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Econometric assessments of Cohesion Policy growth effects: How to make them more relevant for policy makers?

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> Abstract

In recent years, a number of papers have made use of econometric approaches to address the impact of Cohesion Policy funds on economic growth and convergence. The purpose of this paper is to assess the relevance of these studies from the policy makers' perspective. Most of the analysed studies are based on a neoclassical growth model, which in many cases has been enriched substantially. In particular, spatial econometric methods have been used to capture spillover effects between regions; and progress has been made with regard to endogeneity of variables. In addition, new econometric methods such as regression discontinuity design provide strong evidence of the impact of Cohesion Policy funds. In spite of this progress, some remaining weaknesses reduce the relevance of econometric studies for policy analysis. In particular, only a number of studies use good quality data on Cohesion Policy transfers, while the other studies use a dummy variable instead of actual payments. The parameters of spatial dependence are still very simple in comparison to the complex flows between regions. Some important variables, such as national policies or quality of governance, are largely excluded from the regressions. Finally, the conclusions for Cohesion Policy drawn by these studies are not well developed and sometimes contradictory between the studies. The paper concludes with some suggestions for econometric research in the coming years, as the European Commission will release a new set of Cohesion Policy transfer data in 2015.

Disclaimer: This Working Paper has been written by Jerzy Pieńkowski and Peter Berkowitz, European Commission Directorate-General for Regional and Urban Policy (DG REGIO) and is intended to increase awareness of the technical work being done by the staff of the Directorate-General, as well as by experts working in association with them, and to seek comments and suggestions for further analysis. The views expressed are the authors' alone and do not necessarily correspond to those of the European Commission.

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1. INTRODUCTION

EU Cohesion Policy is expected to contribute to two main policy objectives. The first objective, explicitly stipulated in the EC Treaty, is to reduce disparities between the levels of development of the various regions and the backwardness of the least favoured regions[1]. The second objective, which is increasingly important, is to contribute to economic growth. This second objective is especially relevant in the current circumstances when economic growth in Europe is persistently low, but traditional fiscal policy stimulus is not applied due to high public debts and deficits in many Member States.

In recent years, a considerable literature has accumulated on the extent to which the European Union's Cohesion Policy has contributed to these goals. This policy has faced, in particular, three criticisms. The first criticism is that it is unnecessary, or worse distortive. Within a neoclassical growth framework, free markets and competition should lead to the uniform distribution of productive factors between regions and to regional convergence; therefore regional aid would by its nature be unnecessary and in certain cases could lead to a misallocation of factors. A second criticism is that it is inefficient. From the perspective of new economic geography, economic integration encourages productive factors to move to advanced regions where returns are higher, at the expense of peripheral areas. This implies that if the goal of the policy is to minimize interregional inequalities, Cohesion Policy could be effective; but such interventions will not lead to an optimal allocation of resources from the point of maximising EU-wide growth. A third criticism is that the policy is not effective – put simply, it is not achieving its objectives. These criticisms raise important issues that need to be addressed by policy makers[2].

In addition to descriptive assessments of the impact of Cohesion Policy funds, a significant number of studies using quantitative tools, such as econometric analysis and macroeconomic models[3], have attempted to assess the effects of this policy on economic growth and convergence.

The econometric methods used in these studies have been refined substantially over the last decade. While most of these studies are based on a neoclassical growth model, in most cases it has been enriched substantially. In particular, spatial econometric methods have been used to capture spill over effects between regions; progress has also been made on improving relevance and endogeneity of variables used in the regressions. In addition, new methods such as regression discontinuity design or propensity score matching have been used. In spite of these improvements, the econometric analysis of Cohesion Policy still displays some weaknesses, and these studies do not receive significant attention outside the academic community.

The purpose of this paper is to assess, from the policy makers' perspective, the contribution of a number of key papers which make use of econometric approaches to address the impact of Cohesion Policy on economic growth and convergence. Section 2 discusses the theoretical framework for regional growth and convergence and the implications for regional policy. Section 3 gives an overview of the scope and methodology of the reviewed econometric studies and their relevance from a Cohesion Policy perspective. Section 4 analyses the data on Cohesion Policy transfers used as an input into the regressions. Section 5 describes the results of the studies and the relevance of the results for Cohesion Policy. Section 6 concludes with an assessment of issues that need to be addressed to make future research more relevant for policy makers.

2. THEORETICAL FRAMEWORK OF REGIONAL GROWTH

There is abundant economic literature which attempts to explain the main factors of regional growth, their impact on convergence and divergence between countries and regions, and their implications for regional policy.

The neoclassical growth model, developed by Solow in the 1950s, focuses on the effects of capital, labour and total factor productivity on economic growth. Capital is subject to diminishing returns; economic integration, market competition and free trade lead to movement of production factors until there is uniform distribution among countries and regions. This leads to economic convergence between territories[4]. In the absolute (unconditional) convergence hypothesis, per capita incomes converge towards one steady state for all regions. This implies, in principle, that economic integration promotes convergence and that there is no need for regional policy.

1 Article 174 of the Treaty on Functioning of the European Union.

2 This paper will not address the issues raised by the tensions between the assumptions underlying the neoclassical and new economic geography approaches.

3 Several macroeconomic models have been developed since the 1990s to evaluate the impact of Cohesion Policy funds on GDP, investment, employment, productivity and other macroeconomic variables. These models, such as HERMIN, QUEST and more recently RHOMOLO, take into account the complex effects of EU funds both on the demand and on the supply sides of the economy. Therefore they can be used to generate policy counterfactual scenarios and place Cohesion Policy interventions in a wider macroeconomic context, where spillover impacts and externalities can be examined (Bradley and Untiedt 2012). However, these models are based on a wide range of theoretical assumptions, and the plausibility of some of these assumptions might be contested. They also assume that funding is fully absorbed and is spent efficiently, which may not always be the case (Polvelari, Bachtler et al. 2014).

4 A classical study of Barro and Sala-i-Martin (1992) observed the 2 iron law of convergence of 2% per year in a cross section of 98 countries. A revised version of this research based on historical data since 1870s confirms average convergence rates between 1.7% and 2.4% (Barro 2012). According to Barro, this 2 iron law holds among the samples of 2 reasonably homogenous economies; but if key underlying variables such as human capital and institutions differ substantially, the economies may not converge at all.

In practice growth rates and the steady states depend on features specific to each economy, such as production factor endowments (human capital, infrastructure, technological progress), the quality of institutions and various local factors. Therefore convergence may take place, but not necessarily at the same pace, and each region tends towards its own equilibrium. Such convergence is said to be conditional. Regions with similar levels of production factors and other characteristics are considered to form 'convergence clubs'. Within their clubs regions converge towards locally stable steady-states, but it is difficult for them to move to another, 'higher' club[5].

A different line of reasoning appeared in 1990s. The new economic geography argues that economic integration may lead to regional inequality and divergence. With a general reduction of transportation costs, trade openness sends productive factors towards the 'core' regions where returns are higher, at the expense of peripheral areas. High fixed costs, positive externalities and concentration of skills and research and development (R&D) activities stimulate agglomeration effects (Boldrin and Canova, 2001). The increasing gap between core and periphery regions is supported by endogenous growth theory and by innovation economics. In these theories, economic growth is seen as a restless search for new products and services with high rates of return, but the potential for this process is unevenly distributed between regions: the potential of core regions for innovation is much higher than in the periphery (Farole, Rodriguez-Pose and Storper, 2011).

These theories imply that if the goal of the economic policy is to minimise interregional inequalities, less developed and peripheral regions should be supported by regional policies in order to counteract the impact of market forces working towards divergence. However, such interventions will not necessarily be efficient from the point of view of maximising total growth (overall economic efficiency objective) if they work against the natural tendency towards agglomeration. They might also have unexpected effects; for instance excessive investment in transport infrastructure may lead towards even higher concentration of economic activity in the core at the expense of peripheral areas (Rodriguez-Pose and Novak, 2013).

Both these contradictory trends – towards convergence and divergence – can be observed in practice within groups of countries or regions. As regards the EU regions, the recent Cohesion Report of the European Commission (2014) shows that until the crisis in 2008, there was a clear trend towards regional convergence. This trend could be decomposed into two opposite components: on the one hand, there was a marked tendency towards reduction of disparities between Member States, and on the other hand some divergence among regions within Member States took place, reflecting mainly dynamic growth in capital regions of new Member States. The economic crisis interrupted the process of regional convergence, with disparities increasing in 2010 and 2011. This assessment is in line with the results of the majority of independent studies on regional inequalities.

5 See Monfort (2008), Boldrin and Canova (2001), Maynou et al.(2014), Ramajo et al.(2008).

It is less clear to what extent these trends were the result of Cohesion Policy. Therefore, as described in the next sections, we have sought evidence in the recent econometric studies dealing with growth effects of Cohesion Policy.

3. THE SCOPE, METHODOLOGY AND RELEVANCE OF ECONOMETRIC ANALYSIS

We have reviewed a number of econometric studies which make use of econometric approaches to address the impact of Cohesion Policy funds[6] on economic growth and convergence. Table 1 below gives an overview of the scope and methodology of these studies.

The use of regressions of growth on regional policy is in line with rich empirical literature which applies regression analysis to estimate the effects of various economic policies on growth. Typical growth regressions include growth rate as the dependent variable and initial level of GDP, the variable representing given policy and other production factors as explanatory variables (Rodrick, 2005).

In the econometric studies regarding Cohesion Policy which we have reviewed, growth is also usually modelled in this way, according to the logic of the neoclassical model. The dependent variable is usually GDP growth per capita (or per worker). It is a function of a number of factors including initial GDP level, a variable representing Cohesion Policy (the actual level of transfers or a dummy variable – see section 4) and a limited number of other factors. The choice and number of explanatory variables for regression differs widely between studies[7].

The geographical scope of the regressions is usually very broad: the regressions assess the impact of Cohesion Policy on regional growth in EU-15, or in less developed regions (former Objective 1). Only a few studies analyse the impacts in particular regions (Le Gallo 2011, Becker 2012), which is an interesting approach as it reveals heterogeneity in the impact of the funds across regions. There are also some studies examining the impact of Structural Funds in large Member States such as Germany, Italy or Spain; but hardly any studies compare systematically the

6 The scope of EU funds included in the econometric regressions varies between the studies; it usually covers Cohesion Policy funds or Structural Funds, or part of them. See section 4 for more details.

7 For instance, Moll and Hagen (2010) and Le Gallo et al. (2011) included investment, population growth, technological progress and some other variables in growth equations, in addition to the initial GDP level and Cohesion Policy transfers. Esposti and Bussoletti (2008) included human capital, R&D, and infrastructure endowment; Rodriguez-Pose and Garcilazo (2013) also an indicator for the quality of government. See also table 1 below.

impact of Cohesion Policy between Member States or groups of Member States. As the data for analysis end in 2006, there are only a couple of studies concerning new Member States that joined the EU in 2004 and after.

The main question from a policy makers' perspective concerns the relevance of the theoretical framework for the analysis in the econometric studies. Most of the studies were based on a neoclassical growth model. Only a few studies, such as Middelfart-Knarvik and Overman (2002), used the new economic geography approach: an empirical model of industrial reallocation determinants based on a shift-share analysis[8]. However, this study assessed the impact of Cohesion Policy funds on industrial location, and not on economic growth.

The neoclassical growth model on which the studies are based has, however, been enriched to better accommodate the specific needs of regional growth analysis. In particular, (1) spatial econometric methods have been used to capture spill over effects between regions; (2) some progress has been made on improving relevance and endogeneity of variables used in the regressions. In addition, (3) new econometric methods, such as regression discontinuity design provide strong econometric evidence of the impact of Cohesion Policy funds.

First, introducing a spatial dimension into econometric analysis is important to capture spill over effects between regions. Regional economic growth depends not only on the characteristics of production factors of a given region, but also on the features of neighbouring regions, the spatial connectivity structure of the regions, and the strength of spatial dependence (LeSage and Fischer, 2008). Likewise, Cohesion Policy funds have an impact not only on the economy of the region receiving funds, but also on the economies of neighbouring and other regions.

In order to overcome this difficulty, spatial econometric techniques have been developed over the last decade: spatial lag of the dependent variable, spatial lag of explanatory variables, spatial Durbin models which combine these two approaches etc.[9] However, only less than half of the reviewed studies have introduced the spatial dimension into the analysis.

In spite of progress in spatial econometric techniques, they still have one weak point from the perspective of geographers and policy makers: the parameters of spatial dependence are very simple in comparison to the complex trade, capital and people flows actually taking place between regions. In several studies, the same weight in spatial matrixes is given to a certain number (between 3 and 10) of the nearest neighbours of each region, and zero weight to all the other regions. In three studies, other weights were used: the inverses of the squared distance between the centres of regions. Therefore doubts may arise if such simple weight matrixes give a good indication of interregional spill overs. None of the studies used more complex weights known from the literature (Abreu et al., 2005).

The second important issue is the separation of the impact of Cohesion Policy transfers from the impact of the other factors of economic growth. Such a separation is not easy to do; catching-up by less developed regions is a natural feature under the neoclassical growth model, independently from the receipt of EU transfers (see Becker 2012).

Regression models normally require that the independent variables used in analysis are exogenous – independent from the other variables in the system. This might be problematic in growth regressions as growth is a complex phenomenon, and its factors are interlinked. For instance, there is a correlation between initial GDP level and Cohesion Policy transfers: the transfers to poorer regions are usually higher. Cohesion Policy transfers may be also correlated with investment, which is an explanatory variable in many regressions.

Some studies have applied statistical tools to control for endogeneity. However, the problem is not only statistical: would the omitted variables, not included in the equations, actually better explain growth than the variables included in the equations? The literature stresses that researchers are faced with a dilemma regarding a number of potential regressors. There is a trade-off between an arbitrary selection of a small number of variables which may give rise to omitted variables bias, and introduction of a large set of variables which may make it difficult to identify important variables (LeSage and Fischer, 2008).

In the reviewed studies, the authors have usually opted for a limited number of variables. This creates the risk that some important growth factors could have been omitted in the regression. In particular, none of these studies included national policies affecting regional growth[10] (such as, for instance, labour laws or minimum wage regulations). Other important regional growth factors, not included in the regressions, are national redistribution of public funds to poorer regions (apart from EU transfers) or business climate. Only a couple of studies included quality of institutions among the explanatory variables[11].

The third issue on which progress has been made is the use of new econometric techniques to assess the impact of Cohesion Policy on regional growth, such as regression discontinuity design (RDD), generalised propensity score estimation and other non-parametric methods. RDD has been used in particular to compare growth in less developed regions (former Objective 1 regions) receiving much more substantial Cohesion Policy

8 Shift-share analysis is an analysis which divides the change of an economic variable into various components.

9 In the analysed studies, for instance, Le Gallo and Dall'Erba (2011) used a model in which a spatial lag variable containing a spatially weighted matrix of growth rates of the neighbouring regions is integrated into the regression model. This study measured direct (within a given region), indirect (spatial spill overs) and total effect of several variables, including structural funds, on growth rates of each of 145 regions cover by this study. Mohl and Hagen (2010) also included a spatially weighted dependent variable in the regression; De Dominicis et al. (2014) used a spatial Durbin model. Some other studies like Pellegrini (2013), Becker (2010) also controlled for spatial effects of their estimations. See Gibbons and Overman (2010) for a more detailed description of spatial econometric techniques models and the differences between them.

10 The study of Tomova et al. (2013) tested the impact of sound macroeconomic policies on socio-economic development but using country-level, not regional-level, data.

11 In particular, Rodriguez-Pose and Garcilazo (2013) showed the importance of quality of government for growth in a set of EU regions.

support ('treated' group) from non-Objective 1 regions receiving much lower or no Cohesion Policy support at all ('control group'). This method shows an important discontinuity of regional GDP growth at the threshold point corresponding to the border between Objective 1 and non-Objective 1 regions (75% of average EU GDP per capita in PPS), which clearly shows the impact of Cohesion Policy 'treatment' (Becker et al., 2010; Pellegrini et al., 2013)[12].

In spite of important progress made over the recent years in these fields, it is possible to identify some weaknesses and unexplained issues in the analysed econometric studies.

One of them is the impact of business cycles, which is not captured in the regression analysis. The econometric analysis covers long-time periods (7 to 14 years) depending on data availability and is not related to the economic cycles. The literature shows that the impact of Cohesion Policy and other public investment in boom years is different from the impact in the recession periods[13]. The impacts of business cycles differ also by region; the poorest regions tend to be less affected by business cycles than the more competitive and market-oriented regions (Le Gallo et al., 2011).

Another unexplained issue is the consequence of the neoclassical growth models' assumption of full employment. This is far from the reality of many regions receiving Cohesion Policy funds, which have substantial unemployment rates. The studies do not explain whether this difference between the theory and the reality may have an impact on the relevance of the estimations.

There are two further weak points of the econometric studies, which we analyse in the following two sections of the paper. First, econometric studies do not always use robust and consistent data series, or use a dummy variable instead of actual amounts of transfers (section 4). And secondly, the implications for Cohesion Policy drawn from the results of these studies seem in many cases to be less developed than the econometric analysis itself (section 5).

12 Becker et al. applied also regression discontinuity design to analyse how growth response of Objective 1 regions varies with their absorptive capacity (Becker et al 2012a). The same authors used generalised propensity score estimation to examine the impact of how total amounts of aid intensity of Structural Funds transfers on growth (Becker et al 2012b). Crescenzi and Giua (2015) used regression discontinuity design to examine the impacts of Objective 1 5 treatment at local level, separately for each of four Member States.

13 IMF (2014) shows that public infrastructure investment contributes more to growth in period of low growth than during high growth.

Table 1: Comparison of econometric models, objectives and variables in the econometric studies

Author	Framework	The issue analysed in the study	Dependent variable	Explanatory variables	Spatial dimension?
Crescenzi, Giua (2015)	Regression discontinuity design, applied separately by Member State	Net impact of EU regional policy at local level	Variation in the number of employees	Initial number of employees, dependency ratio	No
De Dominicis (2014)	Neoclassical growth model, spatially augmented (2 regressions)	Effects of regional inequality on growth in Objective 1 and non-Objective 1 regions	GDP growth per worker	GDP dispersion, initial GDP, population growth	Spatial Durbin model
Fratesi, Perucca (2014)	Barro-like regional growth model, augmented	Impact of territorial capital on effectiveness of Cohesion Policy funds in CEE	GDP growth per capita	Initial GDP, regional specialisation, industrial transition, SF categories, territorial capital variables	Spatial auto-correlation tested
Maynou et al. (2014)	Dynamic panel data model based on neoclassical convergence model	If Structural Funds (SF) and Cohesion Fund (CF) helped achieve convergence of the Eurozone regions	GDP growth per capita	7 regional and 5 MS level variables incl. investment, education, employment; CPF transfers at MS level	Spatio-temporal adjustment
Pellegrini et al. (2013)	Regression discontinuity design	Causal effects of Structural Funds transfers on GDP growth	GDP growth per capita	GDP per head	Results controlled for spatial effects
Rodrigues-Pose, Garcilazo (2013)	Neoclassical growth framework	Impact of quality of regional government and Structural Funds on growth	GDP growth per capita	Initial GDP, quality of government, Structural Funds transfers, infrastructure, education, employment, etc.	Population density as a proxy for agglomeration effects
Rodriguez-Pose, Novak (2013)	Neoclassical growth framework (2 regressions for 2 periods)	'Learning effects' – changes in impact of SF on regional growth	GDP growth per capita	Initial GDP, investment, infrastructure, education, innovation, quality of institutions, Structural Funds transfers, etc.	A proxy indicator included in the regression

Author	Framework	The issue analysed in the study	Dependent variable	Explanatory variables	Spatial dimension?
Tomova et al. (2013)	Empirical model (at country level)	Impact of Cohesion Policy funds and macroeconomic policies on socio-economic development	Indicator of socio-economic development (SEDI)	Initial level of SEDI, public debt, public deficit, net foreign liabilities, Structural and Cohesion Funds payments per GDP	No
Becker (2012b)	Dose-response function based on generalised propensity score estimation	Dose-response effect of Cohesion Policy regional aid intensity on regional growth	GDP growth per capita	Structural and Cohesion Fund transfers	No
Becker (2012a)	Regression discontinuity design with heterogeneous treatment effects	Heterogeneous causal effect of SF transfers on growth	GDP growth per capita	GDP initial level, SF, CF transfers, education levels, quality of government	No
Le Gallo et al. (2011)	Neoclassical growth framework with spatial lag	Regionally differentiated impact of SF on growth	GDP growth per capita	Initial GDP, investment, population growth, technical progress, SF transfers	Local spatial lag model
Becker (2010)	Regression discontinuity design	Effect of SF transfers on growth and employment	GDP growth per capita at PPP; employment growth	SF Objective 1 eligibility; employment, population, investment	Results controlled for spill over effects
Moll Hagen (2010)	Neoclassical Solow growth framework, extended for regional spill overs	Growth effects of Cohesion Policy funds at regional level	GDP growth per capita	Initial GDP, investment, population growth, technical progress, SF and CF transfers per population	Spatial weight matrix
Dall'erba Le Gallo (2008)	Neoclassical convergence model, augmented for a spatial lag	Impact of SF on EU regional convergence	GDP growth per capita	Initial GDP, share of industry and agriculture, unemployment, infrastructure, SF transfers, dummy for core/peripheral regions	Spatial weight matrix
Esposti, Bussoletti (2008)	Augmented conditional convergence model	Impact of Objective 1 SF on growth	GDP growth per labour unit	Initial GDP, SF payments, human capital, R&D, infrastructure endowment	No
Lesage, Fischer (2008)	Spatial Durbin model based on neoclassical model	Direct and indirect impacts of various growth factors	GVA per capita	23 variables (but not SF)	Spatial Durbin model
Ramajo et al. (2008)	Conditional convergence model (2 regressions)	Speed of convergence in Cohesion vs. non-Cohesion countries	GDP growth per capita	Initial GDP, employment rate, share of agricultural sector	Spatial weight matrix
Puigcerver-Penalver (2007)	Hybrid model derived from Cobb-Douglas production function	Impact of Structural Funds on growth in Objective 1 regions	GDP growth per capita	Initial GDP per capita, public and private national co-financing, SF variables	No
Ederveen et al. (2006)	Neoclassical growth framework	Impact of Structural Funds and quality of institutions on growth	GDP growth per capita	Initial GDP per capita, ERDF payments, human capital, savings, technological progress, population etc.	No
Barrios, Strobl (2005)	Semi-parametric regression estimate	Link between development level and regional inequalities	GVA growth per capita	Initial GDP	No
Rodriguez-Pose, Fratesi (2004)	Neoclassical growth framework	Impact of SF on regional growth	GDP growth per capita	Initial GDP, SF transfers (also broken down by 4 main categories), employment rate	No
Midelfart-Knarvik, Overman (2002)	Empirical model of industrial reallocation determinants (shift-share analysis)	Impact of SF and of national state aid on industrial location	Change in share of country/region in an industry	Many variables including the size of country, market access, SF transfers, national state aid	No
Boldrin, Canova (2000)	Barro convergence model	Test convergence in the EU	Dispersion of GDP/head and labour productivity	Initial GDP per capita	No

4. COHESION POLICY DATA USED FOR ECONOMETRIC ANALYSIS

The use of appropriate and good quality data is crucial for achieving meaningful results from econometric analysis. In this section we examine in particular what data on Cohesion Policy Funds have been used in the analysis.

There are several datasets about Cohesion Policy transfers which have been used in econometric studies. A good database exists for ERDF and Cohesion Fund for 2000-2006 programming period (SWECO 2008). This database includes commitments broken down by geographical units (NUTS 2 and NUTS 3 level) and by expenditure categories (1- and 2-digit expenditure categories covering 4 and 20 sectors respectively). For the 1994-1999 programming cycle, ESPON's database exists (ESPON 2005). Data about regional Cohesion Policy transfers for 2007-2013 are not available yet, so analysis does not cover the period after 2006. However, such a database is expected to be available in the second half of 2015 (see section 6).

Some studies have made a significant effort to construct and integrate a broad dataset of Cohesion Policy transfers, even before the SWECO database became available[14]. However, even in these studies, it is not always clear which EU funds are included in the dataset. Some of the studies suggest that they use Structural Funds[15] data but actually use the data from the SWECO database which covers the ERDF and Cohesion Fund only, and does not include the ESF or EAGGF. Some of the other studies do not give details which data they use for the Cohesion Policy variable.

Although Cohesion Policy payments are the main variable of interest in the examined growth regressions, many of the studies (see Table 2 below) did not use the actual amounts of transfers in the analysis, but instead used dummy (binary) variables indicating whether a given region is eligible for Objective 1 Structural Funds transfers or transfers or not. This binary indicator is either included in the regressions as one of the explanatory variables, or used to distinguish two datasets (such as 'Objective 1' and 'non-Objective 1' regions) on which separate regressions are run.

Using dummy variables for Structural Funds payments neglects substantial differences in aid intensities between regions. As regional maps in ESPON (2005) and SWECO (2008) reports show, regional EU transfers intensity varied from below 1% of GDP in some Objective 1 regions to above 10% in the others. Higher intensity of transfers is normally expected to have higher impact on growth, but there are also some arguments about declining returns of EU transfers when their intensity increases (see Becker, 2012b).

Only a couple of studies[16] used the data about Structural Funds transfers broken down by categories of expenditures (such as human capital, public infrastructure, business support), although such data are available. Including such data in the regressions is useful to examine the growth impact of different types of expenditures.

Finally, the issue of data availability for regression analysis concerns not only the data on EU funds transfers, but also the other variables. For instance, even well documented studies such as Moll and Hagen (2010) assume, following some earlier research papers, that technological progress and depreciation jointly amount to 5% in any EU region, which means that in practice their differences are not taken into account.

14 For instance, Esposti and Bussoletti (2008) compiled a database of regional payments under Objective 1 from the European Commission's annual reports on Structural Funds (such as European Commission, 2000). This database covers years from 1989 to 1999. Rodriguez-Pose and Fratesi (2004) created a similar database for all regions for the same period. Moll and Hagen (2010) used data from the same annual Commission's reports for 1994-1999 and combined it with the SWECO dataset for 2000-2006.

15 Most of the studies refer to Structural Funds, which, until 2006, included the European Regional Development Fund (ERDF), the European Social Fund (ESF), the European Agricultural Guidance and Guarantee Fund (EAGGF), Guidance Section, and the Financial Instrument for Fisheries Guidance (FIFG). Since 2007, the Structural Funds are made up of ERDF and ESF. As Table 2 shows, in some cases, the EU transfers data used in the regressions cover also the Cohesion Fund, or the ERDF and Cohesion Fund only.

16 For instance Rodriguez-Pose and Fratesi (2004) and Fratesi and Perucca (2014).

Table 2: Cohesion Policy data used in the econometric studies

Author	Cohesion Policy data used in analysis	Time period	Territorial units*
Crescenzi, Giua (2015)	Structural Funds (SF) Objective 1 eligibility (Yes – No)	1988-1989	LAU-2 (municipalities) in 4 MS: DE, ES, IT, UK
De Dominicis (2014)	SF Objective 1 eligibility (Yes – No)	1991-2004	188 NUTS2
Fratesi, Perucca (2014)	ERDF and Cohesion Fund (CF)	2004-2006	108 NUTS3 in CEE
Maynou et al. (2014)	ERDF, CF, EAGGF, FIFG transfers, as % of GDP, at country level	1995-2006	17 MS (Euro area)
Pellegrini et al. (2013)	SF Objective 1 eligibility (Yes – No)	1995-2006	190 NUTS2
Rodrigues-Pose, Garcilazo (2013)	Structural and Cohesion funds payments	1996-2007	169 NUTS2
Rodriguez-Pose, Novak (2013)	SF payments to Objectives 1,2,5b and 6	1994-2006	133 NUTS2
Tomova et al. (2013)	ESIF payments (ERDF, CF, EAGGF, FIFG, Cohesion Fund), at country level	1980-2013	28 MS
Becker (2012a)	Structural Funds (actually: ERDF?) and CF commitments	1989-2006	251 NUTS2
Becker (2012b)	Structural Funds (actually: ERDF?) and CF commitments	1994-2006	2078 NUTS3
Le Gallo et al (2011)	Not clear what Structural Funds data have been used	1989-1999	145 NUTS2
Becker (2010)	Eligibility for Objective 1 transfers (Yes – No)	1989-2006	1498 NUTS2 and NUTS3
Moll Hagen (2010)	Structural (actually: ERDF?) and CF commitments	2000-2006	126 NUTS2
Dall'erba Le Gallo (2008)	Structural Funds transfers (no details given)	1989-1999	145 NUTS2
Esposti, Bussoletti (2008)	Objective 1 payments (ERDF, ESF, EAGGF and FIFG) per capita (in PPS)	1989-2000	206 NUTS2
Lesage, Fischer (2008)	No Structural Funds data used in the regressions	1995-2003	255 NUTS2
Ramajo et al. (2008)	No Structural Funds data used in the regressions	1981-1996	163 NUTS2
Puigcerver-Penalver (2007)	ERDF, ESF and EAGGF transfers	1989-1999	41 NUTS2 (Obj.1 regions)
Ederveen et al. (2006)	ERDF payments	1960-1995	13 MS
Barrios, Strobl (2005)	No Structural Funds data used in the regressions	1975-2000	NUTS2
Rodriguez-Pose, Fratesi (2004)	Structural Funds commitments (also broken down by 4 main categories)	1989-1999	All NUTS2
Midelfart-Knarvik, Overman (2002)	ERDF, ESF and EAGGF expenditures in Objective 1 regions per capita	1989-1993	14 MS and x regions (no details given)
Boldrin, Canova (2000)	No Structural Funds data used in the regressions	1980-1996	185 NUTS2

5. RESULTS OF THE STUDIES AND THEIR IMPLICATIONS FOR COHESION POLICY

The majority of the reviewed econometric studies found a positive, although usually small impact of Structural Funds on regional growth, especially in less developed regions. This small positive impact was found by both the studies using traditional growth regression analysis[17] and by the studies using a dose-response function[18]. Some studies show varied results for different countries and regions[19]. Finally, a small number of studies found no significant impact on regional growth, or even a negative impact[20]. These differences in results may be explained by different methodologies, variables and datasets used in the regressions, but also by different time periods covered by the analysis.

It should be noted that the results of econometric analysis show in general a smaller impact of Cohesion Policy expenditure on GDP growth than the results of macroeconomic models, although there were substantial differences between the models as regards the size and time distribution of these impacts.

The results of these studies may provide conclusions which are relevant for Cohesion Policy. Such conclusions are important for policy makers, who may be less interested in the details of the econometric approach and more about its policy implications.

However, the conclusions drawn from these studies – even from those with similar results from the economic analysis – differ substantially. Several studies have concluded that Cohesion Policy was effective and should continue to focus on support to the least developed regions[21], or that it was modestly effective[22]. Other studies concluded that effectiveness of Cohesion Policy has improved[23].

On the other hand, some studies have concluded that Cohesion Policy would be more effective if it were more spatially concentrated in the most dynamic regions, or should be more equally allocated between regions[24].

However, the conclusions that are drawn about Cohesion Policy are usually less elaborate than the complex econometric analysis on which they are based. The studies often focus on the details of their econometric methodology and on the statistical robustness of the results, but usually do not sufficiently explain the complex economic mechanisms behind these relationships. Only some of the analysed studies address the detail of Cohesion Policy. In a number of cases, the policy recommendations for Cohesion Policy appear oversimplified and may be difficult to implement in practice. In some other cases, the conclusions are not directly linked to the results of the econometric analysis, but repeat the usual recommendations for Cohesion Policy.

The conclusions usually regard EU-wide Cohesion Policy, or concern the whole group of Objective 1 regions. In the few cases when the regressions lead to the results for individual regions, the results are not sufficiently differentiated (even when the analysis brings surprising results) because the analysis does not take account of regional specific factors to explain these results. This weakens the usefulness of these studies from the point of view of national or regional policy makers: the studies fail to provide convincing explanation of differences in the performance of regional economy.

17 Among the studies which used the actual amounts of Cohesion Policy transfers in the regressions (and not dummy variables, as explained in section 4), Rodriguez-Pose and Novak (2013) found a positive impact of Structural Funds on growth in 2000-2006 period, but no significant effect in 1994-1999. Puigcerver-Penalver (2007) observed a significant impact on growth rates in 1989-1993 and a weaker impact in the 1994-1999 period. Esposti and Busoletti (2008) showed a positive, although limited, impact of Structural Funds on Objective 1 funds on regional growth, in spite of negative effects in some specific cases. Moll and Hagen (2010) had similar results in Objective 1 regions, but no clear-cut results in a mixed sample of regions under Objectives 1, 2 and 3. Rodriguez-Pose and Garcilazo (2013) found some impact of Cohesion Policy funds on regional growth, but less important than the impact of the quality of government. The studies which assessed the impact of Cohesion Policy at country level (Tomova et al. 2013, Maynou et al. 2014) also observed significant positive effect of Cohesion Policy funds on growth and development.

18 Becker (2010) and Pellegrini (2013) found a small, but positive and statistically significant effect of Objective 1 interventions on GDP growth in these regions as compared to the other regions. The other studies using this methodology showed that regions with higher education levels and quality of government are more likely to turn SF transfers into faster per capita growth (Becker et al., 2012a); and that the average growth effects of Cohesion Policy transfers decreased with increasing transfer intensity (Becker et al. 2012b). Crescenzi and Giua (2015) found a positive impact of Objective 1 interventions in Italy, Spain and UK and a negative impact in Germany.

19 Le Gallo et al. (2011) found positive impact of Structural Funds on growth in some regions in the UK, Italy, Spain and Greece, and negative in some regions of Germany, France and Benelux. Esposti and Busoletti (2008) showed the highest positive impact of Structural Funds on growth in some French regions, and lower, and sometimes even negative, impacts in German, Spanish and Greek regions.

20 Dall'erba and Le Gallo (2008) and Rodriguez-Pose and Fratesi (2004) found no significant statistical relationship between Structural Funds and regional growth. Ederveen et al. (2006) found, in general, negative impact of Structural Funds on growth; positive impact only in countries with good institutions.

21 Moll and Hagen (2010) concluded that EU regional policy explicitly designed for the less-developed regions is the most effective in promoting growth. Ramajo et al. (2008) consider that stronger regional convergence observed in Cohesion countries in comparison to non-Cohesion countries provides support to EU cohesion policy.

22 Becker (2010) and Pellegrini (2013) considered that average Objective 1 transfers are modestly effective.

23 Rodriguez-Pose and Novak (2013) concluded that effectiveness of Cohesion Policy has improved in 2000-2006 in comparison to 1994-1999 period.

24 De Dominicis (2014) concluded that concentration of Structural Funds in a limited number of regions may enhance growth in the early stages of developments. At later stages, higher factor costs and/or agglomeration diseconomies emerge in the leading regions, prompting investment capital to shift to places where the potential returns to investments are higher. Fratesi and Perucca (2014) concluded that investing Cohesion Policy funds in regions more endowed with territorial capital pays more than investing them in weaker regions. Barrios and Strobl (2005) argued that allocation of Structural Funds would provide greater welfare if it were more concentrated in the most dynamic regions. Becker (2012b) concluded that in order to enhance aggregate impact of Cohesion Policy funds on growth, these funds should have been relocated from the regions receiving the highest transfer intensity to regions receiving less funds. Boldrin and Canova (2000) concluded that Structural Funds were not efficient for growth nor for regional convergence.

Table 3: Main results and conclusions from the econometric studies

Author	Main results of the study	Conclusions for EU Cohesion Policy
Crescenzi, Giua (2015)	Positive impact of Objective 1 interventions in Italy, Spain and UK; negative in Germany.	The results support the role of Cohesion Policy and suggest its reform towards giving it a stronger 'place-based' dimension.
De Dominicis (2014)	Inequality has a positive impact on GDP growth in less developed regions and no significant impact in the other regions.	Concentration of Structural Funds in a limited number of regions may enhance growth in the early stages of developments.
Fratesi, Perucca (2014)	Cohesion policy is not very effective *per se*, but is more effective in regions more endowed with territorial capital.	Investing Cohesion Policy funds in regions more endowed with territorial capital pays more than investing them in weaker regions.
Maynou et al. (2014)	Significant positive effect of SCF on GDP growth at country level, but no significant effects of SCF on convergence.	No conclusions for Cohesion Policy.
Pellegrini et al. (2013)	Positive and statistically significant effect of ERDF Objective 1 interventions on regional growth (0.6-0.9% additional annual growth).	Growth effects of Cohesion Policy are rather modest.
Rodrigues-Pose, Garcilazo (2013)	High impact of quality of government on regional growth in poorer EU regions; smaller impact of Cohesion Policy funds.	Above certain intensity level, Cohesion Policy transfers need to be accompanied by measures aimed at improving local governance and institutions.
Rodriguez-Pose, Novak (2013)	Positive impact of 2000-2006 Structural Funds on regional growth, but no impact in 1994-1999.	Effectiveness of Cohesion Policy has improved in 2000-2006 in comparison to 1994-1999.
Tomova et al. (2013)	Cohesion Policy funds contributed to improving socio-development at country level. Higher impact when combined with sound fiscal and macroeconomic policies.	Making Cohesion Policy funds conditional on sound fiscal and macroeconomic policies likely to improve effectiveness of these funds.
Becker (2012b)	Growth effects of Cohesion Policy transfers decrease with increasing transfer intensity. Optimal transfer intensity: up to 0.4% of GDP. Max. desirable intensity: up to 1.3% of GDP.	Cohesion Policy transfers should have been relocated from the regions receiving the highest transfer intensity to regions receiving less funds.
Becker (2012a)	'Objective 1 treatment' has significantly higher growth impact in regions with good human capital and quality of government.	To maximise growth impact, Objective 1 transfers should be reallocated to regions with the best good human capital and quality of government.
Le Gallo et al. (2011)	Insignificant impact of Structural Funds on regional growth. Important spatial spill over effects. Positive impact in some regions in UK, IT, EL, negative in some regions in DE, NL, FR.	Structural Funds did not have the expected result on growth process in Europe in total but could have been positive in some regions.
Becker (2010)	Positive effect of 'Objective 1 treatment' on GDP growth per capita by 1.6 percentage points in comparison to non-Objective 1 regions. No effects as regards employment growth.	'On average, Objective 1 transfers might well be effective and not wasteful'.
Moll, Hagen (2010)	Positive but small impact of Cohesion Policy funds in Objective 1. No clear-cut results for Objective 1+2+3. Substantial regional spill overs.	EU regional policy for Objective 1 regions is the most effective in promoting growth, while the transfers to Objective 2 and 3 regions are not.
Dall'erba Le Gallo (2008)	Insignificant effect of Structural Funds on regional GDP growth; faster convergence in peripheral regions than in core regions.	Structural Funds may be insufficient to counterbalance the agglomeration process, or fail to stimulate higher economic growth.
Esposti, Bussoletti (2008)	Limited but positive impact of Objective 1 funds on growth, with a negligible, or even negative, effect in some specific cases.	No conclusions for Cohesion Policy.
Lesage, Fischer (2008)	Importance of spatial dependences for regional growth.	Possible divergence between the regional and broader (EU-wide) interests.
Ramajo et al. (2008)	Strong regional convergence, especially in Cohesion countries.	The results provide support to policies designed to promote regional growth in Cohesion countries.
Puigcerver-Penalver (2007)	Structural Funds had significant impact on growth rates; stronger impact in 1989-1993 than in 1994-1999.	Structural Funds should not be expected to quickly reduce gaps between regions.

Author	Main results of the study	Conclusions for EU Cohesion Policy
Ederveen et al. (2006)	Negative impact of Structural Funds on growth; positive only in countries with good institutions.	Structural Funds should be allocated towards institution building in the first instance.
Barrios, Strobl (2005)	Confirmation of bell-shaped convergence curve: inequalities rising up to certain level of development, then decreasing.	Allocation of Structural Funds would have provided greater welfare if more concentrated in the most dynamic regions.
Rodriguez-Pose, Fratesi (2004)	No significant statistical relationship between Structural Funds and regional growth. SF investment in human capital brings better effects than investment in infrastructure, business support or agriculture.	EU regional policy should be revised towards a more locally tailored combination of investment priorities, avoiding excessive focus on infrastructure or business support.
Midelfart-Knarvik, Overman (2002)	Structural Funds have an impact on location of industry, notably by attracting R&D intensive industries.	Structural Funds should be focused on interventions helping regions to specialise according to their competitive advantage.
Boldrin, Canova (2000)	No convergence in per capita GDP, small convergence in labour productivity levels.	SF not efficient for growth nor for convergence.

6. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK

The preceding sections have shown that progress has been made in the recent years to improve the robustness of regression analysis of the impact of Cohesion Policy on economic growth. In particular, spatial econometric methods have been used to capture spill over effects between regions; the relevance and endogeneity of variables used in the regressions have improved; and new methods such as regression discontinuity design started to be applied.

However, there are some issues which still need to be addressed to make future research more relevant for policy makers.

1. The quality and consistency of data is essential. The currently available datasets for Cohesion Policy transfers cover the period until 2006 and do not allow analysis to address the major changes created by enlargement, but data availability is expected to improve soon. DG REGIO of the European Commission has launched a study for a database on the ERDF and Cohesion Fund projects in 2007-2013 period, broken down by NUTS 3 and by 86 priority themes; these data will be also integrated with the 2000-2006 database, although at a more aggregated level. This new database is expected to be publicly available for researchers at the end of 2015. The use of dummy variable regarding the eligibility of region to a certain category of Structural Funds instead of actual transfers should be assessed as it leaves out substantial differences in aid intensities between regions.

2. The relevance of econometric analysis for policy makers would be improved if the scope of the regression analysis were broader. Most of the currently available studies assess the effects of Cohesion Policy funds on regional economic growth in EU-15, or the impact in less developed (former Objective 1) regions. It would be useful to extend the scope of research. For instance, it would be interesting to identify and test the existence of convergence clubs among the EU regions. It could be also useful to run separate regressions showing the impact of Cohesion Policy per Member State and the impact of main expenditure categories of payments (such as infrastructure, human capital, business support). New Member States, which currently receive the bulk of Cohesion Policy funding, need to be included in the analysis.

3. Efforts need to be continued to further improve the methodology of the studies. The spatial dimension is very important to capture regional spill over effects; its modelling could be further improved to better reflect real interactions between regions. The choice of explanatory variables for the regressions is a difficult issue, but including some variables omitted so far would be useful. Modern econometric methods, especially non-parametric estimation, have also considerable potential for use in regional econometric analysis, although their limitations need to be taken into account (data intensity, limited link to economic theory, etc.).

4. The link between econometric analysis and the conclusions for Cohesion Policy drawn from these studies need to be improved. Better knowledge of the details of Cohesion Policy would help researchers draw more relevant conclusions about this policy. One of the possibilities would be a joint work of econometricians with academics and policy makers dealing with Cohesion Policy at EU and national level, in order to achieve synergies of knowledge.

5. From the policy makers' perspective, the results of the econometric studies are not easy to understand for non-experts. Many of them use a very technical language; and the results are more difficult to interpret than, for instance, the results of macroeconomic models, which are more intuitive, for instance expressed in terms of induced growth or multipliers. The results of the regressions, but also their limitations, need to be more clearly explained.

6. Finally, the econometric analysis of the impact of Cohesion Policy funds could be expanded beyond the GDP analysis. GDP growth is a good single indicator for assessing the health of economy, but the impact of Cohesion Policy funds is not limited to the economic dimension and includes a contribution to the Europe 2020 strategy for smart, sustainable and inclusive growth in areas such as employment, innovation, energy efficiency and combating poverty.

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