{\frac{\sigma-1}{\sigma}} + \sum_0^{N_2} (N_2^\gamma x_{2i} t_{2i})^{\frac{\sigma-1}{\sigma}} + \sum_0^{N_3} (N_3^\gamma x_{3i} t_{3i})^{\frac{\sigma-1}{\sigma}} + \sum_0^{N_4} (N_4^\gamma x_{4i} t_{4i})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

with $\sigma > 1$
and $i = 1..4$

Where N_j is the number of varieties produced in region j and x_{ji} is the amount of varieties produced in region j consumed in region i . γ is a parameter that measures the economies of agglomeration and is assumed to be smaller than 1, for the model to be solvable and larger than 0, otherwise economies of agglomeration no longer exist. Finally, t_{ji} are the bilateral transport cost coefficients between regions j and i , which are ≤ 1 and, by definition $t_{ji} = 1$ when $i = j$. The assumptions on the transport costs between the various regions, allow to derive the model results in different spatial settings, involving different degrees of integration within and between countries and also different spatial collocations of regions (see Section 5). Notice that in this functional form all the varieties produced in a region are by definition consumed in the same quantity because they enter symmetrically and there is love for variety. This would imply that it is possible to

rewrite the utility function avoiding the summation over the varieties, but the formulation of equation 1 is clearer from a theoretical point of view.

Each region will consume as much as it earns, in nominal terms. This is expressed by the following equation for the nominal income (I):

$$I_i = k_i r + L_i w_i = p_1 N_i x_{1i} + p_2 N_2 x_{2i} + p_3 N_3 x_{3i} + p_4 N_4 x_{4i} \quad (2)$$

$$i = 1..4$$

Notice that in each region any consumer consumes tx but pays x , i.e. the full quantity which is shipped. In practice, consumers are assumed to pay the gross price including transport costs; should the transport costs be paid by the producers, this would change the mathematical set-up of the model but not its consequences.

By solving the utility maximization in each region i under the constraint of equation 2 it is possible to derive the price conditions for the demand equilibrium, which are, if we use the price of the good of region 1 as numeraire:

$$\begin{cases} p_1 = 1 \\ p_2 = \left(\frac{N_2}{N_1}\right)^\gamma \left(\frac{x_{2i}}{x_{1i}}\right)^{-\frac{1}{\sigma}} \left(\frac{t_{2i}}{t_{1i}}\right)^{\frac{\sigma-1}{\sigma}} \\ p_3 = \left(\frac{N_3}{N_1}\right)^\gamma \left(\frac{x_{3i}}{x_{1i}}\right)^{-\frac{1}{\sigma}} \left(\frac{t_{3i}}{t_{1i}}\right)^{\frac{\sigma-1}{\sigma}} \\ p_4 = \left(\frac{N_4}{N_1}\right)^\gamma \left(\frac{x_{4i}}{x_{1i}}\right)^{-\frac{1}{\sigma}} \left(\frac{t_{4i}}{t_{1i}}\right)^{\frac{\sigma-1}{\sigma}} \end{cases} \quad (3)$$

Notice that the relative prices of the goods produced in different regions will be affected by the quality of goods, represented by the number of varieties produced in each region as well as by the different transport costs.

This is more evident by looking at the relative demand in region i of the goods produced in two regions y and z . This can be derived from equation 3 and shows that three effects are at play non linearly: the relative quality of goods, the relative transport costs (i.e. the relative distance of the two production regions) and the quality of goods, which is linked to the number of varieties produced:

$$\frac{x_{yi}}{x_{zi}} = \left(\frac{N_y}{N_z}\right)^{\gamma(\sigma-1)} \left(\frac{p_z}{p_y}\right)^\sigma \left(\frac{t_{yi}}{t_{zi}}\right)^{\sigma-1} \quad (4)$$

2.2 The supply side of the model

On the supply side, the model features two production factors, namely capital and labour, similarly to Behrens and Thisse (2006) and (Baldwin et al., 2003, ch. 4), but extends the framework to take into account regional policy

(see Section 3.1). Labour is assumed to be a fixed endowment of regions, i.e. it is not only immobile internationally but also interregionally, a situation that represents the short run and is not very different from the EU situation at present times.

The assumption of almost immobile labour is also at the basis of most present regional policies, which would not be justified if people would flow from the poorer to the richest regions. Other scholars (Puga, 2002) maintain that people mobility would be the solution to the imbalances due to agglomeration economies. However, people are, for personal reasons, very unwilling to move and the European regional policies consider them immobile and try and bring assistance and economic growth where they live. For these reasons, people are modelled as immobile here. Moreover, including labour mobility in order to allow longer run analysis will bring with itself the need to include the skill content of labour flows, with results for regions which are undetermined a-priori (Fratesi and Riggi, 2007; Ozgen et al., 2009).

Capital, differently from labour, is assumed in the model to be perfectly mobile across regions and countries, since people can invest wherever they find it profitable. As a consequence of capital market equilibrium, capital is rewarded with a nominal interest rate r which is the same in all regions; however, the real purchasing power of capital owners depends on the location where they are living because of transport costs which affect the prices of goods imported from other regions and countries.

For this reason, each region i will be characterized by its endowment of capital and labour. In particular, it will have L_i units of labour and k_i units of capital. The former will only be used in the regions, whereas the latter will be freely invested in any region and will bring profits back in the home regions where consumption takes place.

A monopolistic competition framework will be used, where capital is necessary for the set-up of firms (the fixed costs) and labour is used for the production of goods, so that the flexible costs are in terms of nominal wages w_i which can be different from a region to the other.

Differences of regional technology will be introduced in the rest of the paper through different values of the parameters.

The cost function of a firm operating in region i will therefore be the following:

$$C(x_i) = F_i r + a_i w_i x_i \quad (5)$$

Where x_i is the amount of goods produced by the firm, a_i is regional labour productivity and F_i is the fixed set-up cost.

Despite of the fact that the individual firms maximize their profits by selling different quantities to different regions, solving their maximization problem still brings a result in which they set up their prices as a mark-up

on flexible costs depending on the demand elasticity, just as it is in the usual Dixit and Stiglitz (1977) framework:

$$p_i = \frac{\sigma}{\sigma - 1} a_i w_i \quad (6)$$

Since free entry is assumed, in equilibrium each firm will have null profits (total costs will be equal to total revenue, $C(x) = px$) and hence the following condition will hold:

$$x_i = x_{i1} + x_{i2} + x_{i3} + x_{i4} = F_i \frac{\sigma - 1}{a_i} \frac{r}{w_i} \quad (7)$$

The dimensions of the individual firms are determined once determined the amount of labour available in the individual regions and the amount of capital available in the world economy. Since the demand of labour of the individual firm is:

$$L_{D_i} = a_i x_i = F_i (\sigma - 1) \frac{r}{w_i} \quad (8)$$

The number of firms in a region will be determined by the amount of available labour L_i , i.e. it will be determined by the labour market clearing:

$$w_i = \frac{N_i r}{L_i} (\sigma - 1) F_i \quad (9)$$

$$N_i = \frac{L_i w_i}{F_i (\sigma - 1) r} \quad (10)$$

$i = 1 \dots 4$

The 4 sets of equations above are sufficient for the labour market to clear. The capital market, which is unique due to perfect capital mobility, clears when the used capital is the same available worldwide, i.e. when the following holds:

$$N_1 F_1 + N_2 F_2 + N_3 F_3 + N_4 F_4 = k_1 + k_2 + k_3 + k_4 \quad (11)$$

With 4 regions, the model is therefore defined by 29 equations (the 12 of equation 3, the 4 of equation 14, the 4 of equation. 6 the 4 of equation 10 and equation. 11) in 29 unknowns. Notice that, in order to solve the system, the price of the production in region 1 has been taken as the numeraire and imposed to 1. The system can be reduced to 21 equations in 21 unknowns by observing that quantities are known once known the interest rates and the endowments of regions and that wages are known once prices are known.

Because of the concomitant non linearities on the demand and the supply side, it necessary to solve the model numerically. Since the non linearities increase when regional policy is added to the model, instead of solving the model now, regional policy will first be introduced and then all the analysis of the following sections will follow, based on numerical simulations of the full model.

3 The effects of regional policy

3.1 Extending the model to include regional policy

In this section, the national governments will have the possibility to implement policies that affects entrepreneurship in their regions, by intervening on the set-up costs of firms. These policies will look more like firm support or more like business services depending on the extent of rivalry on a publicly provided support to firms (S), similarly to Fratesi (2008). In particular, the support is assumed to be non-excludable and, when it is completely rival, it is like a monetary subsidy to firms. When, on the contrary, the support to firms is partially non-rival, it will look more like business service and assistance, which, though partially rival, is also subject to some economies of scale so that the provision of them to n firms is less expensive than n times the cost of providing them to one firms⁴

With public support to the set up of firms, the cost function of a firm operating in region i will become the following one:

$$C(x_i) = \left(F_i - \frac{S_i}{N_i^\delta} \right) r + a_i w_i x_i \quad (12)$$

Where δ represents the degree of rivalry in the use of public support S_i . x_i is still the amount of goods produced by the firm, a_i is still regional productivity and F_i is still the set-up cost of firms in a given region in absence of government intervention.

The two countries will be allowed to chose the best regional allocation for their national amount of S . To maintain computations simple, we will neglect how the support to firms is financed but will concentrate on how the total amount of S is distributed on the regions, also assuming that the allocation choice does not incurs in additional costs. This assumption also allows to neglect the general welfare implications of providing more or less support to firms to concentrate on the allocation of regional policy; in fact, should we allow countries to distribute different quantities of their support to firms, this will bring with itself the necessity to study how this amount is financed, making it necessary to make assumptions on which is the relative efficiency of the public sector (which would tax and spend for support) with respect to the private one (which would otherwise produce directly). We leave to further investigation taking into account the wide literature on fiscal competition (e.g. Oates, 1972; Ludema and Wooton, 2000; Wildasin, 2003) the outcome of an analogous model in which the regional and national taxation choices to finance the support to production are taken into account,

⁴Another possibility, which will be left out for another paper for reasons of space, is that government can act to increase labour productivity, as in Commendatore et al. (2009), where it reduces the labour requirement of productions. The results are potentially different since labour would be subsidized rather than capital.

because the complexity of the model would increase exponentially since it has been shown that the size of agglomeration economies also influences the taxation choice of regions, allowing them to maintain a tax base or making it convenient to apply different taxation policies in different regions (Fiorillo, 2001).

The labour market clearing conditions (equation 9) will modify to:

$$w_i = \frac{N_i r}{L_i} (\sigma - 1) \left(F_i - \frac{S_i}{N_i^\delta} \right) \quad (13)$$

The free entry conditions (equation 14) will modify to:

$$x_i = x_{i1} + x_{i2} + x_{i3} + x_{i4} = \left(F_i - \frac{S_i}{N_i^\delta} \right) \frac{\sigma - 1}{a_i} \frac{r}{w_i} \quad (14)$$

Finally, the capital market needs less capital thanks to the public support, and still clears when the used capital is the same available worldwide, i.e. when equation 11 modifies as follows:

$$N_1 \left(F_1 - \frac{S_1}{N_1^\delta} \right) + N_2 \left(F_2 - \frac{S_2}{N_2^\delta} \right) + N_3 \left(F_3 - \frac{S_3}{N_3^\delta} \right) + N_4 \left(F_4 - \frac{S_4}{N_4^\delta} \right) = k_1 + k_2 + k_3 + k_4 \quad (15)$$

All other equations, including the mark-up for profit maximization (equation 6) will remain unaffected.

3.2 The effects of the regional allocation of public support

Objective of this paper is to study the consequences for regions and countries, both domestic and foreign, of different spatial allocations of their support to firms (S). Since regions 1 and 2 belong to the country A and regions 3 and 4 belong to country B , given the amount of S available in each country (S_A and S_B), the regional amounts will be determined by the distributions. Indicating with β_A the quota of public support to production which country A allocates to region 1 and with β_B the quota of public support to production which country B allocates to region 3, the amounts of support allocated to the four regions (1 to 4) will be respectively:

$$\beta_A S_A ; (1 - \beta_A) S_A ; \beta_B S_B ; (1 - \beta_B) S_B \quad (16)$$

Most of the study will concern the national the allocations of public support. i.e. β_A and β_B , for given S_A and S_B .

The simulation results will show that the behavior of a country also influences the welfare of citizens of the other country through effects on the prices and on the interest rate. Figure 1 shows the mechanisms through which the policy allocation choice of one country (country A in the example) brings its effects not only on the home country but also on the other (foreign)

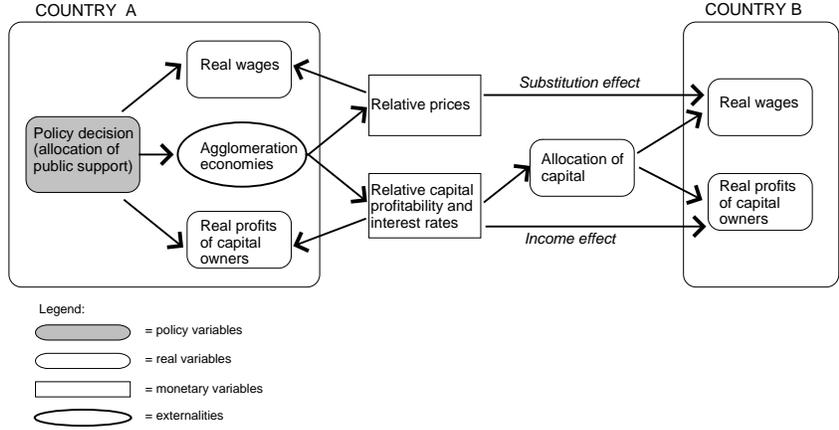


Figure 1: The channels by which the policy regional decisions of one country affect the other country in the presence of agglomeration economies.

country. The allocation of public support not only directly influences the incomes of the two regions which compose the country, by making one richer in spite of the other, but also influences the agglomeration economies that can be exploited in the two domestic regions. Agglomeration economies, in their turn, influence the relative prices for the goods produced in the two domestic and the two foreign regions. Moreover, agglomeration economies will influence the relative capital profitability and hence the international interest rates. Capital profitability influences the allocation of capital, not only between the domestic regions, but also internationally, i.e. attracting capital from the foreign country or exporting it, with effects on foreign wages and profits.

For this reason (figure 1), there is first a substitution effect (positive or negative) due to the changes of relative prices on the real wages of workers in all of the four regions of the model. Second, there is an income effect due to the interest rates on the real profits of capital owners in all the four regions. Also the income effect can be positive or negative.

The final effect on the other country can not be known in advance, since a negative substitution effect can be balanced by a positive income effect when country *B* is enough endowed with capital.

3.3 The indicators of equity, efficiency and welfare

Since the prices of the numeraire region are by definition not affected, the real GDP of nations can be calculated by just multiplying the prices of the

goods produced by the amount of produced goods:

$$\begin{aligned} GDP_A &= GDP_1 + GDP_2 = p_1 N_1 x_1 + p_2 N_2 x_2 \\ GDP_B &= GDP_3 + GDP_4 = p_3 N_3 x_3 + p_4 N_4 x_4 \end{aligned} \quad (17)$$

However, since capital is internationally mobile, the governments can be interested not only in domestic GDP but also in the real income of citizens living in the regions which belong to the country, that is:

$$\begin{aligned} I_A &= I_1 + I_2 = L_1 w_1 + k_1 r + L_2 w_2 + k_2 r \\ I_B &= I_3 + I_4 = L_3 w_3 + k_3 r + L_4 w_4 + k_4 r \end{aligned} \quad (18)$$

Unfortunately, both GDP and income are expressed in terms of amount of varieties produced in the numeraire region that it is possible to buy. Since the value for consumers (i.e. their utility) depends on the number of varieties, the fact that they are more or less affects the utility of consumers, and hence is relevant for welfare of citizens. For this reason it is better to use a measure of utility as the final indicator, calculated accordingly to equation 1.

According to equation 2, the regional total utility can also be divided between the workers (Ul_i) and the capital owners (Uk_i), using their shares of nominal income since the purchasing power of 1 monetary unit of interest rate is the same of a unit of wage inside the same region⁵:

$$Ul_i = \frac{l_i w_i}{k_i r + L_i w_i} U_i \quad (19)$$

$$Uk_i = \frac{k_i r}{k_i r + L_i w_i} U_i \quad (20)$$

It is now possible to define equity and efficiency, which will be the two possible indicators that will be considered by the national governments in their policy choices and that we will study in the rest of the paper:

As an indicator of *efficiency* used will be the total national amount of utility, i.e., for each of the two countries,

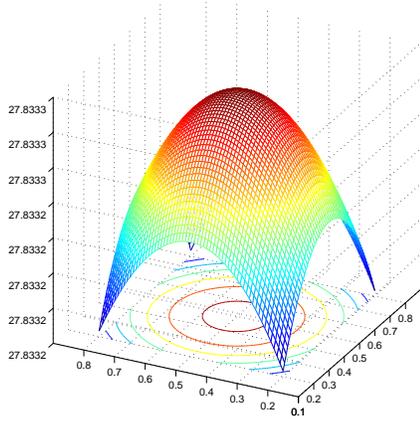
$$\begin{aligned} eff_A &= U_A = Ul_1 + Uk_1 + Ul_2 + Uk_2 \\ eff_B &= U_B = Ul_3 + Uk_3 + Ul_4 + Uk_4 \end{aligned} \quad (21)$$

As an indicator of *equity*, used will be the ratio between the utilities of the two regions belonging to one country, i.e.

$$\begin{aligned} eq_A &= - \left| \frac{Ul_1 + Uk_1}{Ul_2 + Uk_2} - 1 \right| \\ eq_B &= - \left| \frac{Ul_3 + Uk_3}{Ul_4 + Uk_4} - 1 \right| \end{aligned} \quad (22)$$

⁵Notice again that the model is kept symmetric for simplicity, and any region is endowed with the same amount of capital and labour; this allows to concentrate on the differences of regional productivity and location rather than factor endowments.

Low agglomeration economies



High agglomeration economies

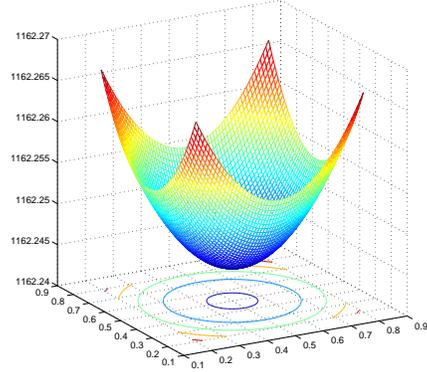


Figure 2: The relationship between the allocation of regional policy (on the horizontal axes there are β_A and β_B) of the two countries and the total world utility (vertical axis) in case of low and high agglomeration economies, when all four regions are identical.

The above indicator has as possible risk: if the regions are differently endowed with capital and labour, the effects of policies can be distorted. For this reason, (1) in all simulations the amount of original capital and labour will be kept identical in all regions and (2) another stricter indicator of *equity* will also be used, comparing only the real utility per unit of labour of the workers of the regions, calculated as:

$$\begin{aligned} eq_A^s &= - \left| \frac{Ul_1/L_1}{Ul_2/L_2} - 1 \right| \\ eq_B^s &= - \left| \frac{Ul_3/L_3}{Ul_4/L_4} - 1 \right| \end{aligned} \quad (23)$$

Notice that the indicators of equations 22 and 23 share the characteristics of being always negative, and have the maximum theoretical equity achievable at 0, where there are no disparities between the regions composing the country.

3.4 The strength of agglomeration economies

As seen in Section 2.1, agglomeration economies are assumed in this model and expressed by the parameter γ . The parameter is in the interval $(0,1)$, but more can be said on what this means for the economy.

In particular, agglomeration economies can be defined as “strong” when, for regions being identical, unbalanced regional allocations of S are more ef-

ficient (i.e. provide more total national income) than balanced ones, “weak” if the opposite is true. The value of γ for which the economies of agglomeration are strong depends on the values of two other parameters, namely σ , the inverse of the elasticity of substitution, and δ , the rivalry in the use of S : the higher the σ , the higher the γ has to be in order to have a convex relationship between β and the country’s GDP ; the higher the δ the higher the γ has to be in order to have a convex relationship between β and the country’s GDP .

To make an example, let’s consider (Figure 2) two identical countries, endowed with the same amount of S and composed of 4 identical regions. The countries can distribute their public support uniformly ($\beta = 0.5$) or differently. If it is by distributing it uniformly that they achieve the maximum utility, we are in a case of low agglomeration economies when congestion prevails (Figure 2 left); if it is by distributing it unevenly that the maximum total utility can be achieved, we are in a case of high agglomeration economies, which are able to overcome the congestion in the public support to production (Figure 2 right).

4 The international effects of regional policy in integrated countries

As a first step of the study, the effects of the regional policy allocation of one country is studied in a context of fully integrated countries, i.e. in a situation in which transport costs are nil and, hence, $t_{ij} = 1$ for any i and j . This restrictive assumption will be relaxed in section 5.

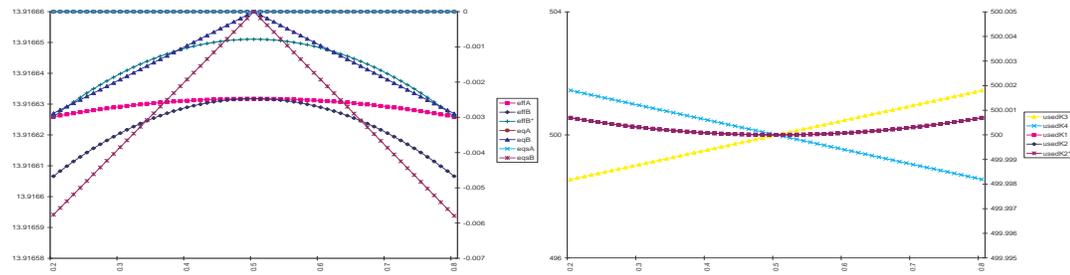
The case of integrated countries is interesting to study because it allows to see the effects of the channels of transmission depicted in figure 1 without confusing their effects with the ones of different spatial settings and transport costs.

All the policy allocation experiments of this section will involve two sub-cases: the one in which countries are composed by identical regions and the one in which the regions within the countries are different. Both sub-cases will be studied under low agglomeration economies and high agglomeration economies.

4.1 The effects of regional policy in integrated countries with low agglomeration economies

The first experiment involves the allocation of public policy support (S) in one country (namely B , hereafter also referred to as “home” country) with low agglomeration economies, identical countries and identical regions. The results, shown in Figure 3 on top show that for the domestic country (B) it is more equous to allocate public support uniformly between its regions.

Identical regions



Different regions

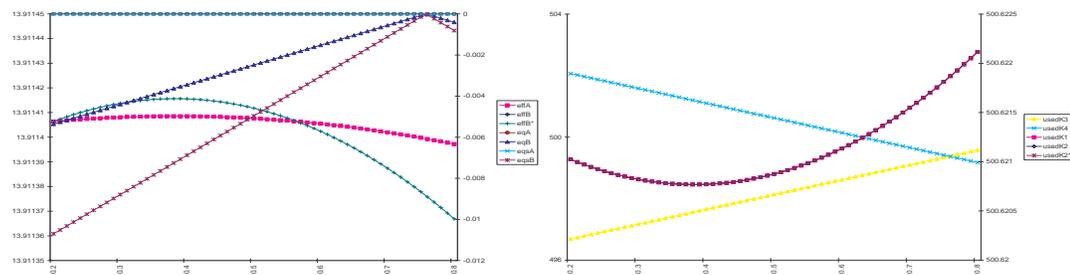


Figure 3: Simulation results of the effects of regional policy decision of country B with integrated countries and low agglomeration economies.

Moreover, due to the fact that agglomeration economies are low and so they are not able to counterbalance the congestion in the use of public support, it is also more efficient for the domestic national government to use a balanced distribution, since the total utility of the nation is higher.

By looking at the effects on the other country (namely A , hereafter referred to as “foreign” country), one sees that there are effects of regional policy of country B on the efficiency of country A . The maximum welfare achieved in country A is in fact when B uses a balanced policy strategy and this is due to the fact that, by allocating S unbalancedly, B is able to attract capital from country A , so diminishing the production of A and without compensating it with higher enough returns to this capital.

There are instead no effects of country B decisions on the equity of country A , due to nil transport costs.

It is also possible to disentangle the effects on workers and capital owners: Unbalanced allocations of S , due to low agglomeration economies, decrease the real interest rate and, since the economies are integrated, the real utility of capital owners living in any of the four regions.

As far as workers are concerned, the results are more complex: for the home country which decides the policy (B), the workers always benefit from a movement of support towards their region. For the workers of the foreign country (A), it is always optimal to see other country (B) to allocate S unbalancedly since, in this case, the inefficiency of the other country attracts capital in their own regions and so makes their work more productive and well paid.

All this can be summarized as follows:

Simulation result 1 *The allocation of regional policy of one country also has effects on the utility of citizens in the other country.*

Simulation result 2 *With identical countries and regions, and low agglomeration economies, the optimum allocation of regional policy for the domestic country is a balanced one and this allocation is also the one which maximizes the income of the foreign country.*

Simulation result 3 *With identical countries and regions, and low agglomeration economies, workers in one country would prefer that the other country allocates regional policies unbalancedly, since in this way the inefficiency of the other country increases the capital invested in their own, increasing their real income.*

The second policy experiment concerns the allocation of S in the home country B under low agglomeration economies but now country B is composed of different regions, for instance region 3 is less productive than the others (i.e. it has a higher a_i). In this case (Figure 3 bottom), one can easily

observe that the most equous allocation of policy for the domestic country (B) is one which allocates it disproportionately towards the weakest region. The most efficient allocation for country B , however, in spite of the weak agglomeration economies, is an unbalanced allocation towards the strongest region, a less intuitive result which was first shown in Fratesi (2008).

The effects in the foreign country (A) are relevant to this paper. The policy decision of the domestic country (B) does not influence the equity of country A , but it has an effect on the efficiency, since relative prices are affected and capital movements. Interestingly enough, also the most efficient allocation of regional policy of country B on country A is one unbalanced towards the most efficient region because it allows higher returns to capital. So the two optimum almost coincide. Notice that this result persists in spite of the fact that, when country B pursues efficiency, it draws capital from country A .

In synthesis:

Simulation result 4 *With different regions and low agglomeration economies, the optimum allocation of regional policy for the domestic country is an unbalanced one towards its strongest region and this disproportionate allocation also benefits the income of the foreign country.*

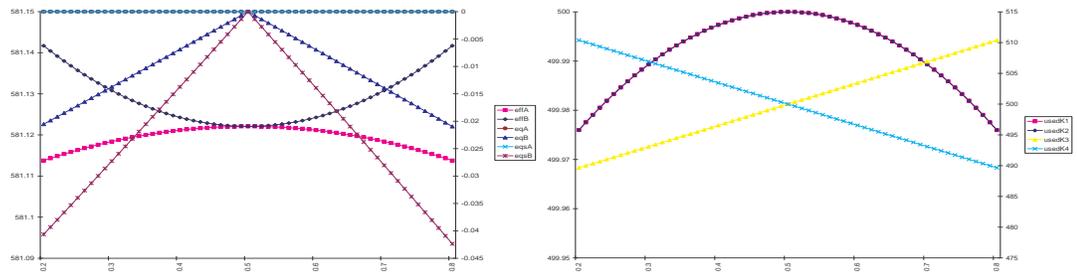
4.2 The international effects of regional policy in integrated countries with high agglomeration economies

The case of high agglomeration economies brings some differences with the previous one. First is depicted (figure 4 top) the case in which all regions are identical. In this case one can observe that the most equous allocation for the domestic country (B) is still to allocate regional policy uniformly. On the contrary, as one can expect because of high agglomeration economies, the most efficient allocation is an unbalanced one, towards either domestic region.

There are no effects on the equity of country A , due to nil transport costs. The effects on efficiency are opposite from those of country B : the allocation for which there is the maximum of efficiency is the balanced one, and the most unbalanced the allocation, the lower the welfare. This effects is due to the fact, with high agglomeration economies, the domestic country (B), becomes more efficient by concentrating its production, so that it takes advantage from economies of agglomeration and draws capital from the other country. For the foreign country (A) the opposite is true, since capital is drawn out and the higher returns on capital do not compensate the effects of production concentrating in one of the foreign regions, leaving domestic ones under-capitalized.

In this case, therefore, the best for one country is the worst for the other.

Identical regions



Different regions

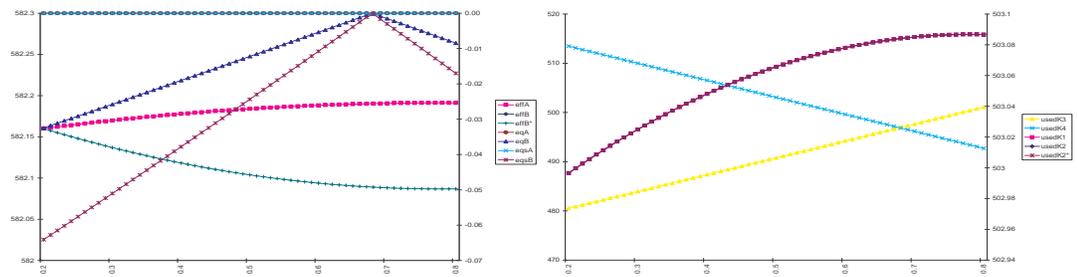


Figure 4: Simulation results of the effects of regional policy decision of country B with integrated countries and high agglomeration economies.

Simulation result 5 *With identical regions and high agglomeration economies, the optimum allocation of regional policy for the domestic country is an unbalanced one towards either region. This unbalanced allocation, however, minimizes the income of the foreign country.*

The last case that will be analyzed with integrated countries is one in which agglomeration economies are high, the regions of the domestic country (B) are different and region 3 is less productive (Figure 4 bottom). In this case, intuitively, for country B , it is more efficient to allocate disproportionate quantities of public support to the most productive region, whereas it is more equous to allocate more of it to the weakest region. For country A , on the contrary, the maximum welfare is achieved when country B renounces to pursue efficiency to pursue equity, i.e. when it helps its weakest region, since in this case it attracts capital from abroad.

In this case, therefore, there is not the coincidence of the optimum of country B with the optimum of the foreign country.

Simulation result 6 *With different regions and high agglomeration economies, the optimum allocation of regional policy for the domestic country is an unbalanced one towards the strongest region. The income of the foreign country, however, is maximized when the domestic country decides for an equous allocation and renounces to pursue efficiency, i.e. a result which is the opposite with respect to the case of low agglomeration economies*

As a conclusion and synthesis of this section we can hence sum up that:

(1) with integrated countries and weak agglomeration economies, the most efficient decision for one country coincides with the allocation which maximizes the welfare of the other country.

(2) With high agglomeration economies, on the contrary, the domestic country pursuing efficiency favours disproportionate allocations (towards the most productive region if the regions are different) whereas the welfare of the foreign country is maximized when the domestic country renounces to pursue efficiency but pursues equity.

5 The effects of regional policy with transport costs and only partial integration: different spatial settings

All the results of Section 4 might be different depending on the spatial setting in which they are simulated. Different geographies, in fact, have different implications for the transport costs between the various regions which affect both utility and relative demand functions. In particular, two spatial settings appear to be the most general and relevant in a 2-country-4-region

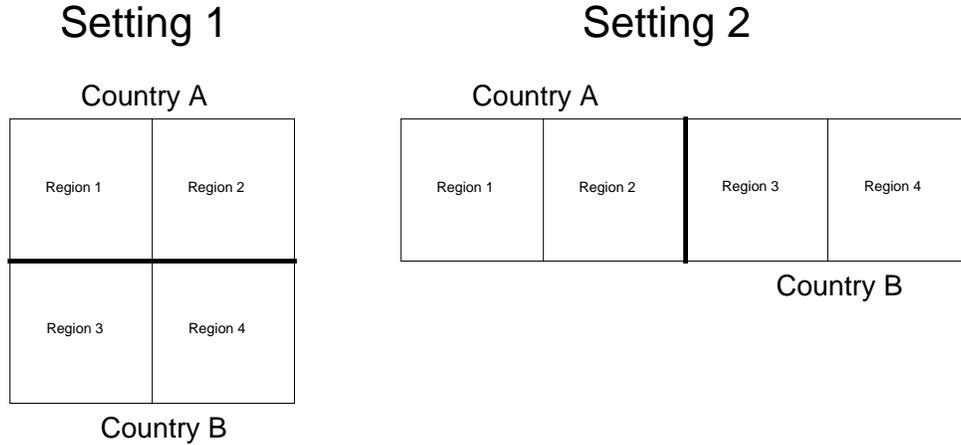


Figure 5: Two different spatial settings which imply a different international transport structure between the four regions.

model. The first one (setting 1 in figure 5, hereafter referred to as *squared*) is one in which the two countries have international borders in all their regions, so that it is possible to go from region 1 to 3 and from 2 to 4 without any further step⁶. The second case (setting 2 in figure 5, hereafter referred to as *linear*) is the case in which only one region per country is bordering the other country, so that these regions have the function of international links. In this case, to go from region 1 to 4, it is necessary to go first to region 2, then to region 3 and finally it is possible to arrive to region 4.

When the setting is linear (figure 5), therefore, each country has one central region (which borders with the other country and with the other domestic region, namely 2 and 3) and one peripheral region (which only borders with the other domestic region, namely 1 and 4).

By definition, any peripheral region has a disadvantage in terms of transport costs, since its goods need to pass through the other region to reach the foreign country and, similarly, also the imported goods have to pass through the other region. Peripherality, in this paper, is hence a geographical concept, differently from the famous Core-Periphery model (Krugman, 1991), where only two regions are present and one of the two ends up being the periphery without differing in any aspect with the other.

It is easy to mathematically represent peripherality in a model with iceberg transport costs such as the one of this paper, since it is sufficient to assume that the part of goods which has not melted down going from Region 1 to Region 2, will partly melt down again when it will go further to reach Region 3, similarly to the goods produced in Region 2 .

⁶Notice that we use a “rook” rule for proximity. This means that this squared spatial setting, when implemented mathematically, is similar to a circular world with 4 locations.

The international boundary can be assumed to be harder to cross than a simple interregional one, and this can be assumed by increasing the transport cost coefficient when an international transfer is needed. It is for this reason that the international boundary is bolder in Figure 5.

We expect that, with only partial integration, the effects on the different regions of country *A* depend on their location with respect to country *B*, due to the different accessibility of regions for consumers.

A comprehensive study, similar to the one of Section 4 has been performed also for the two cases of squared and linear spatial settings. However, to maintain the paper readable, its detail are left out of the text of the paper where we will only concentrate on the favourite choices of the various types of actors in the various regions (Section 6). That section will also investigate which shape efficiency and equity assume in the various cases.

6 Equity and efficiency with only partial integration in different spatial settings

Three variables appear especially relevant in determining which are the favourite policy options of each actor and, less straightforward, in determining which policy options are able to maximize the equity and efficiency of policies within countries. These variables are the following:

1. the strength of agglomeration economies;
2. the spatial, geographical, setting;
3. the difference between the regions of the country which implements the policies.

Of these three variables, only the last one entails – qualitative – consequences on the results, whereas for the strength of agglomeration economies and for the spatial setting it is enough to use the variable with a dichotomy. For this reason, in order to study systematically the effects of policies, investigated will be the maximum of a number of variables depending on the regional differences, in four cases, namely low agglomeration economies in a squared spatial setting (Section 6.1), low agglomeration economies in a linear spatial setting (Section 6.1), high agglomeration economies in a squared spatial setting (Section 6.3), high agglomeration economies in a linear spatial setting (Section 6.4).

6.1 Low agglomeration economies without peripheral regions: a squared spatial setting

In Figure 6 on top, it is possible to observe the best policy choice for the various actors of the four regions of the model depending on the differences between the domestic regions.

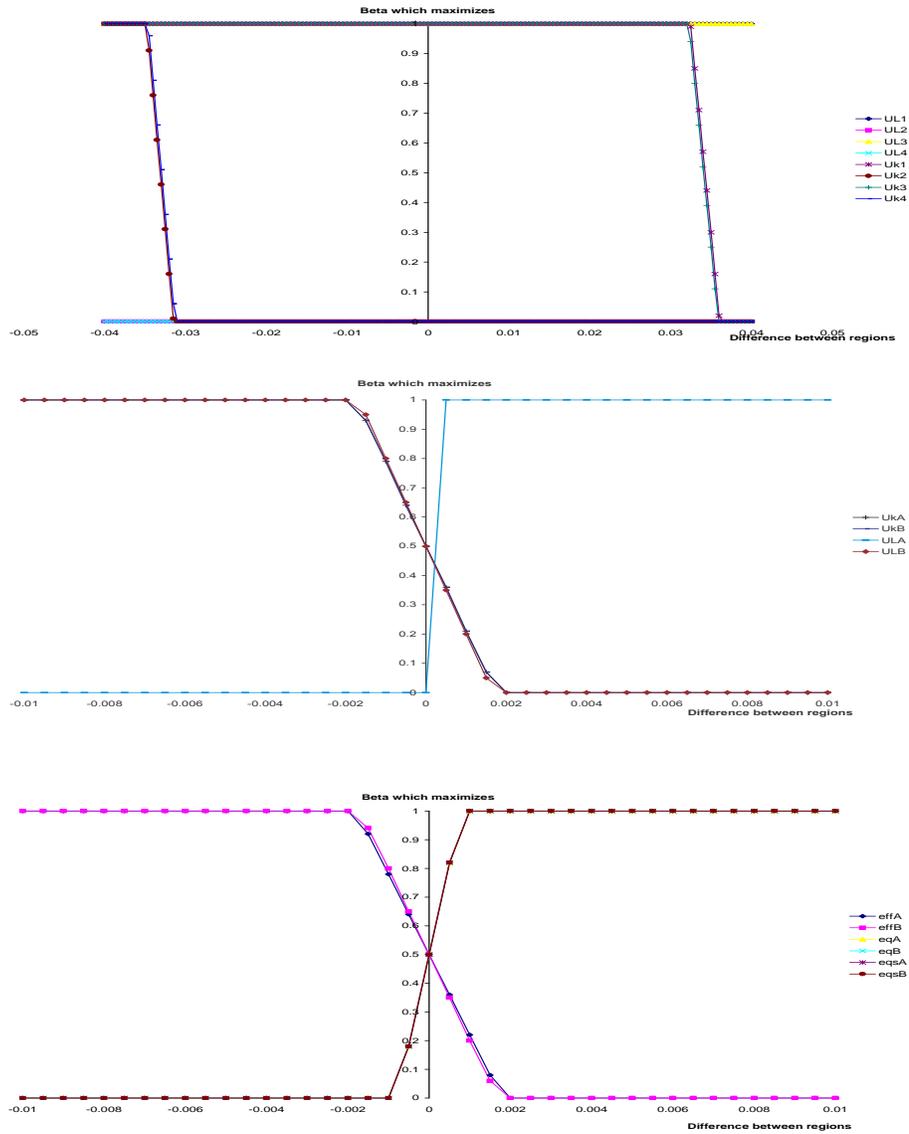


Figure 6: Efficiency, equity and the favourite regional policy of stakeholders with low agglomeration economies in a squared spatial setting.

In Figure 6, as in the ones which will follow, we have on the horizontal axis the differences between the two domestic regions, namely 3 and 4, expressed by how much higher is the labour requirement in region 3 with respect to those of all other regions, which are normalized to 1. Hence, an high value on the horizontal axis means that labour in region 3 is less productive than the other domestic region, due to regional territorial characteristics (i.e. before any effect due to capital mobility).

In the other axis, represented are the favourite choices of the various types of agents in terms of distribution of public support to firms (S) between the two domestic regions, through the value of the β_B (see Equation 16): the closer this value to 1 the most the type of stakeholder favours disproportionate allocations in favour of region 3.

It can be observed that, as expected, for the workers of the domestic country, it is always better if the nation supports fully their region, because of home market effects and capital attraction which makes their labour more productive. Also for the workers of the foreign country the result is unaffected by regional territorial differences, and it is always better if the other country choses to support fully the region which is closer to theirs; in fact, in this way they experience more accessibility to the foreign markets .

Results for capital owners are less straightforward. In fact, should there exist no difference between the domestic regions, domestic capital owners would prefer full assistance to their region, and foreign ones to the region which has boundaries with their own.

However, when there are sufficiently wide differences between the regions, despite of the fact that agglomeration economies are low, capital owners living in any domestic or foreign region would prefer that the regional policy in the domestic region is devoted to exploit as much as possible the agglomeration economies where they are most effective, i.e. in the most productive domestic region.

The capital owners of one domestic region, in fact, would prefer *ceteris paribus* that their region is the supported one. However, if their region is sufficiently weaker than the other domestic region, they will prefer that the regional policy is unbalanced towards the stronger region, despite of the fact that this means for them lower accessibility. In fact, the higher profits that they obtain from the exploitation of agglomeration efficiencies, more than compensate the fact that they have to spend their income farer from the larger market.

Analogously, the capital owners of the foreign country would prefer *ceteris paribus* that the regional policies of the domestic country are unbalanced towards the region closer to their own, unless there are differences sufficiently wide that they would also prefer that domestic regional policies are devoted to efficiency.

If we consider the workers and the capital owners of the two countries as a unique body, independently of their region of residence (Figure 6 middle),

we see that capital owners in both countries would prefer a regional policy with full assistance to the most productive region, and balanced choices only for small differences. The workers of the domestic country, taken as a whole, would also prefer to support the most productive region, since the benefits of those living in the supported regions would overcome the losses of those living in the other region. Only for the workers of the foreign country the result is opposite, and they would prefer that the regional policy of the domestic country would be devoted to supporting the weaker region, since otherwise capital would be drained out of their country.

It is now possible to analyze the efficiency and the equity issues (Figure 6 bottom): despite of the low agglomeration economies, the most efficient regional policy is almost always the support to the strongest domestic region, since this maximizes the utility of residents in both the domestic and the foreign country; intermediate values are only efficient when the differences between the domestic regions are small.

Equity, on the contrary, is maximized when the support is given to the least productive domestic region, whatever measures is used to assess it: intermediate regional policies only provide the maximum of equity for small differences between the domestic regions.

6.2 Low agglomeration economies and peripheral regions: a linear spatial setting

The results are less straightforward when the spatial setting is a linear one, since not only the differences between regions are relevant, but there are the concurrent effects of centrality and peripherality.

On top of Figure 7, it is possible to observe the favourite policy choice of the eight stakeholders. Domestic workers, living in either region, would prefer that regional policy fully supports their region. Foreign workers, living in either region, will always prefer that the domestic government supports the domestic central region, since in this way their accessibility on the consumption side is greater and, also, capital is not drained too far towards the domestic peripheral region.

As far as capital owners are concerned, results are only slightly more complex: capital owners in the central domestic regions, as well as capital owners in both foreign regions, will prefer that the domestic regional policy is fully unbalanced towards the domestic core region, unless this region is considerably weaker than the domestic peripheral one. Capital owners in the domestic peripheral region, on the contrary, will prefer that regional policy support is given to their region, unless the domestic core region is significantly stronger; only in the latter case, the strength of this region makes their investments more productive should the domestic government decide to support that region, overcoming their loss of accessibility.

If we consider the workers and the capital owners of the two countries as

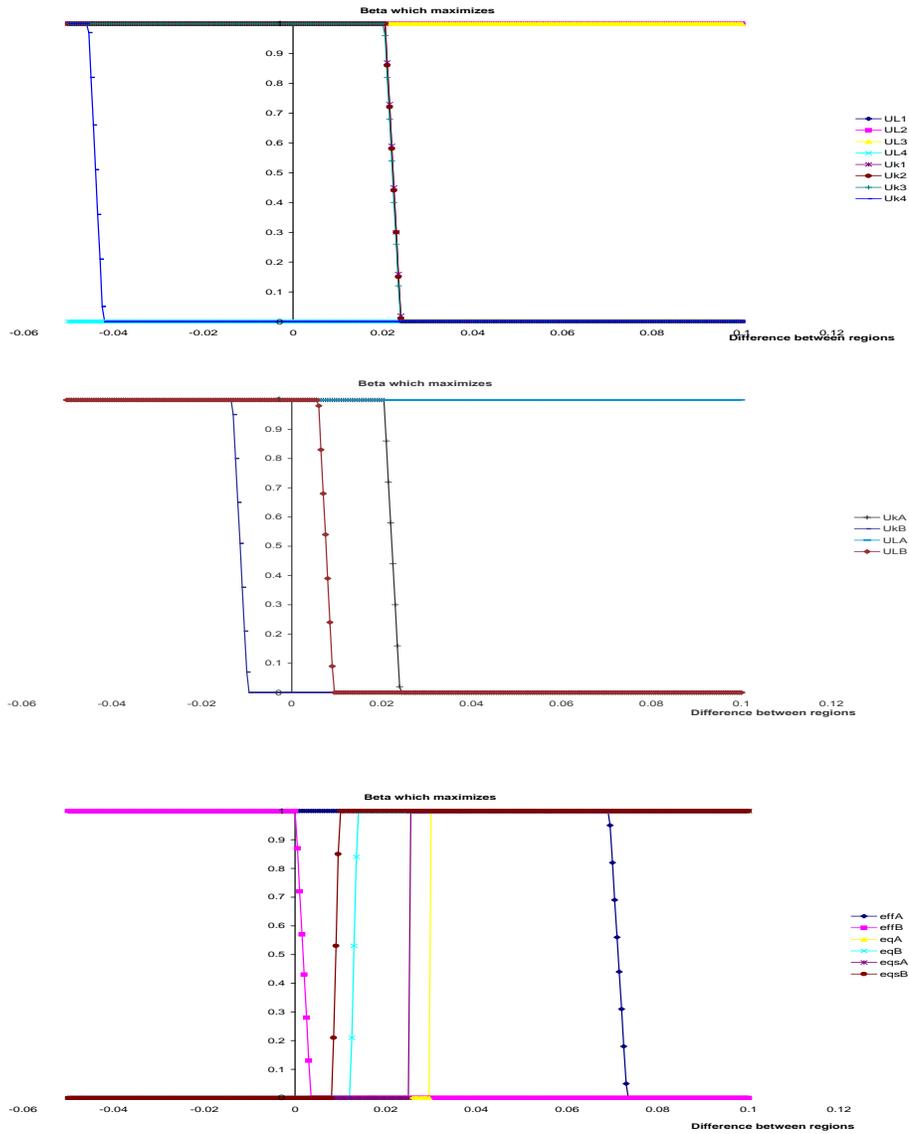


Figure 7: Efficiency, equity and the favourite regional policy of stakeholders with low agglomeration economies in a linear spatial setting.

a unique body, independently of their region of residence (Figure 7 middle), we see that for the workers of the domestic country taken as a whole, it is better if regional policy is unbalanced towards the domestic central region, unless this region is sufficiently weaker than the other one; for workers of the foreign country taken as a whole, straightforwardly, the best situation is the one which is best for both foreign regions, i.e. the domestic government supporting the domestic central region.

For capital owners of the domestic region, since economies of agglomeration are low, it is better if their government supports the peripheral region, unless the central region is sufficiently stronger, which would make profitable for them a support concentrated in the central region.

Capital owners of the foreign country, on the other hand, will prefer that the domestic regional policy is concentrated in the domestic central region also when this region is identical to the domestic peripheral one, and until it is much weaker. For these capital owners, in fact, there would be a higher loss of accessibility with respect to the domestic ones.

It is now possible to analyze the efficiency issue (Figure 7 bottom), starting with the domestic country, which is in charge of policies. Interestingly enough, the balanced regional policy is not the most efficient one if the central and the peripheral regions are identical: the accessibility to markets advantage of the central region makes it efficient to fully support it. However, as far as the central region becomes weaker, it first becomes efficient to provide a balanced regional policy and then to unbalance the support towards the peripheral region.

The pattern which is most efficient⁷ for the foreign country is similar, but translated rightwards; it is in fact better for the foreign country if the domestic one decides to support the domestic central region also if it is weaker, unless it is considerably weaker.

Looking at the equity issue (Figure 7 bottom), the domestic country maximizes its spatial equity by supporting disproportionately its peripheral region, unless this region is sufficiently stronger than the central one. Also the spatial equity within the foreign country is maximized with support provided to the domestic peripheral region, and this takes place until the latter region is much stronger. Notice that the absolute value for this shift is larger than the one of the domestic country; this is due to the fact that the foreign central region has an accessibility advantage with respect to the foreign peripheral region, and this advantage only fades out if the domestic central region is largely weaker than the domestic peripheral region.

⁷If it is really possible to use the term efficient, since the foreign country is not in charge of the policy.

6.3 High agglomeration economies and peripheral regions: a squared spatial setting

To analyze what changes with high agglomeration economies, the issue is first investigated in a squared spatial setting, since this leaves out the effects of centrality and peripherality.

In Figure 8 on top, represented are the situations which are favourite by the stakeholders in this situation. It is immediately clear that high agglomeration economies, allowing to overcome the congestion in the provision of the publicly provided support to production, make unbalanced situations preferable in some cases in which they are not with low agglomeration economies.

Workers in both domestic regions still prefer an unbalanced regional policy towards their region, as with low agglomeration economies. Workers in the foreign region, differently from the low agglomeration economies case (in which they would always favour policies unbalanced towards their bordering region), will still favour a policy towards their bordering region if it is the weakest foreign region, but would gradually shift their preference towards the region which is not bordering to theirs if the bordering region is the strongest one. In fact, the advantages of accessibility are overcome by the drainage of capital entailed by the exploitation of agglomeration economies in the other country. Being the setting a squared one, the two patterns are symmetric.

As far as capital owners are concerned (Figure 8 on top), being capital a mobile production factor, the preference of capital owners living in any of the four regions goes for a regional policy unbalanced towards the strongest domestic region when there are differences sufficiently wide.

When regional differences are small, on the contrary, capital owners will prefer full support to their own region or (in the foreign country) to the bordering region, until this region is sufficiently weaker so that there is a very rapid shift of preference towards the other region. The difference with the low agglomeration economies case is that the shift is more sudden and that smaller differences are needed for the shift of preference.

If we consider the workers and the capital owners of the two countries as a unique body, independently of their region of residence (Figure 8 middle), we see that for the workers of the domestic country, taken as a whole, it is always better if full support is given to the stronger region, whichever it is, since the advantages for the workers in the agglomerated region more than compensate the disadvantages for the other region. The same situation is best for capital owners of both countries. For the workers of the foreign country, however, the situation is different and they would favour a balanced regional policy if the two domestic regions are identical, and a regional policy unbalanced towards the weakest domestic region if there are differences sufficiently wide. As in the case of low agglomeration economies,

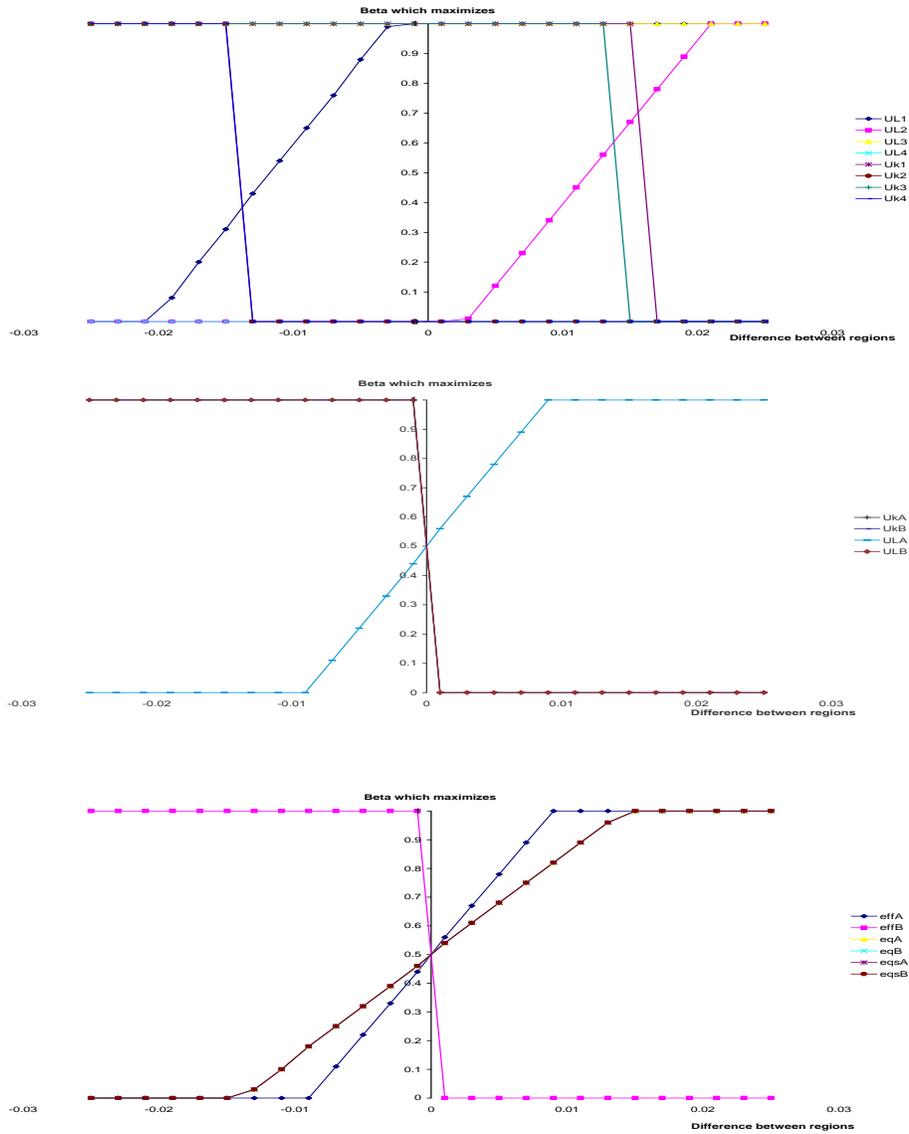


Figure 8: Efficiency, equity and the favourite regional policy of stakeholders with high agglomeration economies in a squared spatial setting.

the workers of the foreign country are better off if the domestic country is most inefficient because of capital drain.

Apparently, results are hence the same as with low agglomeration economies: *workers in the domestic country and all capital owners favour efficient choices, and workers in the foreign country favour inefficient choices.* However, it is how efficiency is achieved which is different, and implies that the shift of favourite choice of the three efficiency-prone categories is sudden with high agglomeration economies (it was gradual with low agglomeration economies) and the shift of choice of the inefficiency-seeking category is gradual (it was sudden with low agglomeration economies).

To better see this, and to fully analyze the efficiency issue, Figure 8 at bottom draws the maximum efficiency achieved in the two countries.

The maximum of domestic efficiency is achieved with any unbalanced allocation when the two regions are identical (it was with a balanced one with low agglomeration economies) and with an unbalanced allocation towards the strongest region when there are differences; conversely, the maximum of efficiency for the foreign country is achieved with balanced regional policy allocations when the domestic country is made of two identical regions, and only gradually, with larger domestic territorial differences, there is a preference for situations in which the domestic country makes the most inefficient choice. Very interesting is to observe that for the domestic country it is only the shape which shifts from gradual to sudden with agglomeration economies changing from low to high, whereas for the foreign country it is also the choice: *when economies of agglomeration were low the foreign country as a whole would prefer that the domestic country pursues efficiency, whereas for high agglomeration economies the foreign country would prefer inefficient choices from the domestic country.*

Let's now analyze the equity issue (Figure 8 bottom): the most equous situation, for all categories in both countries, now remains a balanced one if the two domestic regions are identical, irrespectively of the strength of agglomeration economies. In both cases, as far as the domestic regions become different, it becomes most equous to support with regional policies the weaker domestic region. Interestingly enough, in the case of high agglomeration economies the shift is more gradual. More interesting is to observe that, domestic equity and efficiency are always at odds when there are sufficiently wide regional differences but, *with high agglomeration economies, foreign equity and foreign efficiency as the results of domestic regional policies are consistent.*

6.4 High agglomeration economies and peripheral regions: a linear spatial setting

The last, most interesting and most complex case to analyze is the one of high agglomeration economies in a linear spatial setting, since it allows

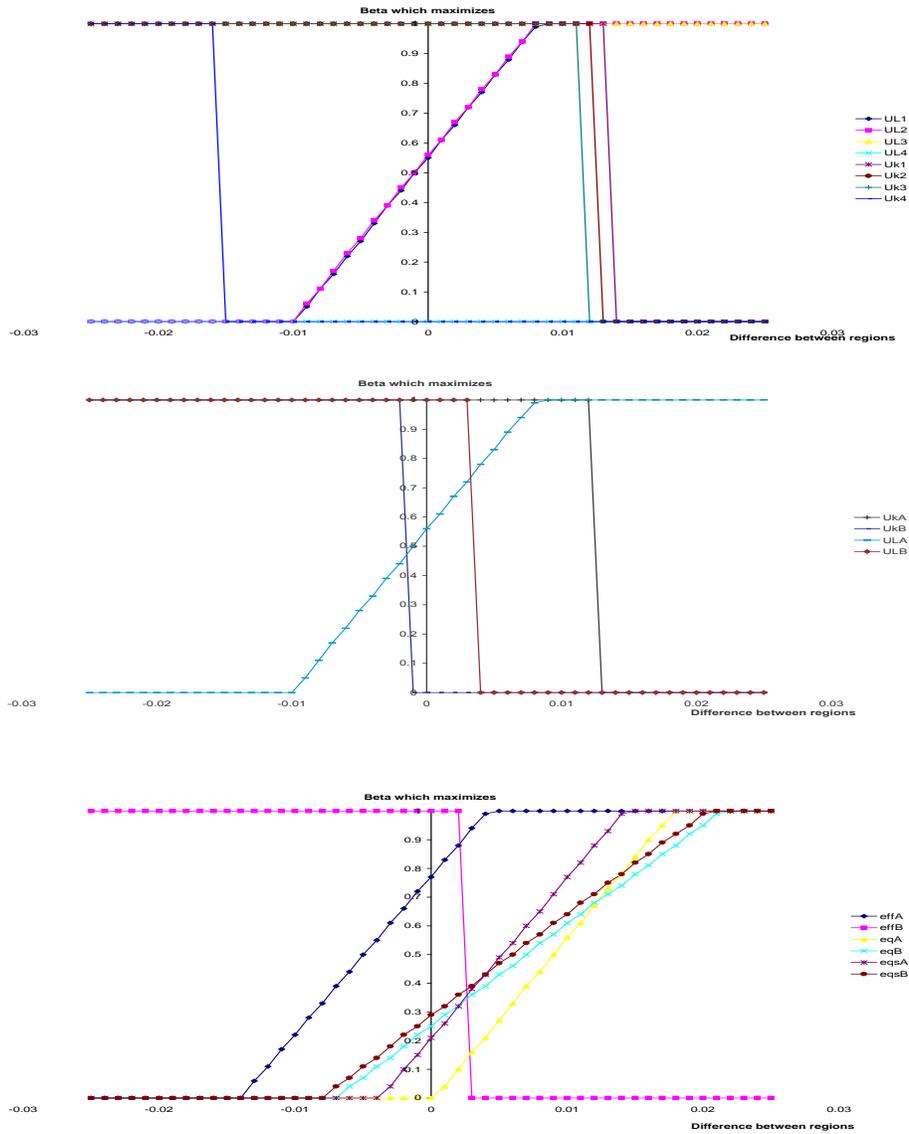


Figure 9: Efficiency, equity and the favourite regional policy of stakeholders with high agglomeration economies in a linear spatial setting.

to study the effects of peripherality. In this case, in fact, the advantages of centrality play a role together with the high agglomeration economies which would favour concentration, with concurrent effects whose results are reported in Figure 9.

First shown are the regional policy choices which are favourite by the individual stakeholders (Figure 9 on top). If the workers of the domestic country always prefer a regional policy fully unbalanced towards their region, the workers of the foreign country, in both regions, would prefer a policy which is slightly unbalanced towards the foreign central region if the two foreign regions are homogeneous. This is due to two concurrent effects: (1) on the production side, the fact that the high agglomeration economies would drain capital from the foreign to the domestic country if an unbalanced policy is implemented and (2) on the consumption side, the fact that the foreign central region is more accessible.

When the domestic central region becomes weaker, an unbalanced regional policy towards this region is favourite by the workers of the foreign country also because of effect (1), hence the favourite choice moves in that direction; when the domestic central region becomes stronger, effect (2) is weakened and effect (1) is reinforced, hence the favourite choice moves towards the domestic peripheral region.

As far as capital owners are concerned, their favourite regional policy normally is one in which the most supported is the domestic central region, which allows the exploitation of economies of agglomeration, unless this region is structurally much weaker. The exception is composed by the capital owners of the domestic peripheral region who prefer that their region is supported for accessibility to market reasons, unless in the case in which their region is so much weaker that the extra-profits obtained by a surplus of agglomeration in the domestic central region exceed the losses due to transport costs in consumption.

If we consider the workers and the capital owners of the two countries as a unique body, independently of their region of residence (Figure 9 middle), we see results which are different from the case of low agglomeration economies (Section 6.2) but also from the case of high agglomeration economies and a squared spatial setting (Section 6.3). In fact, the favourite regional policy for domestic workers is not simply a policy towards the strongest region, since if the domestic central region is slightly weaker its bigger accessibility more than compensates its weakness.

The favourite regional policy of foreign workers is one which would like to keep most capital in their country, i.e. one which avoids exploiting the agglomeration economies in the domestic country, similarly to the squared high agglomeration economies case. However, the domestic central region is *ceteris paribus* more accessible so their best choice is more in favour of this region than it would be in the squared case.

Domestic capital owners as a whole will prefer regional policy unbalanced

towards the most efficient region. Capital owners in the foreign country will prefer a solution which supports the domestic central region exploiting there the high agglomeration economies, because of its largest accessibility, unless it is much weaker.

We can now look at the efficiency issue (Figure 9 bottom): differently from the squared case, in which support to the strongest region was always the best choice, in this case the domestic country will implement efficient regional policies with full support to the central region even when it is slightly weaker, provided it is not too weak.

The maximum utility of the foreign country also keeps into account the centrality issue, and in fact, for structurally identical domestic regions, the foreign maximum takes place with a policy significantly unbalanced towards the domestic central region, differently from the squared setting case. As in all cases with high agglomeration economies, the favourite choice moves towards the weakest region as far as differences between the two domestic regions arise.

Finally, the equity issue: as in the squared case it is more equous to support the structurally weaker region, whatever equity measure is used. However, since the central region has an accessibility advantage, the maximum equity gives it less than half of the regional policy support when it is identical to the others. Also, the two measures of equity within the two countries (defined in Section 3.3) now have different shapes, so that a policy maker who would like to implement regional policies to maximize equity will first have to choose which meaning she wants to give to it.

7 Summary of results and conclusions

This paper has analyzed the effects of the regional policy choices of one country on the regions of the other country, also differentiating for the strength of agglomeration economies, for the spatial setting and for regional “territorial” differences, in order to help explain why international bargaining exists also for what concerns the allocation of regional policy within countries in cases, such as the EU, where supra-national institutions exist.

It has shown that, in the presence of economies of agglomeration (either strong or weak) regional policies in one country are not neutral to the other country’s welfare, because of trade and capital mobility.

Moreover, it has shown that the effects of regional policy in the other country are not spatially neutral, since they affect the regions differently, apart from the limit case of full integration and no transport costs.

It has also been shown that domestic and the international effects are very different depending on the strength of agglomeration economies. Moreover, they are different with respect to the spatial setting, since it is relevant the geographical position of regions.

Finally, the differences between the regions of the home country are not only relevant to the efficiency and equity entailed by home regional policies, but also to the effects that home regional policies entail to the foreign country. Apparently, no effects are present for the differences within the foreign country, the one which does not implement the policies in the model.

For what concerns in particular equity and efficiency, the paper has brought the following results:

(1) with fully integrated countries and weak agglomeration economies, the most efficient decision for one country coincides with the allocation which maximizes the welfare of the other country, being a balanced one.

(2) With high agglomeration economies, on the contrary, the domestic country pursuing efficiency favours disproportionate allocations (towards the most productive region if the regions are different) whereas the welfare of the foreign country is maximized when the domestic country renounces to pursue efficiency but pursues equity.

The results above persist if integration is not full but there is a squared spatial setting. In addition to them:

(3) The relative utility of the foreign regions depends on the allocation of domestic public support, being higher for the region which borders the assisted region.

(4) There is also an effect on the equity of the foreign region which is highest when it is highest for the domestic country. Otherwise, the utility of the foreign region which has boundaries with the advantaged domestic region is higher.

In a linear spatial setting, i.e. when some regions are geographically peripheral, it has also been observed that:

(5) Foreign capital owners get higher welfare if the home country implements regional policies aimed at fully exploiting economies of agglomeration, i.e. in favour of the central region unless it is much weaker. Foreign workers, on the contrary, have on the one side positive effects on the goods available for their consumption but lower income when capital moves out of their region.

(6) With weak agglomeration economies, *ceteris paribus*, the welfare of the home country is higher if some additional support is given to the central region, but the foreign country would prefer a totally unbalanced policy

(7) With high agglomeration economies, the home country maximizes its total welfare with unbalanced solutions, better towards the central region unless it is too much weaker. This solution is not in favour of the foreign country, despite the effects on capital owners, because foreign workers are made worse-off.

(8) With weak agglomeration economies, in all cases, there is more spatial equity, in the home and in the foreign country, if the home country supports its peripheral region.

(9) With strong agglomeration economies, the most equous allocation depends on the relative strength of regions and is achieved with support to the peripheral region unless it is structurally stronger.

Moreover, it is possible to draw general conclusions for the various types of actors concerned and the effects of peripherality:

(10) **Capital owners** (i.e. the possessors of mobile production factors) tend to prefer regional policies which exploit the potential of agglomeration economies. This is testified by the fact that: (i) with either low or high agglomeration economies, domestic capital owners prefer solutions unbalanced towards their region only if it is not much weaker; (ii) with either low or high agglomeration economies, foreign capital owners prefer solutions unbalanced towards the central domestic region, unless it is much weaker.

(11) **Workers** (i.e. the possessors of immobile production factors), *ceteris paribus*, tend to prefer regional policies which support their purchasing power and which attract capital in their region. This is testified by the fact that: (i) workers in the domestic country always prefer regional policies in favour of their region; (ii) with low agglomeration economies, workers in the foreign country prefer that the domestic country supports the central domestic region, whose goods are more accessible to them; (iii) with high agglomeration economies, workers in the foreign country have *ceteris paribus*, a slight preference for domestic regional policies supporting the central domestic region, whose goods are more accessible to them; (iv) but if the domestic regions are different, foreign workers prefer solutions unbalanced towards the weakest domestic region in order to avoid capital drain out.

(12) Peripherality and centrality play an important role in the achievement of **efficiency**: (i) domestic efficiency is achieved with support unbalanced towards the strongest region when they are different, but if they are identical, it is efficient to support with regional policies the central region, especially when agglomeration economies are high; (ii) with weak agglomeration economies, the maximum foreign utility is for domestic regional policy supporting the central region, unless it is much weaker and it is better to support the strongest region; (iii) with strong agglomeration economies, the maximum foreign utility is for domestic regional policy supporting more central region when they are identical, and for the domestic country supporting the weakest region otherwise.

(13) Peripherality and centrality also play an important role in the achievement of **equity**: (i) with either low or high agglomeration economies, domestic equity is achieved with larger support to the disadvantaged region, and the disadvantage can be of two types: due to the territorial characteristics of regions due to the lower accessibility of regions; (ii) with either low

or high agglomeration economies, foreign equity is larger when the domestic country supports more its peripheral and/or disadvantaged region.

In all cases, the strength of agglomeration economies, the regional “territorial” differences and the geographical shape of the economy are essential in determining which are the domestic and foreign effects of regional policies and how it is possible to use them to achieve equity and/or efficiency.

As a general conclusion, we have here shown that domestic regional policies also have an international effect and that concurrent and often conflicting interests co-exist; these interests are especially conflicting when agglomeration economies are strong or peripheral regions exist, a case which clearly fits the actual world.

For this reason, when regional policies within countries are largely financed by a supra-national body, as in the European case where EU cohesion policies – which have in the past 20 years acquired a leading role in the development process of European regions and now account for roughly 1/3 of EU budget – it is clear why the allocation of these policies within the countries is not simply left to the individual nation states but also involves bargaining with supra-national bodies (such as the EU Commission) which ought represent the collective interests. Further investigations directly accounting for the effects of fiscal policies would provide additional insights.

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