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EUROPEAN REGIONAL DEVELOPMENT POLICIES:
THE TRADE-OFF BETWEEN EFFICIENCY-EQUITY REVISITED

by

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European Regional Development Policies: The Trade-off Between Efficiency-Equity Revisited

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Abstract:

Testing the convergence pattern of the poorest European Union members (Ireland, Spain, Portugal and Greece) reveals that it is characterized by a catching-up of their income on the European average, but also increasing regional disparities within each country. Since they are the major beneficiaries of European regional development funds, a reconsideration of the impact of these funds on regional development is necessary. Theoretical analysis shows when such investments come to financing intra-regional transport infrastructures in the poorest regions they favor convergence but reduces the country's aggregate growth rate, whereas interregional transport infrastructures foster the aggregate growth, but lead to greater concentration in the core. Recent estimations show that their impact on regional development depends on the change in the region's accessibility. Therefore, transportation infrastructures cannot always be seen as an efficient instrument to reduce interregional disparities in Europe.

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1. Introduction

European regional policies have been created and developed with the successive enlargements to peripheral and less developed countries (Ireland, Spain, Portugal and Greece, also called cohesion countries) in order to accelerate a deeper integration necessary for the implementation of the Single Market and the single currency. The enlargement to Southern countries revealed even more important differences in infrastructure endowments than in per-capita incomes with the other countries. The European Commission devotes therefore respectively 30% and 60% of structural and cohesion funds to transportation infrastructure improvement since it gives this type of infrastructure a key role in efforts to reduce regional and social disparities. Hence this paper proposes in section 2 to test whether the four cohesion countries have succeeded in catching-up to the European average income since their membership, which also corresponds with the implementation of regional assistance in the country. The convergence pattern among regions within each country is investigated as well. In the light of the convergence pattern described in section 2, section 3 starts with a theoretical overview of the impact of regional development policies on cohesion, and points out the trade-off efficiency versus equity when regional funds are devoted to transportation infrastructures. Then section 3 shows that their impact on regional development clearly depends on recent changes in the field of transport and on the improvement in a region's accessibility. Section 4 summarizes the main findings and adds some concluding comments.

2. The Convergence Pattern in Europe

Rather than review the convergence literature broadly, we prefer to focus directly on assessing the convergence process in cohesion countries pointing up issues to be explored here. We therefore start with an analysis on inter-temporal differences in GDP per capita (calculated in Purchasing Power Parity) of each cohesion country to the European average from 1960 to its admission date (i.e. 1973 for Ireland, 1981 for Greece, 1986 for Spain and Portugal), and from this date to 2001. Their admission date also corresponds to the implementation of regional assistance in the considered country, as the cohesion countries received this help from the very

first year of their membership. We also investigate the convergence process of regions within each cohesion country.

2.1 Testing the Catching-up Process of Cohesion Countries

The convergence measure for each cohesion country i with observations spanning over t time periods can be formalized as follows:

$$(X_{i,t} - \bar{X}_t) = \mathbf{a}_i + \mathbf{f}(X_{i,t-1} - \bar{X}_{t-1}) + \mathbf{m}_{i,t} \quad (1)$$

where \bar{X}_t is the log of the yearly Community average, calculated according to the method of the European Commission (ratio of the total EU12 GDP in PPP on the total EU12 population), $X_{i,t}$ is the cohesion country i 's log of income per capita in year t , \mathbf{a}_i is the constant and $\mu_{i,t}$ is an error term. Adding a constant suggests that each country shifts to its own steady state, reflecting the differences in investment rates, public expenditure, opening rates, and in education levels. Cadoret and Tavéra (1999) evaluated European convergence by formalizing their model with a constant that is justified in this way as well.

Convergence in the above context requires that the differentials in the respective variables become smaller and smaller over time. For this to be true, \mathbf{f} must be less than one. On the contrary, if \mathbf{f} is greater than one, this indicates a divergence of this differential. The value of \mathbf{f} itself represents the degree of convergence. From the construction of the test, it follows that, as the value of the statistically significant coefficient \mathbf{f} approaches zero, the convergence effect becomes greater. Implicitly, as the value of the statistically significant coefficient \mathbf{f} approaches unity, the convergence effect decreases and vanishes. The interest focuses on the value of \mathbf{f} after joining the EU, in comparison with its value prior to membership. If the first one is higher than the second one, it would imply that convergence prior to membership was less strong than the convergence after membership, in other words that catching-up has occurred.

The convergence coefficient \mathbf{f} for a particular group of countries can be obtained using the Dickey and Fuller test (1979) on the estimates of equation (1). The augmented version of this test (ADF) is used in order to remove possible serial correlation from the data. Denoting the

differential of variable $X_{i,t}$ as $d_{i,t} = X_{i,t} - \overline{X}_t$, and its difference as $\Delta d_{i,t} = d_{i,t} - d_{i,t-1}$, the equation for the ADF test is written:

$$\mathbf{D}d_{i,t} = a_i + (\mathbf{f} - 1)d_{i,t-1} + \sum_{j=1}^k \mathbf{g}_j \mathbf{D}d_{i,t-j} + z_{i,t} \quad (2)$$

where the subscript $j = 1, \dots, k$ indexes the number of lagged differences, a_i is the constant and $z_{i,t}$ is a white noise.

Equation (2) then tests for a unit root in the differentials of variables. The null hypothesis of a unit root is rejected in favor of the alternative of level stationarity if $(\mathbf{f}-1)$ is significantly different from (less than) zero. In the current context, this tests whether the convergence coefficient \mathbf{f} is significantly different from (less than) one. To evaluate the statistical significance of the convergence coefficient \mathbf{f} , the critical values for unit-root tests tabulated by Dickey and Fuller (1979) were used.

The number of lagged differences (k) in equation (2) is determined using the parametric method proposed by Campbell and Perron (1991) and Ng and Perron (1995). An upper bound of k_{\max} is initially set at 4 ($k_{\max} = 4$) because of the relatively short studied period. The regression is estimated and the significance of the coefficient γ_k is determined. If the coefficient is not found to be significant at the 10% level, then k is reduced by one and the equation (2) is re-estimated. This procedure is repeated with a diminishing number of lagged differences until the coefficient is found to be significant. If no coefficient is found to be significant in conjunction with the respective k , then $k = 0$ and a standard form of the Dickey-Fuller test is used in the analysis. The advantage of the recursive t -statistic method over alternative procedures lies in its simplicity, its applicability to relatively short groups of countries, and its utility to compare the results of different periods of time.

The second step is to test for each country whether the values of the unit-roots are significantly different from each other. This test can be written in the following form:

$$t = \frac{\mathbf{f}_1 - \mathbf{f}_2}{\sqrt{\left(\frac{\mathbf{s}_1^2}{n_1} + \frac{\mathbf{s}_2^2}{n_2}\right)}} \quad (3)$$

where \mathbf{f}_1 is the value of the unit root before membership, \mathbf{s}_1 the standard deviation and n_1 the number of observations (similarly, the index 2 denotes the period after membership).

2.2 Empirical Results

The results are presented in table 1. Recall that the closer \mathbf{f} is to zero, the stronger the convergence, and conversely the more \mathbf{f} tends to one, the less strong the convergence of GDP per capita is between the studied cohesion country and the Community average (EU 12). If membership to the EU favors convergence, then \mathbf{f} must be lower after joining the Union than before.

<<insert table 1 here>>

The results of equation (3) show that the value of the unit root after membership is significantly different from the one prior to membership for the three cohesion countries, but not Greece¹. Interpretation of the results in table 1 suggests that convergence occurred after 1986 for Spain and Portugal, as the value of \mathbf{f} diminishes strongly after they joined the EU. The membership and the reforms associated with the Single Market increased the attractiveness of Spain and Portugal for industry location and foreign direct investments. As regards Greece, there is no evidence of convergence to the European average. The value of \mathbf{f} is not significantly different prior to and after membership. Greece seems handicapped by its lack of competitiveness and geographical proximity with the EU. The degree of peripherality of this country increased with

¹ For Spain: $t = 6,50808$; for Portugal: $t = 2,89575$; for Greece: $t = -0,03603$; for Ireland: $t = -3,21592$.

economic integration, since the potential of the center increased, almost by definition, faster than any other with the enlargement of the integrated area. Moreover, Greece joined the EMU later (January 1, 2001) and this may have delayed potential investments until now.

A strong and increasing presence of multinational firms that occurred in Ireland over the last two decades enhanced its catching-up to the EU average. The country also took advantage of its strong trade relation with the United-Kingdom (UK) and of the fact that free trade with the UK was established a long time before free trading with the European Community. Ireland had a GDP per capita that was very low before joining the EU in 1973. The value of f after membership and the results of the table 2 show that Ireland not only converges to the European average, but has exceeded it reaching 102% of the EU in 1997 and increased even more after this time. As a result of this impressive catching-up (Ireland's GDP per capita is over 90% of the European one's since 1997), Ireland is no longer eligible for the allocation of cohesion funds. However, cohesion funds have already been allocated to it for the 2000-06 programming period in order to sustain long-run investment and because of the methodology of the European Commission bases the calculation of the European per capita GNP on the Community data of the three previous years. For example, when the allocation decision was made at the end of 1999, the EU average was based on 1996-1998 data².

Joining the EU generated a series of changes in macro-economic policies, trade, in the production and investment structures, that have interfered with the efficiency of the European structural assistance and have generated important changes in production levels in peripheral countries. These effects are more fully discussed in Baldwin and Seghezza (1998). On the other hand, dynamic effects depending on human and physical capital accumulation and on technical progress are more difficult to measure because of the short period of time since the countries of interest joined the EU.

² The European Commission, which also uses a per capita GDP in PPP, concludes that there has been a catching-up of Ireland, Spain and Portugal and divergence for Greece. The manner in which the the purchasing power parity is estimated is however fragile. If the Greek PPP GDP appears relatively stable in comparison with that of the EU over a decade after its adhesion, it corresponds to an 11% appreciation of the Greek Standard of Purchasing Power (SPP) rate, because of a deep modification in the price structure. That counterbalances a decrease of the Greek GDP per capita to 7 percentage points over 1981-1991. The convergence process of Ireland is partially due to a very favorable evolution of its relative prices as well. For Spain and Portugal, their catching up occurs after 1986 even if their SPP rate depreciated. As a conclusion, if domestic prices were evaluated in another way, the estimations of PPP GDP could be different. In the present case, the same conclusions are drawn when GDPs are estimated in constant dollars.

Drawing on the prior results, greater cohesion (except for Greece) appears to have occurred, and while this evolution may not be due solely to regional policies, at least they may have positively contributed to it. However, this is only one aspect of the convergence process that has been occurring in cohesion countries for more than fifteen years; a closer look into the convergence process among regional incomes within each cohesion country is necessary. Figure 1 represents the evolution of the dispersion of regional per capita GVA (Gross Value Added), at 1990 million euro, within each cohesion country; the data considered are at the NUTS II level. Convergence occurs among regions of a particular country whether the dispersion of the distribution reduces over time. All the regions of Ireland, Portugal and Greece have been financed as objective 1 targets for the period 1989-1999, i.e. they had a per capita GDP below 75% of the European average. For Spain, only 7 regions out of 18 had a per capita GDP beyond this threshold, the others being also financed, but as objective 2 targets.

<<insert figure 1 here>>

In Ireland, inequalities have increased, but it should be noted that Ireland is composed of only two NUTS II regions, Border and Southern and Eastern. Thus, in this figure when the share of the regional income in the national one decreases for one region (Border), it automatically increases the share of the other region (Southern and Eastern). Among the three other countries, inequalities have increased at most in Spain: the European integration benefited at first the relatively prosperous regions. Except for the regions of Melilla and Baleares, there is no net relation between the development gap and the catching-up speed. The region of Extremadura, for instance, is the poorest one and its regional income has been around 65% of the national average for more than fifteen years. On the other hand, Rioja, Aragon, Madrid and Cataluna have established a significant gap. In Portugal, regional inequalities increase strongly too; the regions of Madeira and Azores have not caught up with the country average, while the regions of Norte, Centro and Algarve have developed rapidly. Concerning Greece, regional income disparities have been constant over time. The region of Ipeiros has remained the poorest one over time, whereas both Notio Aigaio and Kriti have dramatically increased their regional income. The convergence pattern described above confirms the results of Esteban (1994), Neven

and Gouyette (1995), Quah (1996), and more recently Martin (1999) and Fayolle and Lecuyer (2000).

The increase in regional inequalities is not a phenomenon specific to the poorer countries. Regional disparities have increased in almost all the European countries, at different rates. Italy is the country where they are the greatest. The Mezzogiorno has failed to catch up with the dynamic and developed regions of the northeastern part of the country. In France, Ile-de-France maintains its great distance from the other French regions. In the UK, regional inequalities seem to decline, but this result is due to the decline of manufacturing industry in almost all the regions of the country. Only in Germany, Netherlands and Belgium have regional disparities decreased.

3. The Trade-off effect of Regional Development Intervention

According to the previous results, it cannot be claimed that the objective of “*reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas*” has been fully reached (Article 158 of the Treaty establishing the European Community). In spite of the high level of structural intervention in cohesion countries (3.98% of the GDP in Portugal, 3.67% in Greece, 2.82% in Ireland, 1.74% in Spain over 1994-1999), regional policies have not been effective enough to impede the process of increasing regional income inequalities within a particular country. This section focuses on some theoretical issues and recent empirical works that help to understand the impact of regional policies on regional development.

3.1. Impact of EU regional policy: theory

In a neoclassical growth framework based on Solow (1956), a higher level of physical capital per worker corresponds to a higher steady state income. However, due to the decreasing marginal product of capital, the rate of investment must decline towards the steady state income, where the stock of capital per person is constant. The investment rate is then equal to effective capital depreciation; therefore, a higher investment rate in poorer regions may increase their convergence speed to rich regions, but it is only transitional and does not raise the steady state income in the long run. On the other hand, endogenous growth theory lends an important role to

public policies in the determination of growth rates in the long run. For instance, Aschauer (1989) and Barro (1990) predict that if public infrastructures are an input in the production function, then policies financing new public infrastructures increase the marginal product of private capital, fostering capital accumulation and growth. However, the addition of public capital in the production function does not allow one to look explicitly at the impact of regional policies on industry localization, as firms choose to relocate not only according to Community transfers of purchasing power to the poorest regions but also to their effects on capital returns and trade costs between and within regions. Note also that Keynesian theory, with its focus on demand, is not efficient either to study current regional policies, as they have a high supply effect in the long run. Hence, the theoretical approach used here draws on the new economic geography literature, as it considers the effects of spatial localization of firms on the welfare of agents. Since the works of Krugman (1991a, b), this literature rests on core-periphery models, which is not an abstract representation of reality since European peripheral countries are equally the poorest ones. In economic geography models, the main sector is the industry sector that operates in monopolistic competition à la Dixit-Stiglitz (1977). Consumers value diversity and consume differentiated industry goods. In the industry sector, returns are increasing, whereas they are constant in the agricultural sector.

According to core-periphery models, the long-run location equilibrium will depend on the maximization of profits in both the local market and the foreign market. They are influenced by several elements, the first of which are intraregional and interregional public infrastructure endowments. Investments in public infrastructures induce spillovers that act on the production function of firms - since public infrastructures are freely consumed (Barro, 1990), or their remuneration rate is below their marginal productivity - and favor knowledge externalities (Artus and Kaabi, 1993) through a higher circulation of information and innovations. Then, local market size differentials act through the linkages that bind workers and firms in the labor market and in the trade market. These are the forward and backward linkages, highlighted by Hirschman (1958), and vertical linkages through the existence of an intermediary sector (Krugman and Venables, 1995, Venables, 1996). Finally, firms locate where their capital return is the highest, namely in the region with the lowest capital intensity. However a low capital

intensity induces a low regional income too, therefore a low relative demand, and this will induce firms to relocate.

In core-periphery models, the core (also called the rich or northern region) is characterized by higher wages and associated higher production costs. The advantages of this region rely on its richness and the fact that it constitutes an important market: transaction costs between the production site and the sales location are low, implying that the intraregional infrastructure is good. On the other hand, the periphery (also called the poor or southern region) is poorer, with a smaller market and higher transaction costs. Its advantage stems from lower wages than in the rich region. Public infrastructures will be interpreted in a broad sense as comprising “any facility, good or institution provided by the state which facilitates the juncture between production and consumption”, i.e. not only transport and telecommunication, but also an institutional legal framework (Martin and Rogers, 1995). In economic geography models, transfer costs usually take the “iceberg” form introduced by Samuelson (1954); the poorer the infrastructures and/or the more remote producers and consumers, the larger the portion of goods produced and traded that is not actually consumed by purchasers. It is also assumed that non-distortionary lump sum transfers are possible: a region that experiences relocation of its economic activity is not assumed to be compensated by another region, otherwise there would not be any problem of regional inequalities (Martin, 2000).

3.1.1 Transfer of purchasing power to the South

Martin (1998 and 1999) starts with an equilibrium situation where transaction costs between regions are high enough to force firms to produce in both regions. First, he supposes that government support is a pure financial transfer to the poor region. Transfers of purchasing power increase the attractiveness of the South, since public expenditures and the regional income have increased. Northern firms could decide to export more to the southern region, but in this case they would have to pay interregional and intraregional transport costs in the South to sell in the southern market. Firms may prefer to relocate to the poor region (or open a branch establishment) in order to pay only intraregional transport costs within the South and benefit from increasing returns through higher market power. At the global level, transfers have increased the nominal income of the poor region and industry relocation has decreased

(increased) the price index in the South (North) as more firms produce in the South now. As firms are more dispersed, this induces less local spillovers: the innovative sector is initially in the North and uses inputs from the manufacturing sector, therefore when firms relocate to the South, less concentration induces higher transaction costs. As a result, the innovation rate declines, real income inequality decreases but at the expense of the aggregate growth rate.

3.1.2 Financing of transportation infrastructure within the South

While income transfers may temporarily achieve the treaty objectives of economic cohesion, national and international experience suggests that they can also create a permanently dependent economy, while not necessarily promoting the long-term objective of more rapid growth and convergence of living standards. The funds transferred have to be invested so as to increase the long-term output potential of the economies concerned.

Regional policies are therefore more than simple transfers; they mostly finance transport infrastructures (respectively 30% and 60% of structural and cohesion funds in the EU are dedicated to transportation infrastructures), as they appeared strongly unequal with the enlargement to southern countries, and the Treaty promoted free access to the Single Market for every region. If the European Commission's finances intra-regional transport infrastructures in the southern region, transaction costs of goods produced and consumed in this region decrease, which increases the effective demand for locally produced goods. Unlike the previous case, there is no increase in the nominal income in the southern region, but improving transportation infrastructures increases trade and therefore the overall level of expenditure inside this region. Given increasing returns, firms in the sector of (differentiated) industry goods move to the South until the profit rate of the last firm that relocates is the same in the two regions. After this point, there is no reason for a new northern firm to move to the South, because its profit rate would be lower in the South than in the North due to increasing competition. As the innovative sector is initially in the North but some firms have relocated, the cost of innovation increases; this reduces the innovation rate to the benefit of monopoly profits of firms in both regions. As monopolistic firms are more numerous in the North, interregional income inequality rises. As a result, location inequalities decrease, but regional income inequalities increase and the aggregate growth rate is lower.

As spillovers are usually locally limited, there is a threshold level in transaction costs below which agglomeration takes place and maintains itself. In this case, only a large improvement of southern attractiveness induces firms facing increasing returns to relocate. It is not obvious that intra-regional transportation infrastructures in the South have a relocation impact on the very poor areas within the South for which the agglomeration process has already proved too strong, but may work for its richer areas, where firms are already located.

3.1.3 Reducing interregional transaction costs

If transaction costs are high between the core and the periphery, it is more profitable to produce in both regions. Geographical distance insures southern firms a spatial monopolistic power over local consumers, as high interregional transaction costs make products of northern firms uncompetitive on the southern market. Suppose now that regional policies reduce interregional transaction costs (consider the construction of roads, airports or harbors for the TEN-T, Trans-European Transport Network), firms will consequently concentrate all their production in the core region in order to benefit from local spillovers and lower intra-regional transaction costs of the North. They equally are motivated by the fact that they can supply the bigger market and export easily to the periphery where demand is relatively smaller than in the North. In other words, firms will have no interest in locating in periphery, where the market is small, and with considerable exporting to the core. Agglomeration induces an increase in the innovation rate and in the global growth rate, because there are more numerous local spillovers. Monopoly profits of each firm in both regions decrease, but there are more monopolistic firms in the North, therefore regional income inequality decreases. Such a policy is efficient at the global level, but not necessarily at the regional level, as location inequalities increase. This policy implies also that immobile consumers living in periphery have now to pay international transport costs to import goods that were locally produced so far, but they equally import them at a lower cost. Martin (1998) shows that this second effect always dominates the first one, as the extent of initial differences in domestic transport infrastructures is not so high, otherwise full concentration in the core would occur.

Note also that the same results as above are found when intra-regional transport infrastructures are financed in the northern region. The way the financing occurs is not important for the

results. Note however that in Europe, regional policies are not financed by an increase in taxes where infrastructures are built, so that there is no dissuasive effect in this sense. Unilateral transaction costs (there are higher costs from the core to the periphery than in the reverse sense) may help to undermine concentration and favor growth in periphery. Such a theory would be opposite to the meaning of free circulation of goods (defined in the Single Act of 1986) but is not totally irrelevant as Spain and Portugal benefited from short-term higher trade barriers after their membership due to their development gap. This reduced relocation of firms to the North and promoted their growth rate.

The impact of previous regional policies is therefore always followed up with a negative effect: a simple transfer reduces the aggregate growth rate, financing intra-regional transport infrastructures in periphery reduces not only the aggregate growth rate, but also increases regional income inequalities. Finally, interregional transport infrastructures may lead to higher regional inequalities in firm location. The European Commission faces a trade-off between equity and efficiency, concentration fostering global efficiency but reducing the welfare of immobile southern workers, and location equity reducing local spillovers that are the basis of higher innovation rates and aggregate growth.

The limits of the previous theory are numerous, and require further research. First, it does not deal with the fixed costs linked to relocation, that are irreversibly employed in the short and medium term (construction of plants, contracts for supplying factors of production) and that cannot be removed from their original location without cost. The sensitivity of the core-periphery model is also very dependent on the intensities of scale economies, the consideration of dispersion forces, the level of trade costs (Krugman, 1991a,b, Fujita and Thisse, 1997, Helpman, 1997). At last, some considerations of labor mobility in Europe may help to clarify the convergence pattern previously described. The lack of international labor mobility, due to linguistic and cultural barriers, may be protecting the economic advantage of lower real wages in Southern countries. International labor mobility could reduce the extent of wage differentials and increase concentration in and market size of the core (see Krugman and Venables, 1996). However, the lack of labor mobility also is found within countries, and this may prove to be just as a much a handicap in smoothing regional income inequalities. In Europe, the wage structures

that characterize the labor markets are more rigid within each country than between countries, due to laws that prevent wage differentials in a single sector at the national level. Therefore, if wage differentials do not reflect the economic standing of a region, then unemployment rate differentials do (Puga, 1999). Moreover, a high national unemployment rate that reduces the probability of finding a job and unemployment insurance payments do not provide enough incentive to move outside one's own region.

3.2 Characteristics of Transportation Infrastructures

Transportation infrastructures improvement plays a key role in efforts to reduce regional and social disparities according to the European Commission. Recall that regional funds devoted to transportation infrastructures represent respectively 30% and 60% of structural and cohesion funds. Therefore, their impact on regional development has to be seen in the light of changes in the field of transport. According to the list of priority TEN-T projects defined by the European Commission in 1994, Vickerman (1999) argues that “new transport infrastructures tend to be built within and between core regions, because this is where transport demand is highest. It is therefore likely that, in so far as they increase capacity more rapidly than demand, the trans-European networks will largely benefit the core regions of Europe”. Puga and Venables (1997) and Fujita and Mori (1996) point out that this is relevant with a transport network composed of hub-and-spoke interconnections. They show that this kind of network promotes agglomeration in the hub. Firms located in the hub face lower transaction costs in trading with firms in spoke locations than a firm in any spoke location trading with a firm in another spoke.. The authors add that this network favors disparities between spoke regions. Vickerman *et al.* (1999) analyze the impact of changes in the accessibility, due to the TEN-T for high-speed rail³, on regional economic development. Assuming the high-speed rail lines planned for the European rail network for 2010 are built, they show that travel times will be reduced over the whole territory, but the most winning locations are the current hubs, since they will also increase their access to nearly everywhere. Similarly, “only cities that are nodes of the high-speed rail network gain accessibility, while the areas in between nodes and those not on the network or at its edge do not” (Puga, 2001). However, note that the high-speed rail network is characterized by a strong

³ The role of railways in the TEN-T is increasing. Funds devoted to railways are respectively twice and six times as important as those devoted to roads and airports.

nodal aspect, drawing on the experiences of airlines with similar structures. Moreover, a decrease in high-speed rail costs may have no direct effect on the carriage of goods. It may only create changes in the location of headquarters and business services.

The redistribution of benefits from a new transport infrastructure implemented in a poor region is no clear. Vickerman (1996) argues that the “redistribution of benefits [may be] away from the region and towards users resident in other regions”, more especially if the region is small. The reason is that there will be more non-residents using this infrastructure without bearing the costs, and a smaller proportion of residents users bearing the cost, unless the full cost is borne by every users. With regards to the costs, they may result in higher local taxes which may delay the economic development, and involve indirect costs like local environmental costs. Another aspect to consider is the variations by sector in demands on the transport sector for each individual sector. Since they are different across sectors, it reduces the possibility of drawing lessons for regional development policies. Consequently, current research focuses on measuring empirically these effects. Some examples of empirical studies are given here. Starting with Lafourcade (1998) who notices that for certain products transport costs are so high that the market potential is more or less limited to the demand within the region of production, whereas other products, which are less sensitive to transportation costs, can assemble an overall market potential across many regions. She provides an example of the influence of transportation costs on different goods, focusing on goods with high/low quality. Her analysis suggests that developing an infrastructure network induces a decrease in unitary transport costs and in delivery delays as well. These are gains that could be translated into an improvement in the quality of the traded goods. She shows for instance that constructing a highway in France considerably reduces unitary transport costs (about 15%), while gains are weaker for the other types of road. The influence of transport costs depends in her model on the nature of the goods sold (equipment good, usual consumption good, heavy industry...). It means that transport costs are less important as the transported good has a superior quality, or is more expensive such that other factors become much more important in location decision-making. The model of Midelfart-Knarvik *et al.* (2000) is even more sophisticated as they estimate on 33 industries in 14 EU countries how industry and country characteristics counteracted to determine the location of production over 1980-97 (note that they assume all industries to be perfectly competitive, which

is not an current assumption of economic geography models). Their calculations show evidence that the backward linkage has become less strong through time, while the forward linkage has become stronger. This implies that sectors highly intensive in intermediate goods are moving towards central locations to obtain better access to these goods. Industries intensive in skilled labor locate in countries with high endowments of skilled labor. The coefficient on market potential interacts with transport costs; this suggests that high transport intensity industries tend to locate in countries with lower market potential.

3.3 Empirical evidence: the cases of Tagus Crossing and the Madrid ring road

Changes in transport infrastructures lead to changes in accessibility. To find the effect on regional disparities requires linking changes in accessibility with changes in the spatial allocation of economic activities. Venables and Gasiorek (1999) study this connection by using a general equilibrium approach to evaluate the impact of several road projects financed by the Cohesion Fund. They define and quantify three effects acting on regional development: the direct effect which is due to the building of the infrastructure itself; the induced effect which considers changes in activities directly related to the project; and spillover effects due to forward and backward linkages created by the relocation of a firm, which may attract other firms and lead to cumulative causation in regional development. The main advantage of this approach is the detailed microeconomic structure included in the analysis. Instead of describing more deeply their model, we will focus here on two of the six experiments of their study: the Tagus Crossing in Lisboa (Portugal) and the Madrid ring road (Spain). For both projects they estimate the impact at the regional level and for the whole Iberian Peninsula. Basically the Tagus Crossing provides Lisboa a second bridge over the Tagus River, whereas the Ring road is a circular bypass for traffic traveling through Madrid. This last one also connects the most important Spanish highways to each other, without having to cross Madrid. Table 2 below presents the multiplier effect on the real income in the Iberian Peninsula and the percentage real income increase for each region.

<<insert table 2 here>>

The results for the Madrid Ring road indicate large positive spillovers on the Iberian Peninsula (1.55) due to the new infrastructure. Madrid and its neighbor Castilla-Leon are the main beneficiaries of the project. The Madrid Ring Road enhances Madrid's hub position whereas the main Spanish motorways are spokes. In this particular framework, there is primarily an increase in the income of Madrid itself (+ 0.17%), which benefits from a higher accessibility, and of the areas on the spokes (the motorways). On the contrary, the areas located far from the motorway network benefit less of it. In other words, even if the periphery may gain in accessibility, gains are relatively much larger in the core. In contrast to the previous project, the multiplier of Tagus Crossing is less than unity (0.943), indicating absence of multiplier effect on the Iberian Peninsula. Its effects are given for Portuguese regions alone since they are negligible in Spain. The most important increase in income is in Lisboa (+ 0.1%). Tagus Crossing seems to act as a public infrastructure capital in this region, whereas its benefits are small outside the region. This can be explained by the fact that the new bridge affects mainly local transport costs. As pointed out in section 3.2, since this project does not improve the access to the main Iberian network (of which Madrid is the hub), it has little effect on changes in activity and industry location.

4. Conclusion

The convergence process in Europe is characterized by the catching-up of the poorest countries, but also by an increasing divergence among regions within a country. The gains of integration have thus benefited mainly the richest regions within the poorest countries. Regional development funds did not succeed in impeding this pattern to occur. The reason is given by the characteristics of public infrastructures they finance: the European Commission says that the improvement of transport infrastructures plays a key role in efforts to reduce regional and social disparities, but current and new transport infrastructures planned for the development of the trans-European network tend to be built within and between core regions, because it connects the major centers of population and activity, where transport demand is highest. An increasing part of these new infrastructures also increases hub-and-spoke interconnections, leading to a higher agglomeration in the hub, since accessibility to any spoke location is made easier than from one spoke to another. In terms of accessibility changes, only the regions that belong to the network will gain in accessibility, whereas the regions that do not belong to it or are located at the edge of

it will not. The relationship between gain in accessibility and economic development in peripheral regions has been advanced theoretically but still requires considerable empirical investigation especially given the variations in transportation demands by sector. It is stated however that gains in accessibility due to interregional transport infrastructures will always be relatively higher in the core region than in the peripheral one. Peripheral regions have generally lower unit costs than core regions that may attract activities to locate there. However, this also depends on the level of transport infrastructure, the lack of which impedes the development of growth potential in periphery, but the improvement of which does not necessarily promote its growth. Transportation infrastructures thus promote the country's aggregate growth but cannot always be seen as an efficient instrument to reduce interregional disparities in Europe. The European Commission should therefore focus on the other aspects of regional policies since transportation infrastructures are only one part of the program for balanced regional development. Cohesion countries also call for a reform of the objectives and criteria of regional policy, otherwise the future enlargement to the poor Central and East European countries will considerably modify the map of less developed regions.

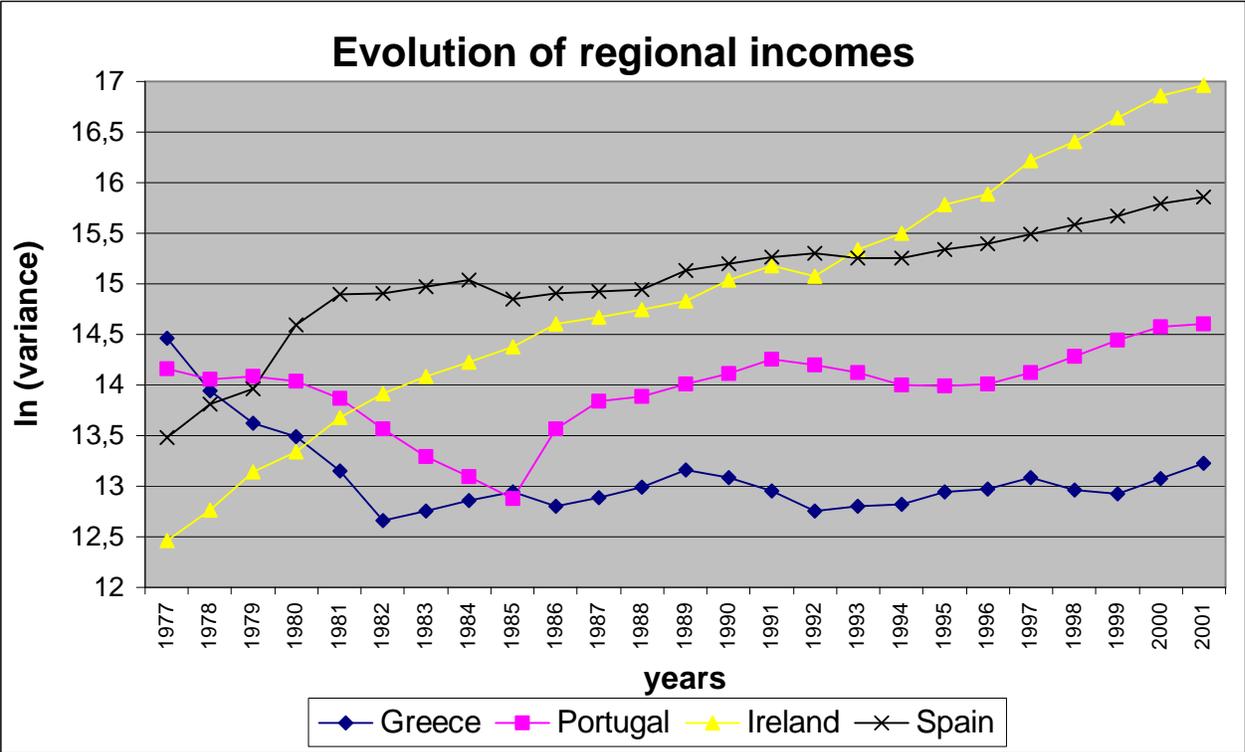
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Figure 1- Evolution of regional income disparities within each cohesion country



Source: Cambridge Econometrics (2001)

Table 1- Conditionnal *b*-convergence of GDP per capita of cohesion countries with the European average

			ADF					DF				
		k	alpha	talpha	<i>f</i>	t	T	alpha	talpha	<i>f</i>	t	T
Spain	1960-2001	4	-0.056	-3.413	0.782	-3.496	-15.957	-0.065	-5.465	0.748	-6.038	-10.342
	1960-1985	4	-0.049	-2.640	0.806	-2.685	-8.979	-0.062	-4.180	0.753	-4.812	-6.177
	1986-2001	0	/	/	/	/	/	-0.141	-3.448	0.461	-3.516	-8.088
Portugal	1960-2001	4	-0.042	-2.476	0.885	-3.255	-2.700	-0.025	-1.744	0.930	-2.527	-2.852
	1960-1985	4	-0.074	-2.020	0.829	-2.600	-1.736	-0.043	-1.515	0.906	-1.995	-2.354
	1986-2001	0	/	/	/	/	/	-0.137	-5.369	0.635	-5.651	-5.468
Greece	1960-2001	3	-0.042	-2.184	0.903	-2.258	-6.073	-0.047	-2.794	0.887	-3.219	-4.646
	1960-1980	1	-0.016	-0.652	0.911	-1.733	-1.021	-0.023	-0.959	0.912	-1.834	-1.756
	1981-2001	0	/	/	/	/	/	-0.044	-2.109	0.918	-1.752	-1.643
Ireland	1960-2001	0	/	/	/	/	/	0.051	4.858	1.099	3.846	4.086
	1960-1972	0	/	/	/	/	/	-0.176	-1.548	0.633	-1.529	-4.399
	1973-2001	0	/	/	/	/	/	0.048	4.158	1.081	2.558	2.265

Source: Chelem-CEPII (2001)

Note: Calculations of the authors, k is the significant lagged difference, / show that *k* is null, the results are then estimated according to DF. The ADF results are significant at 10% level according to Dickey and Fuller tables

Note: The same test has been performed without considering the studied cohesion country in the EU average. This second test eliminates the autocorrelation effect due to the presence of the studied country in the EU average. The results are not significantly different from these ones, which may be justified by the fact that cohesion countries are small countries that have little influence on the value of the EU average.

Table 2- Real income changes due to Madrid ring road and Tagus Crossing in Lisboa

	Madrid ring road	Tagus Crossing
Multiplier effect for the whole peninsula	1.55	0.943
Galicia	0.07	
Asturias	0.08	
Cantabria	0.04	
Pais Vasco	0.08	
Navarra	0.08	
Rioja	0.09	
Aragon	0.04	
Madrid	0.17	
Castilla-Leon	0.12	
Castilla-Mancha	0.06	
Extremadura	0.11	
Catalunya	0.03	
Comunidad Valenciana	0.06	
Baleares	0.08	
Andalucia	0.03	
Murcia	0.00	
Canarias	0.04	
Norte (Portugal)	0.06	0.01
Centro (Portugal)	0.07	0.02
Lisboa (Portugal)	0.06	0.10
Alentejo (Portugal)	0.10	0.02
Algarve (Portugal)	0.10	0.02

Source: Venables and Gasiorek (1999)

Note: Effects of Tagus Crossing on Spanish regions are negligible