A META-ANALYSIS OF EU REGIONAL POLICY EVALUATION

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Abstract

Structural Funds are the most intensively used policy instrument to promote convergence across the regions of the member states of the European Union. Huge theoretical and empirical controversies exist in the literature that aims to evaluate the effectiveness of Structural Funds in promoting regional economic growth. This paper takes stock of the econometric literature that has investigated the impact of the Funds on economic growth. This literature is clearly divided between studies that find a positive and statistically significant impact, and those which conclude that the Funds have no statistically significant or even a negative impact. We start with an evaluation of the existing econometric literature evaluating the effectiveness of the Funds. We subsequently apply meta-analysis to provide a formal statistical and objective summary of the results found in nine papers on the topic. Meta-regression analysis is used to explain the variation in observed outcomes in the primary literature.

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1. Introduction

It is surprising that after three decades of regional policy devoted to the least developed regions of the Europen Union (EU) and the increasing number of studies that have been focusing on its impact, the question as to whether regional development support has been successful in favoring cohesion remains open. This is true from a theoretical as well as empirical point of view. Indeed, while the neoclassical approach predicts that financing physical capital in capital-scarce regions temporarily stimulates growth above its usual steady state level, endogenous growth theory grants public policies an important role in the determination of growth rates in the short as well as in the long run. For instance, Aschauer (1989) and Barro (1990) show that if public infrastructures is an input in the production process, then policies financing new public infrastructures increase the marginal product of private capital, hence fostering capital accumulation and growth. The conclusions of the new economic geography theory are more ambiguous and emphasize that when such investments are used to finance transport infrastructures, their impact depends on the region's characteristics and change in accessibility, and on a balance between agglomeration and dispersion forces (Krugman, 1991; Fujita *et al*., 1999).

The lack of consensus among empirical analyses partly stems from the struggle with data availability. Indeed, no real effort has been made by the statistical offices of the European authorities to allow an easy access to structural funds data. As a result, from a set of 92 studies on the EU regional policy that we found, only eleven published articles or working papers (i.e. less than 12%) do use appropriate data to assess their impact on regional development. This is a rather small fraction compared to the numerous papers that estimate the impact of aid at the international level (see,

for instance, several reports published by the World Bank and Burnside and Dollar, 2000).

Academic researchers are partly responsible too. If one leaves out the fact that only few of them do communicate directly with the political arena, one needs to recognize that the tools available to perform an appropriate modeling of the impact of cohesion policy are still very limited. In the absence of, for example, input-output tables at the regional level in Europe, empirical studies largely relied on case study analyses using general equilibrium models or cost-benefit analysis, model simulation and econometric estimations. Ederveen *et al*. (2002) provide a review of those studies. Because it is impossible to make an objective assessment of the impact of the funds at the EU level according to individual project proposals, we do not refer to those studies in our paper. We also decide not to focus on model simulation since their results are not independent from the assumptions underlying the model. In addition, they focus only on the impact of regional policies in the four cohesion countries (namely Spain, Portugal, Greece and Ireland) which does not provide a sufficiently objective assessment for the aim of our study. As a result, we focus only on the econometric estimations because they measure the actual impact of the funds. Just as the theory does not succeed in reaching a consensus on the real impact of public policy to regional development, the conclusions of econometric studies differ widely. Therefore this paper intends to fill the gap by providing an objective and quantitative answer to the question of how effective the funds are in raising economic growth using tools developed in the field of meta-analysis. It furthermore intends to enhance our understanding of the sources of variation found in the existing primary empirical literature by using meta-regression analysis.

While section 2 presents these differences and common points across primary studies, section 3 introduces and applies the techniques of meta-analysis to the empirical econometric literature mentioned above. In essence, meta-analysis – oftentimes tellingly referred to as the 'analysis of analyses' – is a set of statistical tools that helps to objectively and quantitatively characterize the results from a body of primary studies dealing with the research topic at hand. It furthermore helps in providing insight in the sources of variation in research results that have been found. Finally, section 4 provides some conclusions and policy implications.

2. The impact of the funds in the literature

In a neoclassical growth framework based on Solow (1956), a higher level of investments in physical capital results in a higher steady state income *level*. However, due to the decreasing marginal product of capital, the *growth rate* of income is only temporarily positively affected by increases in the rate of investment. Therefore, a higher investment rate in poorer regions may increase their convergence speed to rich regions, but it is only transitional. In contrast, endogenous growth theory lends an important role to public policies in the determination of growth rates, also in the long run. If, for example, public infrastructure is an input in the production process, 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 process still does not allow one to look explicitly at the impact of regional policies on industry localization, and hence abstains from an analysis of relocation behaviour in response to Community transfers of purchasing power to the poorest regions.

Hence, the theoretical approach that seems the most appropriate 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 (1991), this literature rests on core-periphery models, which is not an abstract representation of reality since European peripheral countries are also the poorest ones. In addition, a substantive part of cohesion policy (30% of structural funds and 60% of cohesion funds) support investments in interregional transportation infrastructures yielding to a decrease in transportation costs, which affect the process of industry location and favor agglomeration in rich regions. However, the economic geography literature shows that transportation infrastructures do not systematically benefit the region where they are implemented, and therefore cannot always be seen as an instrument to promote regional development (Martin and Rogers 1995; Vickerman 1996; Martin 2000). For instance, while focusing on the characteristics of the transportation sector, Vickerman et al. (1999) points out that new infrastructures tend to be built within or between rich regions, where the demand in this sector is the highest. Moreover, Puga and Venables (1997) show that in a transportation network based on hub-and-spoke interconnections, 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. Consequently, this type of network promotes gains in accessibility in the hub location first (Puga 2001; Venables and Gasiorek 1999). The relationship between gains in accessibility and economic development in peripheral regions still requires considerable empirical investigation especially given the variations in transportation demands by sector and differences in the productive structure of each region. The literature indicates however that gains in accessibility due to interregional

transport infrastructures will always be relatively higher in the central location than in the peripheral one (Vickerman et al. 1999).

In addition, financing transportation infrastructures within a poor area does not guarantee it to catch-up towards the more developed areas either. As spillovers are usually locally limited (see the example of Lisbon's bridge, Portugal, in Venables and Gasiorek 1999), 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 (such as lower wages or tax reduction) induces firms facing increasing returns to relocate. It is not obvious whether 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. The poorest areas offer therefore very little factors to promote relocation. With wages being different across countries but similar across regions of the same country because of labor union agreements, the rich regions in the poor countries are the ones benefiting most from the integration process. This explains why the regions of Madrid and Cataluna (where Barcelona is located) are above the EU per capita GDP while regions such as Extremadura and Andalucia have been around 70% of the national average for more than fifteen years (Dall'erba and Hewings, 2003).

The confusion on the actual impact of the funds on regional growth is sustained by the lack of unanimity among results of empirical studies, as can be seen from Table 1. These primary studies have been selected via extensive search in EconLit, Ideas and Google using the keywords "structural funds" or "regional policy" or "regional cohesion". This a resulted in a list of more than 100 studies in English to which we

have added studies that are quoted in their references. This list has been shortened to focus only on studies displaying an econometric estimation of the impact of structural funds on growth. For purpose of comparison, we eliminated studies that used proxies such as investment in public capital or support to education to measure the impact of structural funds.

Among the studies that find to a positive impact of the funds, Beugelsdijk and Eijffinger (2005) are the ones who find the greatest average impact. They raise the issue of moral hazard and substitution effect in the allocation of the funds. This issue, originally developed in Ederveen *et al*. (2002), relies on the assumption that receivers of structural funds in some cases are not really eligible and may therefore use the funds inefficiently. Their results indicate that the more corrupt countries do not use the funds in a more inefficient way and therefore support the continuation of structural funds. The question as to whether their results are biased by the country-level observations they use remains open. Indeed, Cappelen *et al*. (2003) who base their estimations on NUTS[1] 1 and 2 regions also conclude to a significant impact of the funds. However, they find that support is the most efficient when it is allocated to regions in a good economic environment (low unemployment, high R&D capabilities). Hence support is least efficient where it is most needed.

Rodriguez-Pose and Fratesi (2004) focus on objective 1 regions only since they are the recipients of the highest amount of cohesion support. Their approach is innovative in the sense that they concentrate on different development axes and include a temporal lag of up to 7 years to test whether because public investments take some time before fully impacting on growth. They conclude that despite the

[1] Nomenclature of Territorial Unit Statistics. This is the official way of dividing the European territory into regions. Even if it does raise quite a lot of controversy (see Cheshire and Carbonaro, 1995, who are the first to propose the use functional urban regions), most of the studies on convergence and the impact of the funds use this aggregation level because funds are allocated mostly at the NUTS 2 level, and official EU reports are based on this spatial level too.

concentration of EU support to infrastructures and, to a lower extent, to business support, the returns to commitments on these axes are not significant. Only investment in education and human capital has medium-term positive effects, which is in tune with recent studies (Duranton and Monastiriotis, 2002), whilst support to agriculture has short-term positive effects on growth.

The conditionality of the effectiveness of structural funds is further developed by Ederveen *et al*. (2006). Basically they state that structural funds are inefficient unless they are allocated to countries with good institutions (openness and direct institutional quality). Their findings are thus corroborating the ones of Burnside and Dollar (2000) who focus on aid in developing countries. In the absence of similar data at the EU regional level, their conclusions hold for 13 EU countries (EU15 less Germany and Luxembourg).

Garcia-Solanes and María-Dolores (2001) fully support continuation of the funds. Their results, both at the regional and national level, conclude to a significant and positive impact of the funds on growth. Note, however, that the level of structural funds per inhabitant is the only explanatory variable they add to the usual initial level of per capita GDP in their model. As a result, their results may suffer from a bias of omitted variables.

Ederveen et *al*. (2002) are more careful in their conclusions. They show that the impact of structural funds varies according to the type of convergence one is looking at. In other words, a model without dummy variables leads to a different conclusion than a model with region or country dummies. While the first one concludes to a significant negative effect, the second one is not significant and the last one says the impact is positive and significant. The more optimistic one is about convergence, the less efficient structural funds spending appears to be, and vice versa.

They propose three reasons for the lack of evident effectiveness of the funds. First, nothing impedes regional governments of designing projects that meet the criteria of the EU, but which are not necessarily effective in stimulating growth (rent seeking). Second, they may use the EU funds for low-productive projects, so as to keep their region within the eligibility criterion for cohesion support (moral hazard). Third, they find that, on average, every euro of EU cohesion support withdraws seventeen cents of regional support from the State, as if regional development was primarily a European concern (crowding-out). They add that this phenomenon also occurs when EU funds finance projects that are close substitutes for private capital, or when they subsidy project in lagging regions and thus reduce labor mobility, which tends to promote greater cohesion. Two more institutional drawbacks are described in Dall'erba (2005): first, it is not necessarily a firm from the targeted region which undertakes the construction of the project financed by the funds, so that a substantive part of the value added directly benefits another region. Second, a particular project is never implemented without additional regional or national financing. This is the principle of additionally that impedes regions to present unviable projects. However, there is a bias introduced through this principle which comes from the fact that peripheral regions are just able to double the Community support, whereas the wealthiest northern Spanish regions and numerous core regions succeed in providing between 2.5 and 6.4 times the amount committed by structural funds (Dall'erba, 2005).

Dall'erba and Le Gallo (2003, 2004) adopt a spatial approach to convergence, based on the observation that EU regional growth levels are correlated over space (Le Gallo and Ertur, 2003; Le Gallo and Dall'erba, 2006). This is also true for the distribution of structural funds (Dall'erba, 2005). Spatial econometric estimations

allow them to proxy various variables at the origin of spillover effects, variables such as interregional trade, migration, technology externalities which are not available at the EU regional level. Their 2003 study concludes to a non-significant impact of the funds, while the 2004 study results, where the impact of each development objective is taken into consideration, are more mitigated. Peripheral regions are significantly but very little affected by some structural funds (objectives 1 and 3&4 funds and Community Initiatives). The same conclusions hold for the Community projects total cost (structural funds plus additional funds). When they test for the impact of the spatial lag of each fund, namely the funds received by neighboring regions, peripheral regions are affected by objectives 2, 3 and 4 and Community Initiatives. Funds received as total project cost under objective 1 reveal impacting positively peripheral regions growth too. As a result, peripheral regions seem more affected by the funds allocated to their neighbors than to themselves. With regard to the core regions, only the spatial lag of objective 5 funds seems to impact positively, but to a very little extent. This does not help to draw any significant conclusion since objective 5 is devoted to agricultural support within which core regions are not specialized.

The approach by development objective is also adopted by Fayolle and Lecuyer (2000). They conclude that within an assisted country, the wealthiest regions are the ones that benefit the most from structural funds. This is because the supply of rich regions complies with the demand derived from European funds, or because the producers of the most favored regions convey their products thanks to new infrastructures in poor regions. In addition, they find the co-funding practice (which is all the more significant the richer is the region) rather questionable since it seems to soften largely the redistributive effects of the funds.

Puigcerver-Peñalver (2004) stresses the necessity to separate the tow programming periods. While in the first one (1989-93), her results indicate that the funds have positively benefited to growth on Objective 1 regions, the funds allocated during the second period (1994-1999) had a null or negative impact. This may be the reason for the weak effect of structural funds she observes over the whole period. Her conclusion is the opposite of the one in table 7 of Rodriguez-Pose and Fratesi (2004), where the funds are more significant over the 1994-99 period. However, this may come from the differences in the definition of the funds they use (total funds vs. funds by axe of expenditure).

In Bussoletti and Esposti (2004), the regional growth rate is conditional upon several variables, including the funds and the share of agriculture in regional employment. Among the significant results, the impact of the funds appears very little (less than 4 digits) and positive. Not surprisingly, they conclude that agriculture has a counter-growth effect.

Before we turn to the reasons that may explain the striking differences in the outcomes of these studies, let us start by describing a couple of factors they have in common. The first common point is the type of model used to perform the regression. With the exception of Fayolle and Lecuyer (2000) who use a catching-up model, and some estimates in Rodriguez-Pose and Fratesi (2004), all the studies rely on (versions of) the neoclassical growth model described in Barro and Sala-i-Martin (1991). Even after the recent advances in economic growth theory that highlight the substantive role of increasing returns to scale, these authors comply with the drawbacks of the β-convergence model. The underlying assumption of diminishing returns to scale and

the eventual presence of Galton's fallacy have recently raised some doubts on its theoretical and empirical relevance (Quah, 1993, 1996).

The second common point to the studies in Table 1 is the source they use for structural funds data. With the exception of Beugelsdijk and Eijffinger (2005) who rely on data from the National Institute of Economic and Social Research (2002), all the other structural funds data come from official reports of the European Commission. This is not surprising due to the difficulties encountered by anyone willing to put a hand on those data. At best, the data display the objective (1 to 6) they correspond to, the region where they have been allocated and eventually a vague description of the project financed. Moreover the data do not correspond to actual payments but to investment commitments, and the most recent ones go up to 1999, the final year of the Delors II package, seven years ago. As a result, authors have used several definitions of the funds to perform their estimations, as can be seen in the third column of table 1.

Third, most of these studies do not pay attention to the endogeneity problem of explanatory variables. This problem comes from the fact that 68% of structural funds are devoted to regions of which per capita GDP (as an average of the three years prior the beginning of the programmatin period) is below 75% of the EU average. This is the criteria necessary for a region to apply for objective 1 funds. The only study addressing this problem is the one of Dall'erba and Le Gallo (2003) where the Hausman test results reveal that structural funds are indeed endogenous.

Finally, it is interesting to note that the authors quoted in table 1 come from a little sample of EU countries (only 5!). Those are the Netherlands (Beugelsdijk and Eijffinger, 2005; Verspagen; Ederveen *et al*., 2006; Ederveen *et al*., 2002), France (Dall'erba and Le Gallo, 2004, 2004; Fayolle and Lecuyer, 2000), Spain (Rodriguez-

Pose; Garcia-Solanes and María-Dolores, 2001; Puigcerver-Peñalver, 2004), Italy (Fratesi; Castellacci; Bussoletti and Esposti, 2004) and Norway (Cappelen; Fagerberg). Spain and Italy have been the two first beneficiaries of structural funds over 1994-1999 with respectively 34.4 and 21 billions euros (in 1994 prices). In percentage of GDP, those are respectively 1.74 and 0.42. This is without including the 6 billions euros Spain received over the same period under the form of cohesion funds (because its per capita GNP was below 90% of the EU average). France is close to the median level of benefits with 0.22% of its GDP, while the Netherlands are clearly the least well endowed with 0.15% of their GDP. Even without formal evidence, there is an interesting relationship between the interest of the authors and the level to which their country benefits or contributes to integration efforts.

Table 1. Summary of the structural funds impact on growth in the primary studies

Primary study	**Min- Mean- Max impact**	**Measure of Funds**	**- Nb. of estimates - Sample - Panel/cross-section - Estimator**
Beugelsdijk and Eijffinger (2005)	0.27 5.17 16.08	SF/GDP over 1995-2001 (three periods lagged)	4 EU 15 countries Panel One- and two-step GMM
Cappelen *et al.* (2003)	0.0046 0.0057 0.0068	SF/GDP	3 EU 9 regions Cross-section OLS
Rodriguez-Pose and Fratesi (2004)	-7.586(a) 0.484 6.294(b)	(a) SF over 1989-1993 in agriculture and rural development divided by GDP growth over 1994-1999 (b) SF in education and human capital over 1989-1999	92 EU 8 regions Panel OLS/pooled GLS/LSDV
Ederveen *et al.* (2006)	-0.416 -0.184 0.008	Log of (ERDF as a fraction of GDP plus 1) over 1975-1995	30 EU 12/13 countries Panel OLS/two-step GMM

Garcia-Solanes and María-Dolores (2001)	0.0002 (a) 0.0036 0.012(b)	(a) ESF per ha over 1989-1999 (b) EAGGF per ha over 1989-1999	8 EU12 countries/regions Cross-section OLS
Ederveen *et al*. (2002)	-0.35 0.1233 0.7	(SF + cohesion funds) divided by inhabitant over 1981-1996	3 EU 12 regions Panel OLS
Dall'erba and Le Gallo (2003)	-0.011 (a) -0.0055 0.00052 (b)	(a) SF per ha in core regime over 1989-99 (b) SF per ha in periphery over 1989-99	3 EU 12 regions Cross-section 2SLS-LAG
Fayolle and Lecuyer (2000)	-1.6 (a) 3.0333 6.5 (b)	(a) SF obj. 2 per ha relative to EU average over 1989-99 (b) SF per ha relative to EU average over 1989-99	3 EU 12 regions Cross-section OLS
Dall'erba and Le Gallo (2004)	-0.002 (a) 0.0003 0.007 (b)	(a) Spatial lag SF per ha in the core regions over 1989-99 (b) Total Community costs per ha in periphery over 1989-99	28 EU 12 regions Cross-section ML
Puigcerver-Peñalver (2004)	-3.938 (a) -0.181 1.09 (b)	(a) EAGGF/sum EAGGF received by obj. 1 regions over 1989-99 (b) ESF/GDP over 1989-99	28 EU 12 objective 1 regions Panel OLS
Bussoletti and Esposti (2004)	-0.047(a) -0.009 $4.32.10^{-5}$ (b)	(a) Dummy for obj. 1 region (b) Average objective 1 SF (over the last three years) over 1989-99	12 EU 15 regions Panel GMM-DIFF/GMM-SYS (one-/two-step)
Total sample	0.3054		Nb. of estimates: 214

Note: SF stands for Structural Funds; obj stands for Objective; ESF stands for European Social Funds; EAGGF stands for European Agricultural Guidance and Guarantee Funds; ha stands for inhabitants. Estimators: OLS stands for Ordinary Least Squares; GMM stands for Generalized Methods of Moments; LSDV stands for Least Square Dummy Variable; 2SLS-LAG stands for 2 Stage-Least-Square estimation of a spatial lag model; ML stands for Maximum Likelihood; GMM-DIFF stands for Generalized Methods of Moments in first differences; GMM-SYS stands for System GMM estimator. See the respective studies for further details.

Looking at the previous results, we may wonder what reasons would explain such a diversity of outcomes. First of all, the choice of the sample (only objective 1 regions, all the EU 15 regions or just the countries), time period and estimation process (cross-section or panel) necessarily affects the estimation results. From that point of view, there is a great deal of heterogeneity among empirical studies. In addition, Ederveen *et al*. (2002) note that the results are dependent upon the type of

convergence estimated. In an absolute convergence framework, it is assumed that all the regions are converging to the same steady-state, while adding core-periphery or country dummies allows for differences in regional steady-states. The difference is not trivial since in the latter case the underlying assumption is that inequalities persist, even in the long-run.

Differences in regional steady-states are also controlled by the explanatory variables included in the model. The set and the quality of explanatory variables that have been used in the studies above are rather large. There is no doubt that both affect the quality of the estimations. The extent to which quality of the estimation can affect the outcome of the regression is discussed below and treated by the means of meta-analytic techniques.

3. Meta-analytic techniques

Meta-analysis is a quantitative method of research synthesis that aims at extracting useful generalizations from a large body of literature. The technique has primarily been developed in medicine where the combination of the results of several separate trials presented the advantage of a bigger sample, leading thus to statistically more reliable results. Meta-analysis is already in use in various fields of social sciences (see Cooper and Hedges, 1994), and is getting more popular in economics, particularly environmental economics (van der Bergh *et al*., 1977; Florax 2002). Some recent contributions in the field of regional development include Abreu *et al*. (2005) and De Dominicis *et al.* (2005).

Based on the eleven studies described in Table 1, we will proceed in several steps:

1. further characterize variation in the studies (definition of growth rate, control variables, estimation technique, time period covered, countries/regions covered, statistical significance of the estimated effect sizes, etc.). These characteristics may all contribute to explain variation in outcomes and will be used as explanatory variables in our meta-regression analysis that aims to explain variation in the effectiveness of structural funds.
2. Further describe the outcomes of the studies in terms of fraction of estimates that finds positive and negative effects, fraction of studies that find statistically significant versus insignificant effects, etc.
3. Construct a common and comparable effect size (in so far as possible). This step is required to sensibly compare the estimated effect sizes across different studies that use different definitions of the growth rate and different definitions of the structural funds. The effect size will be in the form of a (semi-)elasticity that measures the effect of a 1-percent increase in the amount of structural funds received on the growth rate.
4. Characterize the variation in the (comparable) effect size by means of standard descriptive tools developed in meta-analysis.
5. Estimate an ordered probit model in which the dependent variable describes whether the effect of structural funds on growth is (i) significantly positive; (ii) insignificant; or (iii) significantly negative. Explanatory variables to be used are described in step 1.
6. Estimate a meta-regression model in which the dependent variable is the semi-elasticity as described in step 3. Explanatory variables to be used are again as described in step 1.

These steps will provide us with a detailed, objective and statistically sound description of the results found so far in the literature and further enhance our understanding of the sources of variation in the effects that have been found.

4. Conclusion

Structural Funds are the most intensively used policy instrument to promote convergence across the regions of the member states of the European Union. Both theories and empirical estimations do not agree on whether they are efficient in promoting regional economic growth. This is an important issue because one-third of the EU budget is devoted to cohesion and the new member countries hope structural assistance will help their regions to catch-up towards the EU average. In order to provide an objective assessment of the impact of the funds, we perform a meta-analysis on the estimations of eleven primary studies on this topic.

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