NBER WORKING PAPER SERIES

REDISTRIBUTION POLICY: A EUROPEAN MODEL

Alessandra Casella

Working Paper 9258
http://www.nber.org/papers/w9258

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2002

This paper owes a large debt to ongoing conversations with Bob Inman. It was prepared for the meeting on The Economics of Political Integration and Disintegration held at CORE, Louvain La Neuve, May 24-25, 2002, and presented at the ESF workshop on Local Public Goods, Politics and Multijurisdictional Economics, held in Paris, July 2-3,2002. I thank participants and organizers of both meetings and in particular Jacques Thisse, Shlomo Weber, Hubert Kempf, Myrna Wooders and Fabien Moizeau. The views expressed herein are those of the author and not necessarily those of the National Bureau of Economic Research.

Redistribution Policy: A European Model
Alessandra Casella
NBER Working Paper No. 9258
October 2002
JEL No. F2, H7, R1

ABSTRACT

Following the rationale for regional redistribution programs described in the official documents of the European Union, this paper studies a very simple multi-country model built around two regions: a core and a periphery. Technological spill-overs link firms' productivity in each of the two regions, and each country's territory falls partly in the core and partly in the periphery, but the exact shares vary across countries. We find that, in line with the EU view, the efficient regional allocation requires both national and international transfers. If migration is fully free across all borders, then optimal redistribution policy results from countries' uncoordinated policies, obviating the need for a central agency. But if countries have the option of setting even imperfect border barriers, then efficiency is likely to require coordination on both barriers and international transfers (both of which will be set optimally at positive levels). The need for coordination increases as the Union increases in size.

Alessandra Casella
Department of Economics
Columbia University
New York, NY 10027
and NBER
ac186@columbia.edu

1 Introduction

A central motivation for redistributive policy in the European Union (EU) is the concern with regional inequalities - disparities in income, unemployment and standards of living among regions often belonging to the same country: Article 158 of the Treaty of Amsterdam reads: " The Community shall aim at reducing disparities between the level of development of the various regions and the backwardness of the least favored regions or islands.." Two aspects deserve to be stressed: first the discussion is explicitly in terms of "cohesion" or "solidarity", recurring terms in EU rhetoric; second, the reference unit is the region, not the country. Especially when comparing European redistribution policy with its North American counterpart, it is important to emphasize that regional inequality cuts across national borders: it is the inequality between regions belonging to the core of Europe - the rich regions clustered around Europe's geographical center - and regions belonging to the periphery - the poorer regions around the Mediterranean Sea and at the Eastern and Northern border of the Union. Figure 1.1 shows a map of the regions entitled to redistributive transfers in 2000-06 because of their economic backwardness, regions whose income per capita, with very few exceptions, was below 75 percent of the EU average in 1994-99. It is immediate that these regions lie at the outer borders of the EU territory.[1]

The analyses of redistributive policy developed for the US and Canada stress the interaction between a federal government and a number of individual states with different endowments, but do not, as a rule, include an intermediate layer of regional inequality that overlaps state borders (for example, Boadway and Flatters 1982, Inman 1988, Inman and Rubinfeld 1996, Wildasin 1991 and 1998). These are models where geographical location plays a role only because it correlates with particular natural endowments or because it subjects firms or individuals to a specific state policy. Not surprisingly, then, the rationale for redistributive policy that emerges abstracts from questions of industrial location and agglomeration effects. In Europe, on the other hand, redistribution programs are tied closely to the belief that

[1] EU redistribution policy is enacted through the Structural Funds and organized around three main objectives. Objective 1 is the development of the poorest regions (70 percent of total transfers); objective 2 is contributions to regions in "structural difficulties", for example declining rural areas (11 percent of total transfers); objective 3 (12 percent) is human capital development. The remaining funds are used to support the common fisheries policy.

geography matters greatly - and not so much because of natural endowments, but because population density and the concentration of economic activity differ between the core and the periphery of Europe, and agglomeration externalities benefit firms located close to other firms and to thick markets. The main arguments and the evidence in their support have been described elsewhere (see for example Puga 2001, Overman and Puga 2002, Quah 1996). Here we want to emphasize how much this view inspires official EU policy. The *Second Report on Economic and Social Cohesion* (European Commission, 2001) reads for example: "Economic location is characterized by important externalities" [...], (and) "the emerging picture is one of very high concentration of activities in central regions, which account for only 14 percent of the land area, but a third of the population and almost half (47%) of the GDP.[...] In all but 11 of the 88 central regions GDP per head in 1998 was above the EU average, while all but 23 of the 111 peripheral regions had a level below the average. [...] Productivity in the central regions was 2.4 times higher than in the peripheral ones " (pp29-30).

The goal of this paper is to tell an extremely stylized but not implausible story that captures this view, and evaluate the redistribution policy, if any, that derives logically from the approach.

We find that, in line with official statements by EU bodies, economic efficiency in our model does indeed entail redistribution, both within a country and, if countries differ in their distance from the core, across countries. Whether or not these transfers translate into the need for a centralized policy is a more delicate issue. The crucial question is the ease of migration. If free migration holds everywhere, decentralized national policies will be efficient: because of migration, individuals must enjoy equal utility in all locations, and national policies will perfectly internalize all externalities abroad. As long as (positive) regional and international transfers are among the policy tools under countries' control, the coordinating actions of a central agency are not required. This is a well-known result, first made clear by Myers (1990), and it holds in the model studied in this paper.[2]

But migration policy is also de facto among a country's policy tools: even within the post-Maastricht EU, free labor movement is far from reality, hampered by official issues of certification and very real concerns about domestic labor forces. In a future enlarged EU, free mobility is not envisioned in

[2] Extensions or qualifications to the original results can be found in Mansoorian and Myers (1993), Wellisch (1994), Hindriks and Myles (2001).

the short term. If the countries' heterogeneity is large enough, at least some of these countries would prefer to impose barriers to migration; if they do so, the barriers will prevent them from internalizing perfectly the effects of their policies abroad and the result will be inefficient. Achieving efficiency then does indeed demand coordination: preventing these countries' unilateral migration policy requires compensating them for foregoing "secession"; the necessary utility differentials can only be achieved if migration is in fact constrained; but at the same time policy decisions must be set at their efficient levels, something that a central agency can do by choosing correctly the flows of international transfers. Once we recognize that border control decisions are endogenous, the approach applied in the literature to questions of political secessions becomes useful, and the scope for redistribution highlighted for example by Bolton and Roland (1997) or Le Breton and Weber (2001) appears in the analysis. Redistributive transfers then play two roles: they influence directly the allocation of resources, but they also affect it indirectly by preventing costly unilateral actions. The conclusion by Boldrin and Canova (2001) that "regional policies serve mostly a redistributional purpose, motivated by the nature of the political equilibria upon which the European Union is built" (p.210) fits our interpretation, but loses its somewhat sinister tone.

The paper is organized as follows. Section 2 describes the model and characterizes the efficient allocation; Section 3 studies optimal national policies; Section 4 analyzes the effects of enlarging the set of countries, and Section 5 concludes. The Appendix contains some of the proofs.

2 The Model

We begin by describing the simple logic of the model, loosely inspired by Ciccone and Hall (1996). Imagine Europe as a circle, composed of different countries, each a slice of equal size. The contribution of the model is to introduce "the region" as a third level of analysis: there are two regions, a central one, the *core* - the lighter area in Figure 1.2, and an external one, the *periphery* - the shaded outer band in the figure. Each country's territory comprises areas from both regions, but the exact shares differ across countries - this is why the smaller circle representing the core is off-center in the figure. This is the only source of heterogeneity in the model.

The regions play a role because labor productivity depends on agglomeration effects which are active at the regional level. Production technology exhibits constant returns to scale at the firm level but labor productivity, taken as given by the individual firms, depends in fact on the density of employed workers in the region. What matters here is whether a firm is located in the core or in the periphery, and not the existence of national borders: all firms in the core share the same productivity, as do all firms in the periphery, independently of their national identity; whereas firms in the same country but in different regions face a different technology.

Individuals' mobility is free within each country and across all countries, unless barriers to migration are explicitly put in place. But the tendency towards agglomeration is checked, in part, by congestion costs that capture the difficulty of living in very crowded environments - they are a short-hand for the increased cost and reduced availability of housing and for congested local public goods. Congestion costs are local and increase with the density of inhabitants in the specific national subregion: they can differ both across regions in the same country and across countries in the same region.

2.1 A Single Country

Consider first the simplest case - a single country in isolation. Its total area is normalized to 1, of which a share α_c (smaller than 1/2) belongs to the core, while the complementary share $\alpha_p = 1 - \alpha_c$ belongs to the periphery. Call n_r $(r = c, p)$ the density of workers in region r, or $n_r \equiv N_r/\alpha_r$, where N_r is total labor living and working in the region. The total population, $N_c + N_p$ equals 1. Labor markets are flexible and workers are paid their marginal product, which in region r equals $f(n_r)$, where f is an increasing function of n_r.[3] A worker in region r has utility $h(n_r)$, equal to his "net income", or his wage net of congestion costs: $h(n_r) = f(n_r) - c(n_r)$, where the function c is increasing and convex in n_r. To illustrate the workings of the model with an example, we will posit specific functional forms: $f(n_r) = n_r$, and $c(n_r) = \frac{1}{2g}\max(0, n_r - 1)^g$ $(g > 1)$ (congestion costs are negligible until density reaches a given threshold, and rise steeply then).

In the decentralized equilibrium, workers locate themselves in the two regions so as to equate their net incomes, if both regions are inhabited, or

[3] An interesting extension of the model has wages set in the core, for the entire national territory. The model can then generate unemployment and richer policy prescriptions. Here we concentrate on the role of agglomeration effects, and ignore labor markets rigidities.

concentrate in one of the two. Taking into account $n_p = \frac{1-\alpha_c n_c}{\alpha_p}$, denote by $h_p(n_c) \equiv h(n_p)$ the net income of a worker in the periphery, as function of the density in the core. Given $\alpha_c < 1/2$, $h_p(n_c)$ is everywhere decreasing in n_c, while $h(n_c)$, the net income of a core worker, may have an interior maximum at some $n_c^* > 2$ if g is larger than a threshold $g'(\alpha_c)$, i.e. if the congestion costs are sufficiently convex. The two functions are drawn in Figure 2.1, from which the equilibria can be easily read. With our functional forms there are always three equilibria: one is always the interior symmetrical equilibrium with $n_p = n_c = 1$, equal productivity and equal congestion costs in both regions; the second is always the equilibrium with full concentration in the periphery; the third has either complete concentration in the core or, possibly, high ($n_c > 2$) but incomplete concentration in the core if g is larger than a threshold $\widehat{g}(\alpha_c) > g'(\alpha_c)$. Note that the interior equilibrium is always dominated by complete concentration in the periphery.[4]

Individuals making their location choice ignore their individual contribution to a region's productivity, and in general the decentralized equilibrium will not be optimal. Consider then the problem of a policy-maker, directly choosing the allocation of workers between the two regions. The policy maker maximizes $H = N_c h(n_c) + N_p h(n_p)$ - with given total population and free mobility across regions, maximizing aggregate net income or per capita income is equivalent. Notice that in all equilibria of the decentralized problem $h(n_c) = H(n_c)$ (or $h_p(n_c) = H(n_c)$ if there is full concentration in the periphery). Thus we can deduce immediately from Figure 2.1 that the symmetrical allocation cannot be a global maximum - as mentioned above it is always dominated by complete concentration in the periphery ($h_p(0) > 1$). Congestion costs are not differentiable at $n_p = n_c = 1$, but given that this point can be ruled out, we can use standard calculus to characterize the optimal partition of workers, taking into account the two different cases $n_c < 1$ and $n_c > 1$. It is not difficult to establish that there cannot be an interior maximum for $n_c < 1$, but the conclusion changes for $n_c > 1$: if congestion costs are sufficiently convex, an interior maximum exists at $n_c^{**} \in (2, 1/\alpha_c)$, and the function $H(n_c)$ has the shape depicted in Figure 2.2. The necessary

[4]The threshold g' solves $\frac{\partial h(n_c)}{\partial n_c} = 0$ at $n_c = 1/\alpha_c$, and the threshold $\widehat{g}$ solves $h(n_c) = 0$ at $n_c = 1/\alpha_c$. Or: $g' = 1 + \ln 2/\ln(\alpha_p/\alpha_c)$; $\widehat{g} = \ln 2/\ln(\alpha_p/\alpha_c) + [\ln \widehat{g} + \ln(1/\alpha_c)]/\ln(\alpha_p/\alpha_c)$. Full concentration equilibria result from the simple functional forms chosen - richer specifications of the agglomeration externalities would easily lead to less extreme outcomes. But full concentration is particularly simple and is maintained here, with the caveat that it should not be read as specially meaningful.

threshold for g, which we call $\widetilde{g}(\alpha_c)$ is smaller than $\widehat{g}(\alpha_c)$, i.e. is compatible with full concentration in the core in the decentralized equilibrium.[5] Three considerations conclude the characterization of the global optimum. First, if an interior maximum exists, it is unique.[6] Second, if an interior maximum exists, it always dominates full concentration in the core, but it may or may not dominate concentration in the periphery - again this will depend on the degree of convexity of the congestion costs. The parameter g must be lower than a ceiling $\overline{g}(\alpha_c)$, where $\overline{g}(\alpha_c) < \widehat{g}(\alpha_c)$. If α_c is not too small, the interval $[\widetilde{g}(\alpha_c), \overline{g}(\alpha_c)]$ is guaranteed to be not empty.[7] Third, if the global maximum is interior, then it cannot be a solution of the decentralized problem. As shown in Figure 2.1, if the decentralized problem has two interior solutions, the symmetrical one always dominates the other, but we know that the symmetrical solution is dominated by full concentration in the periphery.

In conclusion, there is a range of values for the parameter g such that the global optimum is interior: it has high, but not complete concentration in the core. This allocation is not a solution of the decentralized problem, while complete concentration in the core is, for the same range of g values. It is on this case - $g \in (\widetilde{g}(\alpha_c), \overline{g}(\alpha_c))$ - that we concentrate in what follows.

The first result is immediate. We know from Figure 2.1 that at these parameter values net income in the core is higher than net income in the periphery for all $n_c > 1$. To support the global optimum the policy-maker will need to use redistributive tools: transfers must take place from the core to the periphery.[8]

---

[5] Simple manipulation shows that, for all $n_c < 1$, $\frac{\partial H}{\partial n_c} < 0$ if $g > 2$, and $\frac{\partial^2 H}{\partial n_c^2} > 0$ if $g \in (1, 2]$, thus no interior maximum exists. For $n_c > 1$, n_c^{**} must satisfy: $\frac{4g}{\alpha_p} = (n_c^{**} - 1)^{g-2}[n_c^{**}(1 + g) - 1]$; $4 < (n_c^{**} - 1)^{g-2}[n_c^{**}\frac{(1+g)}{2} - 1]$. The threshold $\widetilde{g}(\alpha_c)$ solves the first of these equations at $n_c = 1/\alpha_c$, or: $\widetilde{g} = 1 + \ln 2/\ln(\alpha_p/\alpha_c) + 1/\ln(\alpha_p/\alpha_c)[\ln 2 + \ln \widetilde{g} - \ln(\alpha_p + \widetilde{g})]$

[6] It is easy to show that if $H(n_c)$ is concave at n_c^{**}, then it is concave at all $n_c > n_c^{**}$.

[7] A sufficient condition guaranteeing that the interior maximum, if it exists, is the global maximum is that concentration in the core dominates concentration in the periphery: $h(1/\alpha_c) > h_p(0)$. This condition corresponds to $g < g"(\alpha_c) < \widehat{g}(\alpha_c)$. Checking whether $\widetilde{g}(\alpha_c) < g"(\alpha_c)$ is simple and implies a lower bound for α_c. But the sufficient condition is too strong, and a non-empty range of acceptable g values exists for a larger range of α_c values (as can be verified in numerical exercises).

[8] Note that the story is static, and the subsidies to the periphery have the sole scope of reducing internal migration flows and limiting congestion in the core. Richer stories could be told - where the subsidies take the form of public investment aimed at improving future productivity, but it is not clear that the simple static model is really off the mark.

The important variable at the center of the model is the share of the country's area belonging to the core. The smaller is such a share, the higher is density in the decentralized equilibrium with full concentration in the core. If such concentration is suboptimal, net income is lower the smaller the core area - in such equilibria, we can think of countries with smaller core area as "poorer". In addition, the size of the core area influences the optimal distribution of workers between the two regions, as well as the optimal internal redistribution policy. In particular, if the global optimum is interior, totally differentiating the first order condition in footnote 3 we obtain: $\frac{dn_c^{**}}{d\alpha_c} > 0$, the larger the core area, the higher the optimal concentration in the core (the intuition is straightforward: as the core area increases, maintaining the same concentration requires moving workers into the core, reducing the population in the periphery, and hence the value of supporting salaries there). In all numerical exercises we have run, if the global optimum does not have full concentration, the smaller the core area, the larger the share of national income redistributed from the core to the periphery.

2.2 Multiple Countries

We are now ready to extend the model to multiple countries. Begin with the simplest case of two, 1 and 2, each with a population normalized to 1. The two countries are identical, but for the share of their territory belonging to the core region: if country 1's core area is α_{1c}, call α_{2c} the core area of country 2, where $\alpha_{2c} < \alpha_{1c}$ (we will use progressively higher country labels to indicate progressively smaller core areas). Labor productivity in each region depends on labor density in the region, regardless of the national label of each worker. Thus, if we call N_{ir} the labor force in the r region of country i (and n_{ir} the corresponding labor density), then total labor density in region r is given by $(N_{1r}+N_{2r})/(\alpha_{1r}+\alpha_{2r}) = (\alpha_{1r}n_{1r}+\alpha_{2r}n_{2r})/(\alpha_{1r}+\alpha_{2r})$. It is this labor density that affects labor productivity, which now therefore becomes $f(n_{1r}, n_{2r})$, or, in the specific example we are using here, $(\alpha_{1r}n_{1r} + \alpha_{2r}n_{2r})/(\alpha_{1r} + \alpha_{2r})$. Congestion costs on the other hand are local, hence they equal $c(n_{ir}) = \frac{1}{2g}\max(0, n_{ir} - 1)^g$ in each country i.

The goal of this section is to investigate whether, in line with official European motivations for regional transfers, the optimal allocation in this model

In Italy, for example, convincing readings of the redistribution policy towards the South see it linked, in large part, to the need to contain social tensions in Northern industrial cities, after the large internal migration flows of the Fifties and Sixties.

require international transfers. But before addressing this question directly, we need to evaluate the equilibria without policy intervention. Consider the decentralized equilibria in the two countries when migration is free. There are equilibria where one country becomes empty, but we will ignore them here and focus instead on distributions of workers such that both countries are inhabited. With equal productivity and equal wages in the two core areas (and similarly in the two periphery areas), regardless of national borders, workers will migrate so as to equate congestion costs. If both regions are inhabited in both countries, then $n_{1r} = n_{2r}$, $r \in \{c, p\}$.[9] If instead the equilibrium is a corner solution and workers concentrate in one region, following the same reasoning we know that the region must be the same in both countries (or workers will move, within the same region, to the less congested country). Thus if all workers concentrate in the core (periphery), we must have $n_{1c} = n_{2c} \equiv n_c$ $(n_{1p} = n_{2p} \equiv n_p)$. When all workers concentrate in the core and the density is equalized across countries, then we also know that such a density must equal $1/\overline{\alpha_c}$ where $\overline{\alpha_c} \equiv 1/2(\alpha_{1c} + \alpha_{2c})$, the mean of the core shares (and similarly when workers concentrate in the periphery). Because densities must be equalized across countries, we can study the possible equilibria with the help of a figure that is almost identical to Figure 2.2, taking into account $n_c \in [0,\ 1/\overline{\alpha_c}]$ and $n_p = 1/\overline{\alpha_p} - (\overline{\alpha_c}/\overline{\alpha_p})n_c$. For the larger core country 1, this is Figure 3.1, where the thin line corresponds to the autarky case analyzed in the previous section.[10]

We can conclude that, once again, there are only three candidate equilibria: an interior equilibrium at $n_c = n_p = 1$, a corner solution at $(n_c = 0, n_p = 1/\overline{\alpha_p})$, and, if $g < \widehat{g}(\overline{\alpha_c})$, a second corner solution with full concentration in the core: $(n_c = 1/\overline{\alpha_c}, n_p = 0)$. Before analyzing the implications of these equilibria, notice that everything we have said carries over identically to the case of multiple countries: in all equilibria with free migration, the densities of workers must be equalized across countries, and in equilibrium they will either equal 1 everywhere or, if congestion costs are not too convex, equal 0 in one region and the inverse of the average region share in the Union in the

[9] More precisely, this need only be true in the region where density is larger than 1. In the other, congestion costs are 0, and the national distribution of workers - which does not affect productivity - is irrelevant. It follows that per capita income is independent of the distribution of workers as long as their density is smaller than 1, and in studying it we can focus on $n_{1r} = n_{2r}, r \in \{c, p\}$ without loss of generality. We will return to this point.

[10] For the smaller core country 2, the function $h_p(n_c)$ tilts up, as opposed to tilting down, and the upper boundary of admissible n_c values $(1/\overline{\alpha_c})$ falls, as opposed to increasing.

other.

From these conclusions, we can then immediately predict migration flows, although they will depend on which of the three equilibria emerges. Focus on the case of full concentration in the core. Then, if $n_c = 1/\overline{\alpha_c}\ \forall i$, it follows immediately that $N_{ic} = N_i = \alpha_{ic}/\ \overline{\alpha_c}$, or $N_i > 1 \Leftrightarrow\ \alpha_{ic} > \overline{\alpha_c}$: countries with core regions larger than the mean will be migration recipients, and countries with core regions smaller than the mean will be migration sources. Notice that if congestion costs are sufficiently convex - i.e. if we are in the range $g \in (\widetilde{g}(\alpha_{1c}), \overline{g}(\alpha_{nc}))$[11] - then, starting from full concentration in the core, immigration reduces per capita net income (because it increases an already too high density), while emigration does the opposite. Thus countries that are targets of immigration will be tempted to close their borders to incoming flows of workers. Once we introduce explicit policies, however, simply closing the borders will not be an equilibrium: both countries will consider the full range of available policy tools, including internal redistribution between core and periphery workers, migration barriers and international aid. We leave the analysis of these cases to the next section.

Notice that the meaning of "integration" here deserves a few comments. It is tempting to compare the results above to the single country case analyzed earlier, and in particular to rank welfare, here per capita income. The same logic used earlier would lead us to conclude that large core countries lose from integration, while small core countries gain (across equilibria with full concentration in the core). But the comparison is misleading because two different assumptions change between the two cases. One is free migration, a policy choice appropriately identified among the characteristics of integrated economies; but the second is technology: whether or not a country's regional productivities are subject to spill-overs from abroad. It is not clear that this latter feature is under a country's control - most probably it is not, and in this paper we take these spill-overs as part of the exogenous technological environment. Thus the comparison to the single-country analysis above cannot be interpreted as a comparison between integration and autarky.

Consider now the global optimum in the two-country example. The first observation is that the density of workers cannot be larger than 1 in one national core (or periphery), while being smaller than 1 in the other: with equal productivity, independently of national borders, and convex congestion costs, regional densities must be equalized. If the optimum has high concentration

[11] Where core shares must be such that the interval is not empty

in the core, then $n_{1c}^{**} = n_{2c}^{**} = n_c^{**}$. The statement requires convex costs, and thus does not apply to the international distribution of workers in the periphery, where their density is always below 1. The observation, already made in the decentralized equilibrium, was finally irrelevant there because it only applies to interior equilibria, and even then not to the symmetrical one. Here we proceed for now setting $n_{1p}^{**} = n_{2p}^{**} = n_p^{**}$, even when both densities are smaller than 1, a choice that has no implication for per capita income or for the characterization of the optimal density in the core. However, it does affect migration flows and international transfers, and we will discuss the matter further below.

With densities equalized across countries, we can once again exploit the single country analysis, again taking into account $n_c \in [0, 1/\overline{\alpha_c}]$ and $n_p = 1/\overline{\alpha_p} - (\overline{\alpha_c}/\overline{\alpha_p})n_c$. If $g \in (\widetilde{g}(\alpha_{1c}), \overline{g}(\alpha_{2c}))$, both functions have an interior maximum at high but not complete concentration in the core. It follows that the global optimum will also be an interior solution. Figure 3.2 depicts the result, where the two thin lines correspond to the two single country cases, with different core shares. Notice, trivially, that both countries are guaranteed higher per capita income in the global optimum than in the decentralized equilibrium: migration ensures that income must be equalized everywhere and the global optimum maximizes it by definition.

If the global optimum is interior, then it is associated with internal redistribution, and if $n_{1p} = n_{2p}$, this must be true in each country. But is *international* redistribution always a feature of the global optimum? The answer is closely tied to migration flows. If $n_{1p} = n_{2p}$, we can establish two results: (1) There must be migration into the large core country; (2) There must be international redistribution in favor of the small core country. To see why (1) must hold, notice if densities are equalized, then $N_{1c} = (a_{1c}/\alpha_{2c})N_{2c}$ and $N_{1p} = (a_{1p}/\alpha_{2p})N_{2p}$. By substitution, we can then verify immediately that $N_{1c} + N_{1p} \leq N_{2c} + N_{2p} \Longleftrightarrow n_c \leq n_p$, a condition that cannot be satisfied if the global optimum is interior. Establishing (2) is simpler still: if densities are equalized, the number of workers in the core region is higher in the large core county, and viceversa for periphery workers. But salaries and congestion costs are equalized across core regions (and periphery regions). Thus per capita transfers paid by core workers and received by periphery workers must be equalized. It follows that the total flow of transfers paid by the core region in country 1 must be higher than in country 2, while the total flow received in the periphery of country 1 must be smaller than for the periphery of country 2 - some of the funds must be crossing borders.

These results generalize easily to the case of multiple countries. We can state:

Proposition 1. *Consider a world with n countries and free migration. If the global optimum is interior,* $n_{ic}^{**} = n_c^{**} > 1 \forall i$*, and the optimal allocation* n_c^{**} *and per capita income* $h(n_c^{**}) = h_p(n_c^{**})$ *depend only on the mean core share* $\overline{\alpha_c}$*. In addition, if* $n_{ip} = n_p \forall i$*, then: (i) All countries whose core shares are larger than the mean are migration recipients; and all countries with core shares smaller than the mean are migration sources; (ii) All countries whose core shares are larger than the mean are net disbursers of international transfers, and all countries with core shares smaller than the mean are net recipients.* (The proof is in the Appendix).

If $n_{ip} \neq n_{jp}$ for some i, j, the prediction is less clean, because the total population in each country is not pinned down - any international distribution of periphery workers such that $n_{ip} < 1 \forall i$ is compatible with the optimum; it would not change n_c^*, or per capita income, but it does change population sizes and transfer flows. These asymmetrical equilibria arise from the absence of congestion costs when densities are smaller than 1 - a rather special but not unrealistic assumption. We discuss them briefly here because they will be useful reference points in the next section. Migration flows and international transfers are substitutes in this model. In the symmetrical equilibrium studied above, per capita incomes are equalized when some transfers flow from the larger to the smaller core countries; in the absence of these transfers, further migration would take place into the peripheries of the larger core countries, until all taxes collected on core residents are transferred to each country's own periphery. Notice that the global optimum characterizes n_c^* uniquely - hence the additional migration can only be to the peripheries of countries with larger than average core areas. Similarly, the global optimum can be implemented with an allocation that requires no migration, but larger international transfers - again the only difference is the density of periphery workers; with fewer periphery workers in countries that were migration targets, a larger share of taxes collected on core workers goes abroad.[12]

[12](1) Call per capita taxes collected in the cores t_c and per capita transfers in the peripheries τ_p (note that they must be equal everywhere). Aggregate balance requires: $t_c \sum N_{ic} = \tau_p \sum N_{ip}$. In the absence of international transfers, $t_c N_{ic} = \tau_p N_{ip}$. Simple manipulation shows that the two conditions yield: $N_{ic} + N_{ip} = \alpha_{ic}/\overline{\alpha_c}$. If the corresponding densities in the peripheries are everywhere smaller than 1 and $n_c = n_c^* > 1$, the global

3 Optimal National Policies

Having established the features of the optimal policy in this setting, we can now ask a question that is central to the actual working of redistribution policy in the European Union. The optimal policy requires international transfers - but does it require a central agency, or would it emerge even without coordination, from the decentralized interactions of the individual countries? On one hand, it is clear that the technological spill-overs create important externalities among countries - if effects abroad are ignored, national choices of internal transfers, and thus of regional densities, will be suboptimal. But if migration is free, as we have assumed so far, national policy makers should take into account the effect of their policies on migration flows, or, equivalently, on per capita incomes abroad: free migration provides the channel through which the international impacts of national policies are internalized. The observation, originally due to Myers (1990), applies here and is the logical starting point of our analysis of optimal national policies:

Proposition 2 *(Myers, 1990). Suppose migration is free. Each country chooses the density of its citizens in its two regions, and is free to distribute (non-negative) transfers abroad. Then the decentralized equilibrium will replicate the global optimum.* (The proof is in the Appendix)

Proposition 2 leads to two further observations. First, and most obviously, the optimality of the decentralized policy equilibrium will not follow if migration is costly. This model has the advantage of making quite clear the reason: the problem is not the insufficient migration flow *per se* - after all there exists here a global optimum with no migration - but the fact that migration costs limit the extent to which foreign consequences of national

optimum can be implemented with no international transfers. But only if accompanied by increased migration than in the symmetrical equilibrium: if $n_{ip} = n_p \forall i$, $N_{ic} + N_{ip} = \alpha_{ip}/\overline{\alpha_p} + n_c^* \left(\frac{\overline{\alpha_p} - \alpha_{ip}}{\overline{\alpha_p}} \right)$ which implies smaller migration flows. (2) Similarly, the global optimum can be implemented with an allocation that requires no migration, but larger international transfers. In the absence of migration, each country's population equals 1, and with $n_c^* > 1$ everywhere, $N_{ip} = 1 - N_{ic} < 1 - \alpha_{ic} = \alpha_{ip}$, or $n_{ip} < 1$ everywhere, as required. The difference is in the periphery population, which now equals $1 - \alpha_{ic} n_c$, as opposed to $1 - \overline{\alpha_c} n_c$ in the symmetrical equilibrium. With equal taxes collected in the core, funds transferred abroad (received from abroad) are larger if the core share is larger than the mean (smaller than the mean).

policies are internalized.[13] In this case, the need for a central agency and a centralized policy is immediate, although it can be argued that its first mandate should be the elimination of migration costs, as opposed to redistribution policy. The policy point is not new, but is important: facilitating migration would be a more direct route to higher global welfare than a program of international transfers.[14] The second observation is slightly more subtle, and clarifies why migration flows should be the object of treaties and coordinated policy in most circumstances. The fact that free migration would lead countries to replicate the global optimum does not imply that it is individually optimal for each of them. If migration barriers are a policy tool under the control of countries' policy-makers, then the analysis of optimal national polices should allow for countries choosing whether or not to set up border barriers. If indeed we find that a country would prefer to deviate from the free migration equilibrium and close its borders to foreign workers, then reestablishing the global optimum would require the presence of a coordinated policy including transfers in the country's favor. But here we face a contradiction: differences in incomes cannot be sustained without some cost to migration. We reach the conclusion that some barriers to migration might be optimally preserved but would need to be set in a coordinated manner and accompanied by correct complementary policies.

To clarify this second point, proceed by stages, assuming the absence of exogenous migration costs. Consider the temptation to deviate unilaterally from the global optimum - the free migration equilibrium - by closing borders. More precisely, think of the decision problem as a two-stage game. In the first stage, countries simultaneously decide whether or not to close their borders to migration flows; in the second stage, given migration policy decisions, countries choose their regional densities, or, equivalently, their internal and external transfers. We want to ask whether free migration is an equilibrium. A country (or group of countries acting jointly) deviating and setting up border barriers anticipates the optimal transfer policy of the other countries in stage 2, but takes as given their border policy. Notice

[13] In more standard models, this point is seen most clearly when countries are identical and the equilibrium is symmetrical. Then both the global optimum and the decentralized equilibrium induce no migration, but whether they lead to the same allocation of resources still depends on the absence of migration costs.

[14] Rodrik (2002) argues that a scheme of multilaterally negotiated visa for developing countries' workers would "likely create income gains that are larger than all the items on the WTO negotiating agenda taken together".

that given Proposition 2, we can think of a set of countries among which migration is free as choosing their regional densities so as to maximize jointly their total income.[15] In addition, because the optimal allocation among any set of countries does not depend on the individual core share of each country in the set, but only on the average core share of the set (by an immediate extension of Proposition 1), we can always study the temptation for unilateral deviation as a two country problem, the candidate for deviation, country i, and the rest of the world, $-i$.

Call $\overline{\alpha_{-ic}}$ the mean core share in the rest of the world, i.e. excluding country i. The first immediate observation is that if all countries were identical, there would be no incentive to deviate. The problem is analogous to that of two identical countries choosing between the global optimum and a Nash equilibrium with closed borders. In both cases, incomes per capita are equalized everywhere, and by definition they are maximized in the global optimum: setting up migration barriers can only lead to lower welfare. But matters change when countries differ. We can show:

Lemma 1. *If the global optimum is interior, there exists a threshold* $\sigma < 1$ *such that if* $\overline{\alpha_{-ic}}/\alpha_{ic} \leq \sigma$*, country* i *prefers to close its borders.*

Proof. To see why this is the case, consider the limiting case, where $\overline{\alpha_{-ic}} = 0$. When country i closes its borders, there are no international transfers or migration between i and $-i$, $n_{-ip} = 1$, and n_{ic}^{*} is set so as to maximize country i's income. When borders are open, on the other hand, spillovers are taken into account: if the global maximum is interior, n_c^{**} must be larger than 1, but it is different, and smaller than n_{ic}^{*} (because productivity in the periphery, the only relevant objective in the rest of the world, is strictly decreasing in the density of workers in i's core). In addition, at $n_c^{**} > 1$ income in the periphery must be strictly smaller than income in the core (because it is equal at $n_c = 1$ and strictly decreasing in n_c for all $n_c \geq 1$) and transfers must be flowing from the core to the periphery and hence, as long as there is any population left abroad, from country i to the rest of the

[15] We can think of migration policy decisions as a coalitional problem. All such decisions are made simultaneously and the equilibrium concept we use is Strong Nash - free migration is an equilibrium if no country, or group of country, has an incentive to set up barriers, given the absence of barriers among its complement countries. On the other hand, transfer decisions are made in period 2, and here it is appropriate to require that, given the coalitional structure, transfer policies are correctly anticipated. In the language of Hindriks and Myles (2001), we are studying a membership-based equilibrium, as opposed to a policy-based equilibrium.

world. Comparing country i's welfare with closed borders and in the global optimum is particularly easy when the global optimum is implemented with no migration. In this case, $n_{-ip} = 1$ by necessity; the only two differences are the outflowing transfers and the smaller core density at n_c^{**}. Since the allocation abroad is unchanged, i is transferring resources to the rest of the world and n_c^{**}does not maximize i's income, it follows that country i must be worse off in the global optimum: it strictly prefers to close its borders. In the global optimum, per capita income is determined uniquely, hence the result holds more generally, for any equilibrium migration flows. Because the problem has no discontinuities in core shares, the result will continue to hold for $\overline{\alpha_{-ic}}$ close to zero but positive, until a threshold σ is reached, and we know from the reasoning above that $\sigma < 1$, since there can be no deviation when countries are identical.[16]

Notice that the equivalence between a single country with core share α_{ic} and a group of countries with mean core share $\overline{\alpha_c} = \alpha_{ic}$ can be exploited to derive two immediate corollaries of Lemma 1. First, by definition of the global optimum, when country i prefers to close its borders, i's complement $-i$ must prefer free migration (or global income would not be maximized). But i's complement $-i$ is equivalent to a single country j with core share $\alpha_{jc} = \overline{\alpha_{-ic}}$: we can then rephrase the lemma from the point of a view of a country j, and state that there exists a $\sigma > 1$ such that for $\overline{\alpha_{-jc}}/\alpha_{jc} \geq \sigma$ country j must prefer open borders. Second, Lemma 1 can be read in terms of incentives for joint deviation by any subset S of countries with mean core share $\overline{\alpha_{Sc}}$ sufficiently larger than the overall mean ($\overline{\alpha_{-Sc}}/\overline{\alpha_{Sc}} \leq \sigma$). Notice that with $\alpha_{1c} > \alpha_{2c} > .. > \alpha_{nc}$, if country 1 has no incentive to close its borders, neither does any other country acting unilaterally, or any possible subset of countries acting jointly. We can identify the frailty of the free migration equilibrium by focussing on the unilateral incentive to deviation of country 1 alone.

Lemma 1 implies that if the global optimum is to be implemented when countries are sufficiently asymmetrical, some compensation towards the larger core countries is necessary. Notice that we are not stating that this is always

[16]For these arguments to hold, the convexity parameter g must be compatible with an interior maximum both in the global optimum and when the country closes its borders, and for different values of $\overline{\alpha_{-ic}}$. In numerical simulations, we have had no difficulty finding an acceptable range of g values for $\overline{\alpha_{-ic}} \in [0, \alpha_{ic})$. The values of σ found in the numerical exercizes were typically large, a 3-4 percent difference in core share being sufficient to trigger deviation.

feasible. The definition of global optimum implies that a country or a group acting jointly can be induced by its complement - the set of remaining countries - to forego the introduction of migration barriers, not that every individual country, or subset of countries, can simultaneously be prevented from doing so. With more than two countries, the second objective is much more problematic. All we can say at this stage is that *if* the efficient regional allocation can be supported in equilibrium, then compensating transfers must be taking place. In other words, either countries are similar enough that country 1 prefers open borders - in which case free migration is optimal, countries should be left to set their transfers, domestically and internationally, without explicit coordination, and the main role of an international agency should be limited to eliminating existing migration costs. Or countries are dissimilar enough that country 1 prefers to set up migration barriers - in which case free migration cannot be maintained in equilibrium, and barriers will be put in place. But migration barriers prevent countries from internalizing fully the external effects of their internal regional policies, and, unless coordinated, the outcome will be inefficient. The efficient allocation of workers among the different regions may be sustained only if accompanied by a cooperative agreement on migration and international transfers.[17] We can conclude:

Proposition 3. *Suppose exogenous migration costs are zero, but countries are free to create barriers to migration. Then, if* $\overline{\alpha_{-1c}}/\alpha_{1c} > \sigma$*, the global optimum is implemented through uncoordinated national policies. If* $\overline{\alpha_{-1c}}/\alpha_{1c} \leq \sigma$ *and the global optimum is interior, the efficient allocation can only be implemented through a coordinated agreement targeting jointly migration barriers and international transfers.*

The Proposition follows from Lemma 1. If large core countries must be compensated for not acting unilaterally, their citizens must enjoy higher per capita income, hence migration cannot be free. Migration costs must be set equal to the required differential in per capita income. But international transfer flows must then be set cooperatively to generate the correct regional densities $n_{ic} = n_c^{**} \forall i$. This last point is shown in the Appendix.[18]

[17] It may be possible, especially if information problems are not too severe, to devise decentralized schemes that would implement the social optimum (see for example Varian 1994 or Piketty 1996). We are making the simpler point that the decentralized equilibrium of the game we are describing would not be efficient.

[18] Notice that, given n_c^{**}, lump-sum transfers among any subset of countries are irrelevant from the point of view of the countries' complement, and in particular do not affect their

The result, ex post not too surprising, still sheds some light on current discussions in the European Union. As the size of the Union, and most importantly its diversity are due to increase, the fundamental tension between centralization of responsibilities and national autonomies is again evident. As one would expect, national governments appear more than ever jealous of their sovereignty and read the anticipated presence in the Union of new and "further away" members as requiring larger national powers, relative to the centralized institutions of the EU. These institutions on the other hand, and the Commission preeminently among them, see a larger Union as requiring more coordinated actions, exactly as counterpart of its increased diversity.[19] Our model gives qualified support to the Commission's position: the larger heterogeneity of the future Union will indeed require more coordination, to prevent negative spillovers from the correspondingly more heterogenous policies of the member states. But part of any coordinated agreement must be easing the concerns of the current members, to prevent them from adopting policies that would become serious obstacles to any form of substantial market integration.

The question of enlargement deserves more thought, and we turn to it now.

4 Enlargement

We define enlargement as a pure policy question. A Union in our model is a group of countries whose policies implement the jointly optimal regional density, either because they choose to allow free migration across their borders, or because they have a common agreement on border controls and transfers. Technological spill-overs are taken as given and may link a larger number of countries than those forming the Union, but outside the Union migration is prevented and international transfers do not take place. The question is exactly whether, in the presence of these spill-overs, the original Union chooses

incentive to deviate.

[19] A summary view of the debate can be found in the Summer 2002 issue of the CESifo Forum, reporting on the Munich Economic Summit of June 7-8, 2002. Among the official documents, see European Commission (2002) and, making the case for the member states, European Parliament (2002). As for policy actions, the public debate on the interpretation of the Stability Pact in the Summer months of 2002, as large member countries approach the ceiling on governement deficit, is clearly indicative of national impatience with EU constraints.

to expand and admit new members. The model represents a situation where markets are de facto already integrated, and the question of integrating policies presents itself - a not implausible description of the expansion of the European Union towards the countries of Eastern Europe.

As we have seen, one advantage of our model is to it lends itself easily to the case of multiple countries. In particular, the results of the previous section anticipate the different incentives towards enlargement faced by different members of an original Union. Suppose that countries considered for enlargement have progressively smaller core shares - hence, given n countries, the first question is whether 1 and 2 want to form a Union; then whether they want to include 3, if 3 wants to join; then whether $1, 2$, and 3 want to admit 4, etc. Enlargement then reduces the mean core share in the Union, and by Proposition 1 modifies the flow of transfers and migration. In particular, if the joint optimum is interior, convexity in congestion costs continues to require $n_{ic}^{**} = n_c^{**}$ for all countries belonging to the Union; if we focus on the symmetrical equilibrium with $n_{ip}^{**} = n_p^{**}$ then we know that countries in the Union will be sources of international transfers and recipients of immigration or viceversa depending on whether their core share is above or below the Union mean.[20] In terms of transfers and migration then, the impact of enlargement will be most obviously felt by those countries that move from below to above the Union mean as a result of the entry of new members: while net receivers of Union's funds before enlargement, they are asked to become net contributors; while sources of migration abroad before, they are transformed into destination countries for foreign workers. The parallel to Spain or Ireland in the current debate on Eastern enlargement is hard to avoid.

Changes in transfer and migration flows do not *per se* imply changes in per capita income. We do know however, by Lemma 1, that if the entry of a new country reduces the Union's core share too much, the old members, acting together, would move to prevent enlargement. This observation is intriguing but incomplete. It ignores both the individual incentives of old members to put obstacles to enlargement (in addition to their possible joint action), and the potential for compensating transfers, here the willingness of new members to accept reduced transfers in exchange for being allowed to join the Union.

[20] The reasoning is identical to the proof of Proposition 1, regardless of the presence of non-Union countries.

To see more concretely how compensation can change the picture, we have studied a simple numerical example, whose results are reported in Figure 5. There are three countries with core shares $\alpha_{1c} = 0.4$, $\alpha_{2c} = 0.375$ and $\alpha_{3c} = 0.325$, and the convexity parameter g is set equal to 5. Two scenarios are considered, a partial Union formed by countries 1 and 2, and a Union comprising all three countries. The top half of the figure reports the changes in per capita income associated with enlargement, in the first case starting from a prior situation where all countries are isolated and moving to a partial Union; in the second case moving from the partial to the complete Union. On the left are the results in the absence of compensation, or equivalently with free movement of labor among Union members: country 1 opposes the partial Union, favored instead by country 2 (and by country 3, although 3 remains outside), and, starting from a partial Union, both 1 and 2 oppose admitting 3. It is clear however that in each case the perspective member would gain, indeed in this example the gain is always enough to compensate the losing member(s). On the top right side of the figure are the changes in per capita income brought about by enlargement after compensation: When 2 compensates 1 for the formation of a partial Union, 1 must be made at least indifferent - the figure assumes that all remaining surplus is appropriated by 2, but the important point is simply that some surplus remains.[21] When moving from a partial to a complete Union, in the absence of compensation 1 and 2 suffer the same loss (income per capita is equalized by free mobility within the Union), but their threat points differ: because 1 has a larger core share, it finds unilateral deviation from the complete Union more advantageous and needs to be compensated correspondingly more. Again, compensation is possible and all three countries stand to gain from enlargement.[22]

The bottom half of the figure reports international transfers as percentage of each country's total income. Compensation requires positive migration

[21] We have also assumed that no compensation comes from 3, although 3 too benefits from the partial Union.

[22] In other words, if the only policy choice available to 1 and 2 was whether or not to admit 3, 3 should compensate them both equally, at least to their point of indifference; but in fact each country has the additional option of unilateral deviation, and here the potential gains differ. Again, the figure assumes that all remaining surplus is enjoyed by 3. As noticed in the discussion of Lemma 1, unilateral deviation is more advantageous than joint deviation for country 1 and less advantageous for country 2. In practice, unilateral deviation should be interpreted as recourse to policies that ignore common agreements, a very real temptation that seems well to acknowledge.

costs, and if these costs are mostly deadweight losses (think for example of bureaucratic obstacles to free movement), then the efficient allocation in this model has no migration at all. Thus we have used the reference case of no migration for the figure, but nothing substantive depends on it. On the left are international transfers in the absence of compensation; positive values are outgoing transfers, negative values are incoming ones. Countries with core shares larger than the Union's mean are sources of transfers, and particularly so in the absence of migration. When country 2 moves from being below the mean (in the partial Union) to being above (in the complete Union) its transfers correspondingly turn from negative to positive. The figure reports very large transfer flows: with no migration barriers in place and our parameter values, preventing the entry of workers from country 3 requires international transfers of the order of 10 percent of 3's GDP. Of course, the specific number is irrelevant here; what matters is the impact of compensation in reducing the flows. The right side of the figure reports equilibrium transfers when enlargement is beneficial for all members: transfer flows do not change sign, but as expected their magnitude is greatly reduced (notice that the scale of the diagram is halved).

The image of enlargement, and of a functioning Union, that emerges when compensation is taken into account seems plausible. Instead of being coerced into accepting a Union that would be too onerous for them, richer countries are induced to favor it by policies that reduce integration just enough to protect their higher standard of living, while allowing new members to reap new benefits. Once again, this would not be possible in the absence of a coordinated agreement.

5 Conclusions

The official documents of the European Union base the need for redistribution policy on the large inequality existing among regions of the Union. Individual regions are contained within national borders, but the areas of intervention naturally straddle countries' frontiers and form an additional overlapping layer between decision-making at the Union level and national jurisdictions. The regions with the lowest standards of living, the main targets of transfers, are located almost invariably at the periphery of the Union, supporting the view that geography matters. This belief is implied or stated repeatedly in the Union's documents: physical distance from the core of the Union and the most densely populated, urbanized and industrialized regions located there is costly.

This paper has studied a very simple model that starts from a stylized description of the Union's view and asks what redistribution policy, if any, should follow logically. The model assumes technological spillovers that are constrained geographically: all firms in the core share the same productivity, as do all firms in the periphery, and since each country is assumed to contain parts of both regions, firms' productivity can vary within the same country. Thus the natural "economic borders" are regional, while policy decisions are taken at the national and possibly at the Union level. Countries differ because different shares of their territory belong to the core.

We have found that under plausible conditions efficiency will indeed require both interregional transfers within the same country, and international transfers within the Union (or, identically, international interregional transfers). If countries cannot impose obstacles to labor movements, the desirable transfers do not require a coordinated Union-level policy: they follow immediately from countries internalizing through free migration the external effects of their domestic regional policies - a well-known result in the literature (Myers, 1990). However, if countries can impose obstacles to immigration (whether officially or not), then the need for a coordinated agreement is likely to arise. Countries that would be the main targets of immigration and the main sources of international transfers in the free migration equilibrium will decide, if the asymmetry is large enough, to prevent the free flow of workers into their borders. By doing so, they will also simultaneously distort their choice of internal regional policy - the externalities abroad are no longer fully internalized. Achieving the efficient economic allocation now requires a coordinated agreement: border policies affecting the international flows of workers and international transfers both need to be chosen cooperatively to induce the correct regional density of workers and, at the same time, the differential in per capita income that richer countries demand for remaining in the Union. If enlargement of the Union implies accepting countries that are progressively further away from the Union core, then enlargement increases the likelihood of unilaterally imposed obstacles to free migration, and, therefore, the need for coordinated action. It may be good to remember, though, that part of that coordination is used to reduce the unsustainable uniformity that would be brought about by full integration.

With respect to the actual policies of the European Union, it seems hardly surprising, then, that the transfers toward the Union's poorer regions are accompanied by other transfers targeting richer areas. Figure 4 is a map of the regions of the European Union that qualify for redistributive transfers either because they are poor, or because they experience "structural difficulties". The contrast to Figure 1.1 is quite clear.[23]

The model described in the paper was designed to handle multiple and heterogeneous countries as simply as possible, and thus to address issues related to the enlargement of an existing Union. But its three-level structure opens naturally questions of political economy that we have not pursued here. The fundamental tension captured by the model is between the two regions, core and periphery, not between richer and poorer countries. Inside any one country the necessary regional transfers could well generate disagreement, and an interesting issue is whether such internal regional disputes would be exacerbated or reduced by the existence and the expansion of the Union. We can conjecture, for example, that with free migration expansion of the Union should increase regional tensions in larger core countries, whose core regions come to face the extra burden of new international transfers, and reduce them in smaller core countries. But the possibility of imposing borders barriers, itself of course a policy choice the country must make as a whole, may well change the result. A second interesting, and possibly important, question is the identification of the correct decision-making unit. If the natural economic borders are regional, does it still follow that the correct political borders are national? We leave both of these points for future research.

[23] These second flows of funds are much smaller in volume, but if we were to add transfers related to the Common Agricultural Policy (CAP) the point would emerge clearly. In 2000, for example, disbursements under the Guarantee section of the CAP, by far the largest, amounted to a total of 40,467 million ECU, v/s 27,585 million for all other redistribution programs. France alone received more than 22 percent of CAP resources; another 9 percent went to Belgium, Denmark and the Netherlands. None of these countries has regions qualifying for transfers because of economic backwardness (if we exclude France's overseas departments and, temporarily, Corsica). (See: www.europa.eu.int/comm/agriculture/fin/.)

References

[1] Boadway, R. and F. Flatters, 1982, Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results, *Canadian Journal of Economics*, 15, 613-633.

[2] Bolton, P. and G. Roland, 1997, The Break Up of Nations: A Political Economy Analysis, *Quarterly Journal of Economics*, 112, 1057-90.

[3] Boldrin, M. and F. Canova, 2001, Inequality and Convergence: Reconsidering European Regional Policies, *Economic Policy,* 32, 207-253.

[4] *CESifo Forum,* 2002, 3, Summer.

[5] Ciccone, A. and R. Hall, 1996, Productivity and the Density of Economic Analysis, *American Economic Review*, 86, 54-70

[6] European Commission, 2001, *Second Report on Economic and Social Cohesion*, adopted January 31rst.

[7] European Commission, 2002, *Communication from the Commission - A Project for the European Union*, Bruxelles, May 2002, COM(2002) 247.

[8] European Parliament, 2002, *Draft Report on the Delimitation of Competences between the European Union and Member States*, rapporteur: Alain Lamassoure, February 6, 2002, 2001/2024 (INI).

[9] Hindriks, J. and G. Myles, 2001, Strategic Inter-Regional Transfers, CORE Working Paper.2001/4.

[10] Inman, R., 1988, Federal Assistance and Local Services in the United States: The Evolution of a New Federalist Fiscal Order, in H. Rosen (ed.), Fiscal Federalism, University of Chicago Press, Chicago, IL, 33-74.

[11] Inman, R. and D. Rubinfeld, 1996, Designing Tax Policy in Federalist Economies: An Overview, *Journal of Public Economics*, 60, 307-334.

[12] Le Breton, M. and S. Weber, 2001, The Art of Making Everybody Happy: How to Prevent a Secession, CORE Working Paper 2001/11.

[13] Mansoorian, A. and G.M. Myers, 1993, Attachment to Home and Efficient Purchases of Population, *Journal of Public Economics*, 52, 117-132.

[14] Myers, G.M., 1990, Optimality, Free Mobility and the Regional Authority in a Federation, *Journal of Public Economics*, 43,107-121.

[15] Overman, H. and D. Puga, 2002, Unemployment Clusters across European Regions and Countries, *Economic Policy*, 34, 115-147.

[16] Piketty, T., 1996, A Federal Voting Mechanism to Solve the Fiscal Externality Problem, *European Economic Review*, 40, 3-17.

[17] Puga, D., 2001, European Regional Policy in Light of Recent Location Theories, CEPR Discussion Paper 2767.

[18] Quah D., 1996, Regional Convergence across Clusters across Europe, *European Economic Review*, 40, 951-958.

[19] Rodrik, D., 2002, Feasible Globalizations, CEPR Discussion Paper 3524.

[20] Wellish, D., 1994, Interregional Spill-overs in the Presence of Perfect and Imperfect Household Mobility, *Journal of Public Economics*, 55, 167-184.

[21] Wildasin, D., 1990, Income Redistribution in a Common Labor Market, *American Economic Review*, 81, 757-774.

[22] Wildasin, D., 1998, Factor Mobility and Redistributive Policy: Local and International Perspectives, in P. Sorensen (ed.) *Public Finance in a Changing World*, London: MacMIllan, 151-192.

6 Appendix

Proof of Proposition 1. The reasoning in the text establishes $n_{ic}^{**} = n_c^{**} > 1 \forall i$. It follows then that at the optimum $h_i = h = n_c^{**} - c(n_c^{**})$ and $h_{ip} = h_p = n_p^{**} \forall i$. Thus total net income, the central planner's objective function, becomes $n_c^{**} \sum \alpha_{ic} h + (n - n_c^{**} \sum \alpha_{ic}) h_p$, or $\left[n_c^{**} \overline{\alpha_c} (n_c^{**} - c(n_c^{**})) + \frac{(1 - n_c^{**} \overline{\alpha_c})^2}{1 - \overline{\alpha_c}} \right] \frac{1}{n}$: the optimum n_c^{**} depends exclusively on $\overline{\alpha_c}$. Notice that since $h_i = h$ and $h_{ip} = h_p$, per capita taxes in the core t_c and per capita transfers in the periphery τ_p must be equal in all countries. Focus now on the case $n_{ip}^{**} = n_p^{**} \forall i$. (i) Country i is a net disburser of international transfers iff $\tau_p N_{ip} < t_c N_{ic}$ where aggregate budget balance requires: $\sum \tau_p N_{ip} = \sum t_c N_{ic}$, or: $\tau_p = (t_c n_c \overline{\alpha_c}) / (n_p \overline{\alpha_p})$. Substituting this expression in the inequality, we obtain that country i is a net disburser iff $\alpha_{ic} / \alpha_{ip} > \overline{\alpha_c} / \overline{\alpha_p}$, or, since $\alpha_{ip} = 1 - \alpha_{ic}$ and $\overline{\alpha_p} = 1 - \overline{\alpha_c}$, iff $\alpha_{ic} > \overline{\alpha_c}$. (ii) Call P_i population in country i, i.e. $P_i = n_c \alpha_{ic} + n_p \alpha_{ip}$, where, given $\sum P_i = n$, $n_p = (1 - n_c \overline{\alpha_c}) / (1 - \overline{\alpha_c})$. Thus we can write: $P_i = [n_c(\alpha_{ic} - \overline{\alpha_c}) + 1 - \alpha_{ic}] / (1 - \overline{\alpha_c})$. It follows that $P_i > 1 \iff (n_c - 1)(\alpha_{ic} - \overline{\alpha_c}) > 0$. But $n_c^{**} > 1$; hence country i is a migration destination iff $\alpha_{ic} > \overline{\alpha_c}$.

Proof of Proposition 2. Consider the case of two countries, where P is the population in country 1, and $(2 - P)$ the population of country 2. Begin with the central planner's problem. The central planner maximizes total net income G and solves:

$$
\begin{aligned}
\max_{\{n_{1c}, n_{2c}, P\}} G &= \alpha_{1c} n_{1c} h_1(n_{1c}, n_{2c}) + (P - \alpha_{1c} n_{1c}) h_{1p}(n_{1c}, n_{2c}, P) + \\
&\quad + \alpha_{2c} n_{2c} h_2(n_{1c}, n_{2c}) + (2 - P - \alpha_{2c} n_{2c}) h_{2p}(n_{1c}, n_{2c}, P)
\end{aligned}
$$

The first order conditions are given by:

$$
\begin{aligned}
\frac{\partial G}{\partial n_{1c}} = \alpha_{1c} h_1 + \alpha_{1c} n_{1c} \frac{\partial h_1}{\partial n_{1c}} - \alpha_{1c} h_{1p} + (P - \alpha_{1c} n_{1c}) \frac{\partial h_{1p}}{\partial n_{1c}} + & \\
+ \alpha_{2c} n_{2c} \frac{\partial h_2}{\partial n_{1c}} + (2 - P - \alpha_{2c} n_{2c}) \frac{\partial h_{2p}}{\partial n_{1c}} &= 0
\end{aligned} \tag{1}
$$

$$
\begin{aligned}
\frac{\partial G}{\partial n_{2c}} = \alpha_{1c} n_{1c} \frac{\partial h_1}{\partial n_{2c}} + (P - \alpha_{1c} n_{1c}) \frac{\partial h_{1p}}{\partial n_{2c}} + \alpha_{2c} h_2 + & \\
+ \alpha_{2c} n_{2c} \frac{\partial h_2}{\partial n_{2c}} - \alpha_{2c} h_{2p} + (2 - P - \alpha_{2c} n_{2c}) \frac{\partial h_{2p}}{\partial n_{2c}} &= 0
\end{aligned} \tag{2}
$$

$$\frac{\partial G}{\partial P} = h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial P} - h_{2p} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} = 0 \qquad (3)$$

Now consider the individual countries' problem. As in the one-country analysis, each national policy-maker has direct control over the density in his national core region (and will use internal transfers to decentralize it); the complication is that population is not fixed, but determined endogenously via migration. Migration occurs unless per capita incomes are equalized, and is thus influenced by regional densities and by international transfers. As noticed by Myers (1990), the analysis should allow for endogenous international transfers, with the constraint that countries can only choose to make non-negative transfers abroad. Each national policy-maker maximizes per capita income in his own country ($g_1$and g_2). Calling T the net international transfers per capita from country 1 to country 2, we can write country 1's problem as following:

$$\begin{aligned}
\max_{\{n_{1c},T\}} g_1 \quad &= \quad [\alpha_{1c}n_{1c}h_1(n_{1c},n_{2c}) + (P - \alpha_{1c}n_{1c})h_{1p}(n_{1c},n_{2c},P)]\,\frac{1}{P} - T \\
\textit{subj. to} \quad (C1) \quad &: \quad \frac{1}{P}\,[\alpha_{1c}n_{1c}h_1 + (P - \alpha_{1c}n_{1c})h_{1p}] - T = \\
&= \quad \frac{1}{2-P}\,[\alpha_{2c}n_{2c}h_2 + (2 - P - \alpha_{2c}n_{2c})h_{2p}] + \frac{TP}{2-P} \\
(C2) \quad &: \quad T \geq 0
\end{aligned}$$

Notice that $(C1)$ can also be written more concisely as: $g_1 - T = g_2 + TP/(2-P)$. Ignoring $(C2)$ for now, we derive the first order conditions:

$$\begin{aligned}
\frac{\partial g_1}{\partial n_{1c}} = [\alpha_{1c}h_1 + \alpha_{1c}n_{1c}\frac{\partial h_1}{\partial n_{1c}} - \alpha_{1c}h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial n_{1c}} + \\
\frac{dP}{dn_{1c}}\left(h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial P} - g_1\right)]\frac{1}{P} \quad = \quad 0
\end{aligned} \qquad (4)$$

$$\frac{\partial g_1}{\partial T} = \left[\frac{dP}{dT}\left(h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial P} - g_1\right) - P\right]\frac{1}{P} = 0 \qquad (5)$$

We can obtain dP/dn_{1c} by totally differentiating $(C1)$, holding T constant:

$$
\begin{aligned}
& dn_{1c}[\left(\alpha_{1c}h_1 + \alpha_{1c}n_{1c}\frac{\partial h_1}{\partial n_{1c}} - \alpha_{1c}h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial n_{1c}}\right)\frac{1}{P} - \\
& - \left(\alpha_{2c}n_{2c}\frac{\partial h_2}{\partial n_{1c}} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial n_{1c}}\right)\frac{1}{2-P}] \\
= \; & dP[\left(g_1 - h_{1p} - (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial P}\right)\frac{1}{P} + \\
& + \left(g_2 - h_{2p} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P}\right)\frac{1}{2-P} + \frac{2T}{(2-P)^2}]
\end{aligned} \tag{6}
$$

Or, substituting from (4) and simplifying,

$$
\begin{aligned}
& dP\left[h_{2p} - (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} - g_2 - \frac{2T}{(2-P)}\right] \\
= \; & dn_{1c}\left[\alpha_{2c}n_{2c}\frac{\partial h_2}{\partial n_{1c}} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial n_{1c}}\right]
\end{aligned} \tag{7}
$$

which we can write as:

$$
\frac{dP}{dn_{1c}} = \frac{\alpha_{2c}n_{2c}\frac{\partial h_2}{\partial n_{1c}} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial n_{1c}}}{h_{2p} - (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} - g_1} \tag{8}
$$

We follow the same procedure to obtain dP/dT . Totally differentiating $(C1)$, holding n_{1c} constant, and substituting (5), we derive:

$$
\frac{dP}{dT} = \frac{P}{h_{2p} - (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} - g_1} \tag{9}
$$

Hence we can write (5) as:

$$
h_{2p} - (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} = h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial P} \tag{10}
$$

Finally, substituting this last expression and (8) in (4), we obtain:

$$
\begin{aligned}
& \alpha_{1c}h_1 + \alpha_{1c}n_{1c}\frac{\partial h_1}{\partial n_{1c}} - \alpha_{1c}h_{1p} + (P - \alpha_{1c}n_{1c})\frac{\partial h_{1p}}{\partial n_{1c}} + \\
& \alpha_{2c}n_{2c}\frac{\partial h_2}{\partial n_{1c}} + (2 - P - \alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial n_{1c}} = 0
\end{aligned} \tag{11}
$$

Equations (10) and (11) replicate (1) and (3), the central planner's first order conditions with respect to P and to n_{1c}. Following identical logic, it is possible to show that solving country 2's problem leads to replicating (2), the central planners' first order condition with respect to n_{2c} (we leave this step to the reader). The two countries' uncoordinated equilibrium replicate the central planner's allocation. Notice that the density in the core regions and per capita income are determined uniquely. In the symmetrical equilibrium where $n_{1p} = n_{2p}$, P is also determined (as are, correspondingly, international transfers. See Proposition 1). However, as discussed in the text, there also exist asymmetrical equilibria where, as long as $n_{ip} \leq 1, i = \{1, 2\}$, only 2 out of the 3 variables $\{n_{1p}, n_{2p}, P\}$ are determined by the maximization problem. This indeterminacy is irrelevant for production efficiency, congestion costs and welfare, but extends to the level of transfers. It is not difficult to verify that for all $n_{1p}/n_{2p} \leq (\alpha_{1c}\alpha_{2p})/(\alpha_{2c}\alpha_{1p})$ (a ratio larger than 1), equilibrium transfers from country 1 to country 2 are positive, and the analysis above applies: country 1 will set the transfers so as to obtain the optimal allocation. If $n_{1p}/n_{2p} > (\alpha_{1c}\alpha_{2p})/(\alpha_{2c}\alpha_{1p})$, the selected equilibrium has transfers flowing in the opposite direction, and the relevant first order condition will be obtained from country 2's problem.

In the case of n countries, the analysis is much more cumbersome, but conceptually nothing changes (as shown formally by Myers, 1990). Each country chooses the level of transfers it disburses to each other country, taking as given the transfers by others. Notice once again the strength of the free migration hypothesis: any temptation to free ride is immediately checked by the realization that all disparities in per capita income would give rise to migration. Suppose a country were to shirk on its foreign obligations, counting on other governments taking up the needed transfers; if the decline in transfers implied an increase in per capita income for the country's citizens, immigration would follow, until incomes were again equalized. There is a unique core density that maximizes per capita income, conditional on no migration in equilibrium; to maintain that core density, the new immigrants would be shifted to the periphery, and the savings in international transfers would evaporate in increased domestic transfers.

Proof of Proposition 3. We must show that country i will choose the efficient core density $n_c^{**}$and achieve required per capita income $\overline{g_i}$ in the presence of migration costs $c_i^{**}$and international transfers T_i^{**}. Consider a two-country world, where country 1 requires compensation. Its problem becomes:

$$\begin{aligned}
\max_{n_{1c}} g_1 &= [\alpha_{1c}n_{1c}h_1(n_{1c},n_{2c}) + (P-\alpha_{1c}n_{1c})h_{1p}(n_{1c},n_{2c},P)]\,\frac{1}{P} - T \\
\textit{subj. to}\ \ (C1') &: \frac{1}{P}\,[\alpha_{1c}n_{1c}h_1 + (P-\alpha_{1c}n_{1c})h_{1p}] - T - c^{**} = \\
&= \frac{1}{2-P}\,[\alpha_{2c}n_{2c}h_2 + (2-P-\alpha_{2c}n_{2c})h_{2p}] + \frac{TP}{2-P} \\
(C2') &: T = T^{**}
\end{aligned}$$

The first order condition (4) is unchanged, but (8) becomes:

$$\frac{dP}{dn_{1c}} = \frac{\alpha_{2c}n_{2c}\frac{\partial h_2}{\partial n_{1c}} + (2-P-\alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial n_{1c}}}{h_{2p} - (2-P-\alpha_{2c}n_{2c})\frac{\partial h_{2p}}{\partial P} - g_1 + c^{**}} \tag{12}$$

Comparing (1) and (4), we obtain that optimality then requires:

$$c^{**} = h_{1p} - h_{2p} + (P-\alpha_{1c}n_{1c}^{**})\frac{\partial h_{1p}}{\partial P} - (2-P-\alpha_{2c}n_{2c}^{**})\frac{\partial h_{2p}}{\partial P} \tag{13}$$

where P is set equal to P^{**}, the solution of equation (3) at n_{1c}^{**}, n_{2c}^{**}. T^{**} must then be defined by the solution to $(C1')$, again at $P = P^{**}$. With our functional forms there is a range of values for P that satisfy optimality, but to each of these values corresponds a specific $T^{**}(P)$.

FIGURE 1

Source: http://www.europa.eu.int/comm/regional_policy/objective1/map_en.htm

Figure 1.1: EU regions eligible for Structural Funds under Objective 1 in 2000-06. (Income per capita below 75 percent of EU average in 1994-99

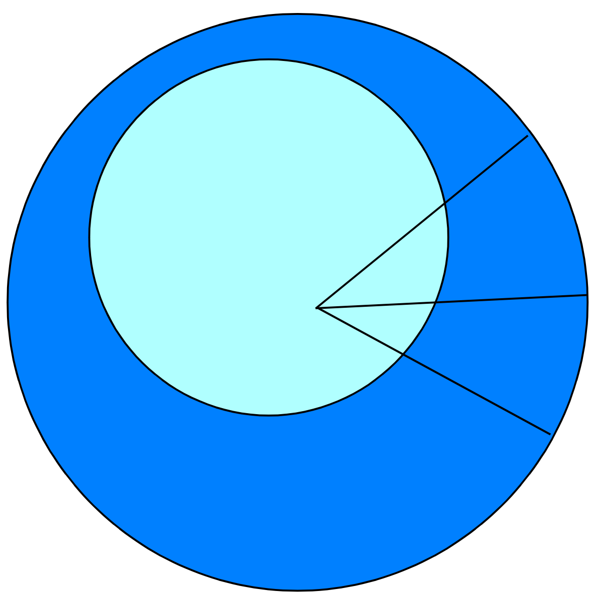


Figure 1.2: The model.

FIGURE 2

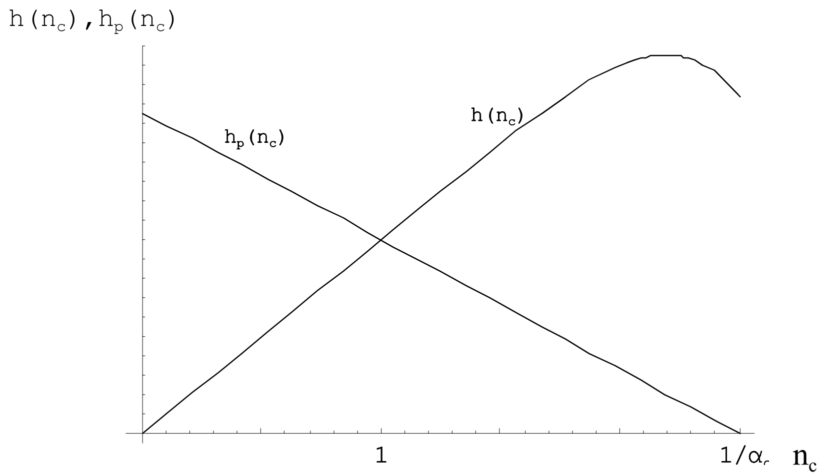


Figure 2.1

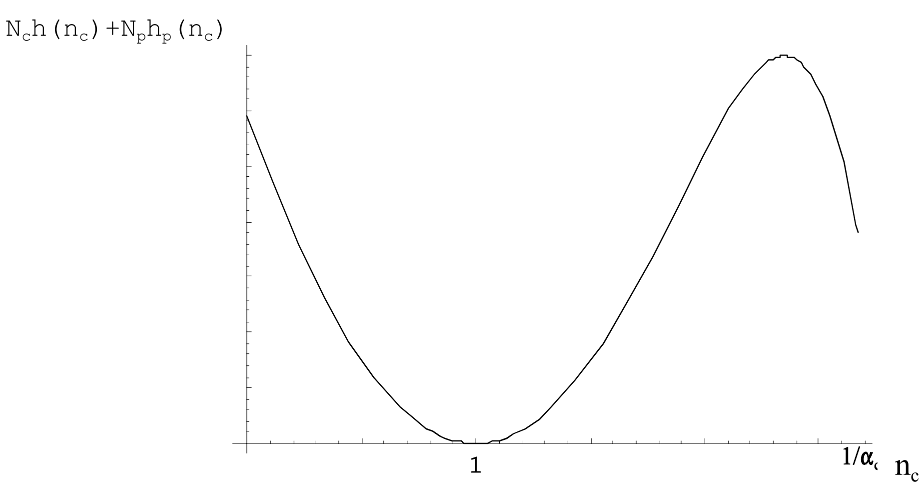


Figure 2.2

FIGURE 3

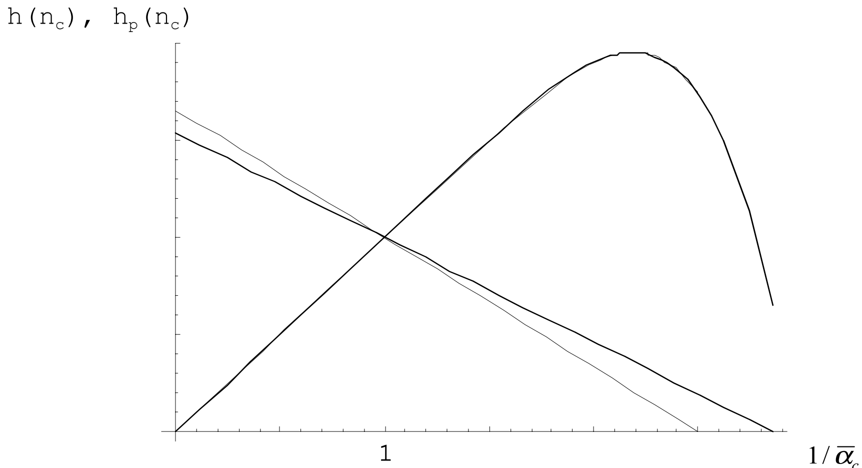


Figure 3.1

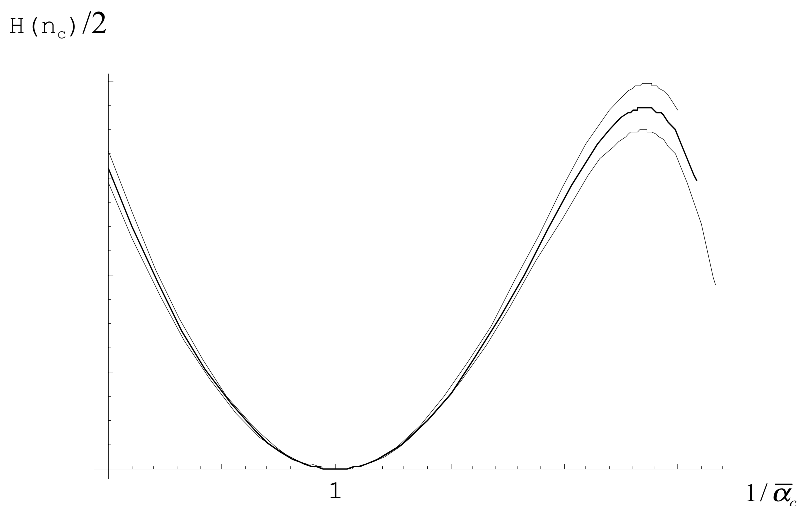


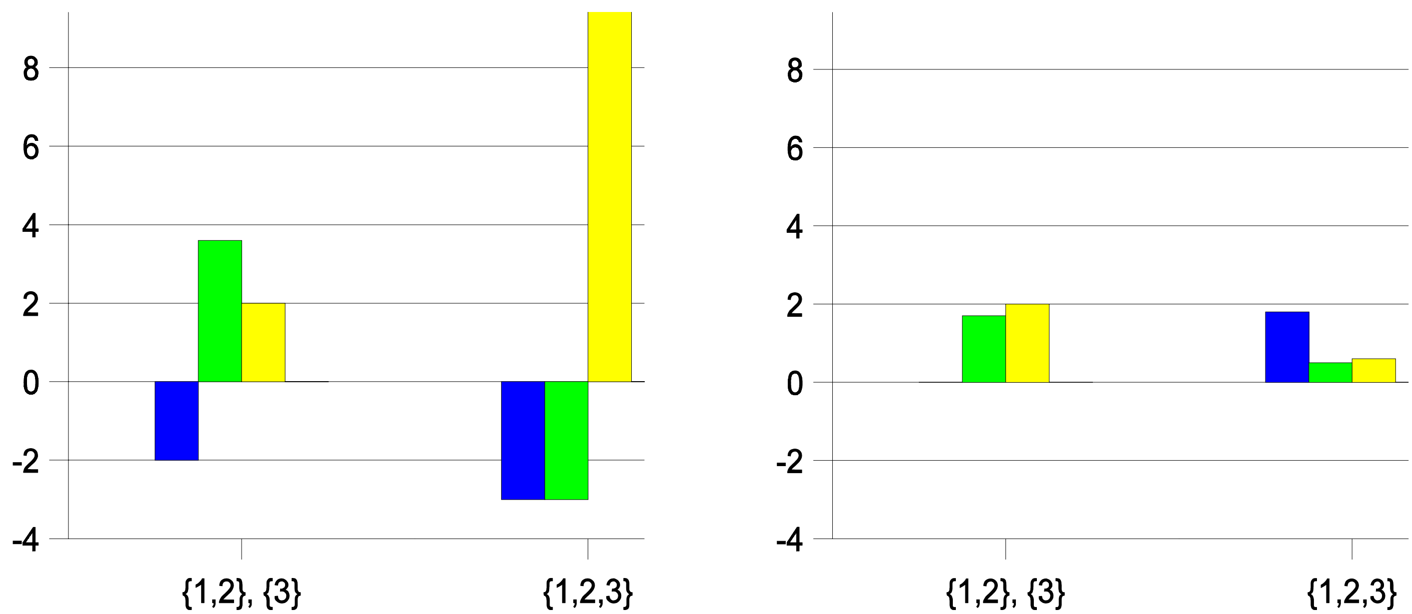
Figure 3.2

FIGURE 4
Enlargement.
An example: *g=5*.

Change in income per capita due to enlargement (%)

Without compensation

With compensation



International transfers/GDP(%). Zero migration

Without compensation

With compensation

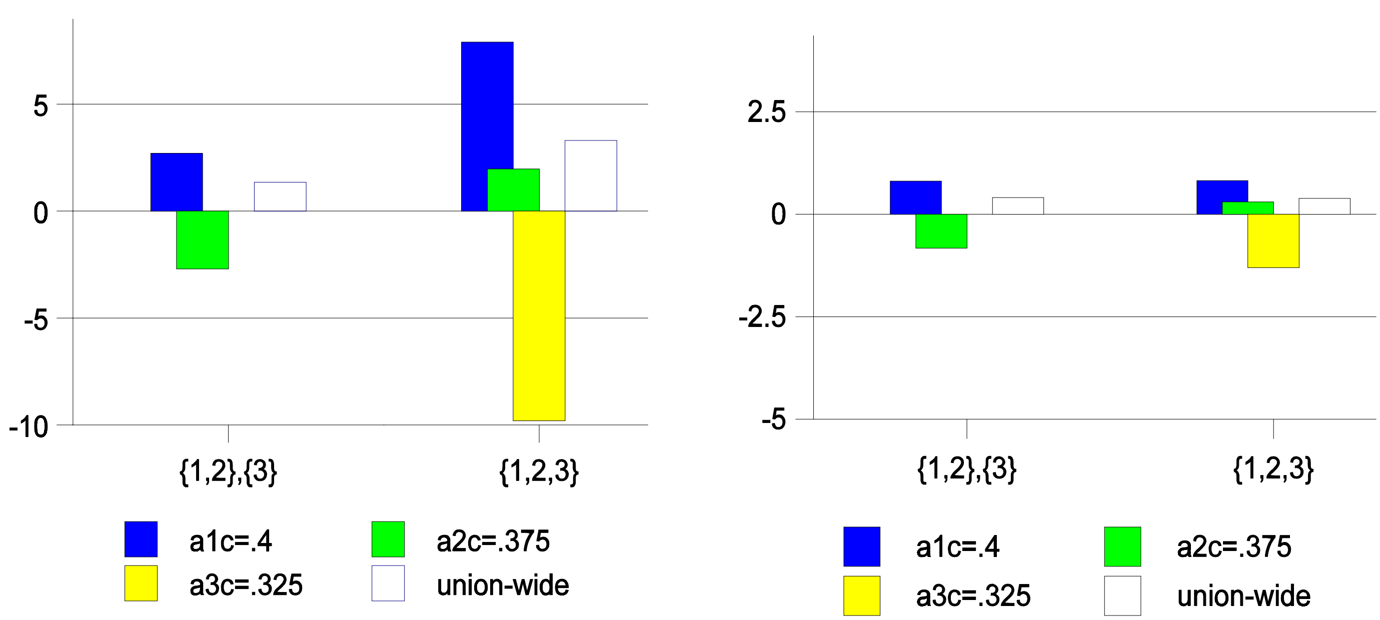
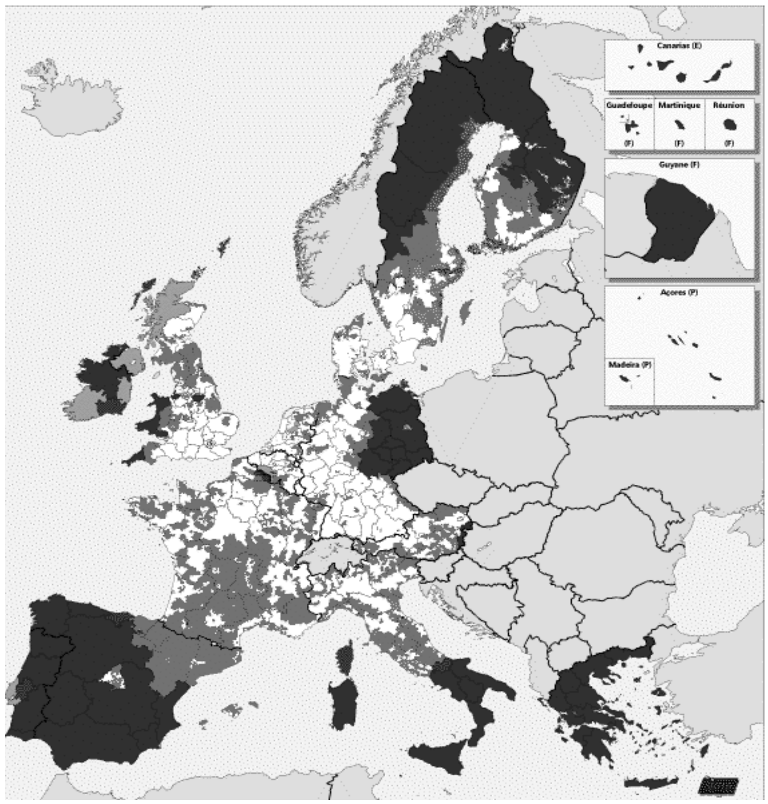


FIGURE 5



Source: http://www.europa.eu.int/comm/regional_policy/funds/prord/guide/euro2000-2006_en.htm

European Union regions eligible for redistribution transfers under Objective 1 and Objective 2 of the Structural Funds in 2000-06.