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Econometric Evaluation of EU Cohesion Policy – A Survey

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Non-technical summary

More than one third of the total EU budget is spent on so-called Cohesion Policy via the structural funds. Its main purpose is to reduce disparities among EU regions and to promote economic growth and convergence. Therefore, the convergence process of EU regions is a question of high political importance. The overall empirical evidence points to a small convergence effect of all or at least some European regions. However, whether or not this potential success results from EU Cohesion Policy remains an open question. The existing empirical evidence has provided mixed, if not contradictory, results. While some authors do find evidence of a positive impact of structural funds on economic growth, others find little to no impact at all.

Against this background, this paper provides a fundamental review of the econometric evaluation of EU Cohesion Policy in order to shed light on the reasons for the diverging results. It has been shown that the econometric evaluation of EU Cohesion Policy is hampered by several econometric issues. Based on these issues we discuss potential solutions on how to cope with these problems and discuss the related literature.

The most that can be concluded from empirical studies using country-level data is that Cohesion Policy seems to be only conditionally effective. Given a good quality institutional setup or decentralised governmental structures, Cohesion Policy has a positive impact on growth. However, using regional level data might be the preferable alternative because, first, EU Cohesion Policy focuses on the development and convergence of regions and, second, the robustness of the results is increased by the higher number of cross sections. The majority of the studies based on EU regions find at least a weak positive effect.

One explanation for the weak results might be the fact that almost all studies are derived from a neoclassical growth model assuming that EU Cohesion Policy increases investments, and ultimately raising the economic growth rate. However, there is some empirical evidence that Cohesion Policy may only have a modest impact on investments. Moreover, we know very little about the labour market impact of EU Cohesion Policy. Hence, one task for future studies will be to investigate more thoroughly the channels through

which EU Cohesion Policy works.

Another reason for the inconclusive empirical results might be that the allocation of funds is at least partly determined by political-economic factors. In this context, the allocation of Cohesion Policy is not solely based on clear-cut criteria, rather there is room for political bargaining and/or side payments. This might result in the funding of politically feasible, and less economically efficient, projects.

Zusammenfassung

Mehr als ein Drittel des EU-Haushalts wird für die Kohäsionspolitik verwendet, deren Mittel über die so genannten Strukturfonds verausgabt werden. Das zentrale Ziel dieser Politik besteht in der Verringerung von Disparitäten zwischen den europäischen Regionen und der Förderung von Wirtschaftswachstum und Konvergenz. Somit ist der Konvergenz-Prozess der Regionen von hohem politischem Interesse. Die verfügbaren empirischen Studien deuten auf einen geringen Konvergenzeffekt aller (zum Teil nur einiger) europäischer Regionen hin. Welche Rolle dabei allerdings die Kohäsionspolitik spielt, ist unklar, da entsprechende ökonometrische Evaluationsstudien keine eindeutige Evidenz liefern. Abgesehen von Studien, die positive Effekte auf das regionale Wachstum herausfinden, existieren auch solche, die zu keinen oder sogar negativen Effekten gelangen.

Vor diesem Hintergrund ist es das Ziel dieser Studie, einen gründlichen Überblick über die ökonometrischen Studien zu geben und mögliche Gründe für die divergierenden Ergebnisse zu durchleuchten. Es wird aufgezeigt, dass die ökonometrische Evaluation der Wachstums- und Konvergenzeffekte der Kohäsionspolitik mit einer Reihe von methodischen Schwierigkeiten verbunden ist. Hierauf aufbauend werden potentielle Lösungen aufgezeigt und die existierende Literatur diskutiert.

Es wird deutlich, dass aus ökonometrischen Studien, die auf EU-Länder-Daten basieren, höchstens auf einen bedingt positiven Effekt der EU Kohäsionspolitik geschlossen werden kann. Es zeigen sich nur dann positive Effekte, wenn bestimmte institutionelle Gegebenheiten vorliegen, wie beispielsweise eine dezentralisierte Regierungsstruktur oder eine hohe Qualität öffen-

tlicher Institutionen. Ökonometrische Studien basierend auf Regionaldaten sind aus zwei Gründen vorzuziehen. Zum einen zielt die Kohäsionspolitik gerade auf Regionen ab. Zum anderen werden die Ergebnisse durch die größere Anzahl an Untersuchungseinheiten stabiler. Die Mehrzahl der Studien findet leicht positive Wachstumseffekte der Kohäsionspolitik auf regionaler Ebene.

Abschließend werden weitere mögliche Gründe für die insgesamt geringe Wirksamkeit der Kohäsionspolitik genannt. Eine mögliche Erklärung besteht darin, dass die empirischen Studien meist auf Annahmen der neoklassischen Wachstumstheorie basieren und (implizit) unterstellen, dass die Kohäsionspolitik die Investitionen erhöht und somit zu einer höheren Wachstumsrate beiträgt. Allerdings ist dieser investitionserhöhende Effekt der Kohäsionspolitik nicht eindeutig nachgewiesen. Darüber hinaus ist wenig über die Arbeitsmarkteffekte der Kohäsionspolitik bekannt. Dies zeigt, dass die Untersuchung der Wirkungskanäle der Kohäsionspolitik von besonderem Interesse ist.

Ein weiterer möglicher Erklärungsansatz für eine ineffektive Kohäsionspolitik besteht darin, dass sich die regionale Verteilung der Mittel der Kohäsionspolitik teilweise durch politökonomische Faktoren erklären lässt, wohingegen die ökonomische Notwendigkeit in diesen Fällen nur eine untergeordnete Rolle spielt. Da Kohäsionspolitik zu einem gewissen Grad als das Ergebnis von Ausgleichszahlungen im Rahmen politischer Verhandlungsprozesse zwischen den Mitgliedstaten zu interpretieren ist, erscheint es denkbar, dass die Mittel nicht immer effizient verwendet werden.

Econometric Evaluation of EU Cohesion Policy – A Survey*

Tobias Hagen* and Philipp Mohl**

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Abstract

More than one third of the European Union's total budget is spent on so-called Cohesion Policy via the structural funds. Its main purpose is to promote the development of the EU and to support convergence between the levels of development of the various European regions. Investigating the impact of European Cohesion Policy on economic growth and convergence is a wide research topic in applied econometric research. Nevertheless, the empirical evidence has provided mixed, if not contradictory, results. Against this background, the aim of this chapter is to provide a fundamental review on this topic. Taking fundamental methodological issues into account, we review the existing econometric evaluation studies, draw several conclusions and provide some remarks for future research.

Keywords: economic integration, regional growth, EU Cohesion Policy, panel data, spatial econometrics
JEL classification: R10; R11; C21; C23

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1 Introduction

More than one third of the total budget of the European Union (EU) is spent on so-called Cohesion Policy[1] via the structural funds (SF). Its main purpose is to promote the "overall harmonious development" of the EU, to reduce disparities between the levels of development of the various regions, and to strengthen its "economic, social and territorial cohesion" (Article 158 of the Treaty establishing the European Community). By making explicit the goal of reducing disparities in economic development, the Treaty implicitly requires that EU Cohesion Policy should affect resource allocation and factor endowment to promote growth. Hence, "cohesion policies are aimed at increasing investment to achieve higher growth and are not specifically concerned either with expanding consumption directly or with redistribution of income'" (European Commission, 2001, p. 117).

European Cohesion Policy is successful if disparities between regions are decreased. Therefore, the convergence-process of EU-regions is a question of high political importance. Generally, the empirical evidence points to a small convergence effect of all or some European regions at least (Barro and Sala-i-Martin (1991); Sala-i-Martin (1996), see, for a survey, Eckey and Türk (2006)). However, whether the potential success with regard to convergence results from EU Cohesion Policy is an open question. Investigating the impact of European Cohesion Policy on economic growth and convergence is a wide research topic in applied econometric research. Nevertheless, the empirical evidence has provided mixed, if not contradictory, results. While some authors do find evidence of a positive impact of structural funds on economic growth (e.g., Ramajo, Márquez, Hewings and Salinas, 2008), others find little (e.g., Esposti and Bussoletti, 2008) to no impact at all (e.g., Dall'erba and Le Gallo, 2008).

Against this background, the aim of this chapter is to provide a fundamental review of the econometric evaluation of EU Cohesion Policy in order to shed light on the reasons for the diverging results. To be more precise,

[1] In the following, the terms "EU Cohesion Policy" and "EU Regional Policy" are used synonymously. Both refer to the policy of the EU to co-finance national projects mostly carried out at the regional level by payments from the so-called "structural funds".

this chapter forms an introduction to the institutional background, presents the theoretical framework used to evaluate EU Cohesion Policy, discusses the main econometric issues and surveys the existing literature. Note that this chapter does not include a discussion on the question of whether or not and to what extent Cohesion Policy may be effective from a theoretical point of view. A more general discussion on Regional Policy can be found in Jovanovic (2009) or Baldwin and Wyplosz (2009). Furthermore, the spatial effects of economic integration – also from the EU – are treated by Camagni and Capello (2010).

The remainder of this chapter is structured as follows. Section 2 starts with a brief introduction to the institutional background, before section 3 explains how the effectiveness of EU Cohesion Policy can be evaluated. This is followed by a review of the main econometric issues and an outline of potential solutions in section 4, while section 5 discusses the related literature against the background of sections 3 and 4. Finally, section 6 concludes and provides some remarks for future research.

2 Institutional set-up of EU Cohesion Policy

The EU Cohesion Policy started in 1975 with the introduction of the European Regional Funds (ERDF). The ERDF focused on expenditure for development projects in the poorer regions. Since that time, the Cohesion Policy has gained importance; several additional funds have been created and it has become the most important budget item comprising almost 36 percent of the total EU budget in the period 2007-2013 (the second most important item is the Common Agricultural Policy).

The Cohesion Policy can be divided into at least two policy regimes: before and after 1989. Before 1989, the EU budget was implemented annually and the Regional Policy focused on the ERDF, where the main beneficiaries were Italy, the UK, France, and Greece. After the passage of the Single European Act in 1987, the regional policy was allocated within multi-annual 'programme periods', the first of which ran from 1989 to 1993.[2] Most impor-

[2]The subsequent multi-annual frameworks comprise the following time periods: 1994-1999, 2000-2006 and 2007-2013.

tantly, the explicit purpose of the Cohesion Policy was established, namely to enhance cohesion and to reduce welfare disparities among the EU regions. The EU also introduced a number of further financial instruments to implement the structural policies. The most important of these are the European Social Fund (ESF), the Guidance Section of the European Agricultural Guidance and Guarantee Fund (EAGGF) and the Cohesion Fund. In addition, several allocation rules and guiding principles were introduced. In our context, the main principle of Cohesion Policy is that the payments by the EU have to be co-funded by the member states and must not crowd out national/regional policy expenditures.

Since 1989, European Cohesion Policy addresses regional problems under various so-called "objectives". These objectives reflect the key priorities for EU expenditures. They are listed for the last two financial periods in Table 1. The current Cohesion Policy (for the period 2007-2013) is not described here since it has not been taken into account in econometric studies yet.[3] The most important objective by far is to support lagging regions (the so-called Objective 1 regions), comprising approximately 75 percent of the total SF. The other objectives are targeted at areas affected by industrial decline (Objective 2), fighting long-term unemployment (Objective 3), adaptation to industrial change (Objective 4), reform of agricultural sectors (Objective 5a), rural areas (Objective 5b) and sparsely populated areas (Objective 6). Note that there is a clear-cut definition on what qualifies a region as an Objective 1 receiver (regional GDP has to be lower than 75 percent of the EU average), while a clear allocation scheme is missing in the case of the latter two objectives. Table 1 shows that both the number and the definition of the objectives are not fixed over time, but rather that they vary over the programme periods. For example, the number of objectives was reduced

[3]Since 2007, the EU Cohesion policy has revolved around three new (rearranged) objectives: (1.) Convergence (formerly Objective 1) (81.7% of total Cohesion Policy payments): support for growth and job creation in the least developed member states and regions (GDP per capita less than 75% of the EU average). (2.) Competitiveness and employment (formerly Objective 2) (15.8%): designed to help the richer member states to deal with economic and social change, globalisation and the transition to the knowledge based society. (3.) Territorial cooperation: to stimulate cross-border co-operation, the development of economic relations and the networking of member states.

from six to three in the financial framework 2000-2006 in order to strengthen the concentration of EU support.[4] However, this rearrangement was purely cosmetic, as the same eligibility criteria continued under different labels. This corresponds precisely to one conclusion which can be drawn from the history of Cohesion Policy: Once introduced, a particular objective is rarely (completely) phased out in future.

Table 1 approximately here

Figure 1 shows the historical development, including the total (nominal) EU Cohesion Policy payments[5](vertical bars) and their shares relative to the EU-GNI (solid line) and to the public national spending (dotted line). It becomes clear that there is a long-term upward trend in payments when measured in absolute terms, which can be explained, inter alia, by the enlargement steps of the EU (1973: EU-9, 1981: EU-10, 1986: EU-12, 1995: EU-15, 2004: EU-25, 2007: EU-27). By contrast, payments measured as percent of EU-GNI or public national spending have almost remained constant since 1993. Furthermore, Figure 1 shows that – on average – SF payments do not seem to be particularly large compared to total public spending with an EU-27 average of below 0.7 percent in 2007.

Figure 1 approximately here

However, focusing on the relatively small EU-average share might obscure the fact that the EU regional policy is quite important for some countries. Figure 2 compares the Cohesion Policy payments with the public investment in the member states. It becomes clear that EU spending is quite important for the poorest countries, that is, those countries receiving money from the Cohesion Fund, namely the so-called "old" (Spain, Greece, Ireland, and Portugal) and "new" (Eastern European countries) cohesion countries. In addition, focusing on the regional level, EU spending has a particularly

[4]There has been a recent discussion on whether further objectives should be introduced. Proposals focused on aid for regions/countries with climate change, environmental problems or strong demographic changes (European Commission, 2007).

[5]These are the ERDF, the ESF, the EAGGF, and the Financial Instrument for Fisheries Guidance (FIFG), as well as the Cohesion Fund and the Instrument for Structural Policies for Pre-accession (ISPA) for the accession countries.

high importance for some regions (e.g., Extremadura received more than 2.7 percent of EU support (as percent of GDP) in 2002). Thus, these figures illustrate two aspects: First, EU policy matters at least in some regions and/or member states. Second, given the volume of the spending, it may indeed be difficult for some countries to absorb the transfers and to co-finance European projects without cutting expenses elsewhere.

Figure 2 approximately here

Furthermore, it should be noted that ever since the introduction of the multi-annual financial framework, the European Commission determines so-called "commitments", which do not have to be equal to the final flows of EU support, the so-called SF "payments". For example, due to missing absorption capability, the commitments may not be entirely depleted or may be called up with a delay of one or two years. In this context, the so-called N+2 rule states that SF payments have to be called up with a delay of two years at the latest. This introduces big time lags between the determination of the eligibility for EU funding and the final flows of EU money. Figure 3 clarifies this issue by using the current financial framework 2007-2013 as an example. The statistical data basis to determine which regions receive EU support is based on the annual averages of the years 2000-2002, whereas the list of supported regions is published in 2006. As the financial framework runs from 2007-2013 the latest possibility to call up EU support is in 2015 due to the N+2 rule. Hence, there is a gap of up to 15 years between the underlying statistical data and the calling up of EU support.

Figure 3 approximately here

Finally, some studies try to explain the entire development of the EU expenditure (and revenue) side in the light of political negotiation processes. Due to the veto power, Cohesion Policy is affected by side payments and the bargaining power of the EU member states (e.g., Blankart and Kirchner, 2003; Feld, 2005; Feld and Schnellenbach, 2007). A prominent example is the establishment of the Cohesion Fund in 1994, which can be explained by the fact that the poor countries had to be compensated against losses of the single currency of the European Monetary Union (van der Beek and Neal, 2004).

3 Measuring the effectiveness of Cohesion Policy

There are several approaches to the evaluation of Cohesion Policy. One may distinguish between ex ante and ex post studies on the one hand, and qualitative, as well as quantitative, methods on the other hand. Qualitative studies are, for example, case studies. Since this type of study is beyond the scope of this chapter, a discussion is omitted here (for example, Davies, Bachtler, Gross, Michie, Vironen and Yuill, 2007; Milio, 2007). With regard to quantitative studies, one may distinguish between macroeconomic simulation studies (which can be used for ex ante, as well as ex post, evaluations; e.g. Bradley and Untiedt, 2007) on the one hand and (ex post) econometric studies on the other hand. The results of the simulation studies strongly depend on the – more or less – plausible assumptions. For example, in this respect it is often assumed that EU Cohesion Policy leads to an increase in investments and that these are profitable. However, this assumption typically leads to the result that all models indicate a positive effect of Cohesion Policy. Hence, the results of simulation models can be interpreted as an estimate of the *potential* of Cohesion Policy and should not be taken as empirical evidence in favour of its *effectiveness*.

As a consequence, we focus on (quantitative ex post) econometric studies here. In these studies the sample consists of EU countries or regions. Beyond this, there are microeconometric studies using individual level or firm level data evaluating the effects of single programmes (co-)financed by SF on various outcome variables at the micro-level. For example, Bondonio and Greenbaum (2006) analyse the effects of (Objective 2) business investment incentives on employment using firm-level data.

So far, theoretically founded econometric evaluations of the Cohesion Policy have mostly been based on the neoclassical growth theory.[6] In the

[6]Roughly speaking, the theoretical approaches can be classified as growth theories and trade theories and one can distinguish between "new" and "traditional" approaches. These have diametric political implications (Heinemann, Hagen, Mohl, Osterloh and Sellenthin, 2009). For example, while traditional neoclassical growth theory (Solow, 1956; Swan, 1956) implies that regional policy have no long-term effects, the new economic

following, it is shown how this theory is applied to panel data, although it was originally applied to cross-sectional data.[7]

The literature on the convergence of income levels (e.g., GDP per capita) distinguishes between the so-called β– and σ–convergence. The former predicts that if countries have the same steady-state determinants converging to a common balanced growth path, then those countries with relatively low initial income levels grow faster than richer countries (Durlauf, Johnson and Temple, 2005, p. 585). Moreover, β–convergence can be easily evaluated in a linear regression context, e.g. of the neoclassical growth model. Assuming that β–convergence holds for $i = 1, ..., N$ regions, the natural logarithm of income y of region i at time t (e.g., measured as GDP per capita) can be approximated by:

$$ln(y_{it}) = \alpha + (1 - \beta)\, ln(y_{it-1}) + u_{it}, \tag{1}$$

where and is an i.i.d. error term (Sala-i-Martin, 1996; Young, Higgins and Daniel, 2008). Since is assumed to be constant across regions, the balanced growth paths are identical. Rearranging (1) yields to the more common version of the neoclassical growth model (Young, Higgins and Daniel, 2008):

$$ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta\, ln(y_{it-1}) + u_{it}. \tag{2}$$

Hence, $\beta < 0$ implies a negative correlation between growth and initial log income.[8]

The neoclassical growth model assumes that economies (countries or regions) with similar economic conditions converge with respect to their income level. Absolute / unconditional convergence refers to an inverse relationship between the growth of income and the initial level if control variables are

geography (Krugman, 1991; Krugman and Venables, 1995) indicates positive effects on regional convergence under certain circumstances. Nevertheless, the latter also predicts a trade-off between growth and convergence. From the perspective of the new (endogenous) growth theory (Romer, 1986, 1990), regional policy may have long-term effects if it promotes R&D or human capital.

[7] A more general survey which includes cross section as well as time series data can be found in Magrini (2004).

[8] y_{it} may also indicate the GDP per capita of the region i relative to the aggregate GDP per capita of all regions at time t. In doing so, common time effects are cancelled out

absent, i.e., a significantly negative $\widehat{\beta}$ in the regression framework described above. Conditional convergence prevails if this relationship still holds after conditioning on further variables. Hence, the neoclassical growth model predicts a negative β. Empirical studies provide evidence in favour of both hypotheses (Islam, 1995, 2003; Cuaresma, Ritzberger-Grünwald and Silgoner, 2008). The estimated convergence rates are typically a little lower in cross-section studies (approximately 2 percent per year Barro and Sala-i Martin, 2004) than in panel studies (Lee, Pesaran and Smith, 1998).[9]

To make the distinction between conditional and unconditional convergence clear, we plug fixed regional or country effects into equation (2) and distinguish two simple regression equations for regional-level data (Ederveen, Gorter, de Mooij and Nahuis, 2002):

$$ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta\, ln(y_{it-1}) + c_i + u_{it}, \tag{3}$$

$$ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta\, ln(y_{it-1}) + \mu_i + u_{it}, \tag{4}$$

with c_i denoting country-specific fixed effects (a set of country dummies) and μ_i region-specific fixed effects (a set of region dummies).

While β in equation (2) is a measure of absolute convergence, (3) and (4) provide estimates of conditional convergence. To be precise, equation (3) analyses convergence conditional on whether a region lies in a particular country. Thus, it allows for differences in steady states of income between country 1 and country 2 (country-specific steady states). It assumes, however, that within countries, different regions receive equal income levels. Equation (4) assumes region-specific steady-states, that is, there may be income gaps between regions which are never bridged even within countries (for a more detailed discussion on this topic see Islam, 2003).

The concept of σ–convergence is a measure of statistical dispersion of income at period T (Barro and Sala-i-Martin, 1991, 1992). σ-convergence holds if the dispersion of income levels declines between t and $t+T$ (Durlauf, Johnson and Temple, 2005), i.e., if:

$$\sigma^2_{ln\, y_t} - \sigma^2_{ln\, y_{t+T}} > 0. \tag{5}$$

[9]For a critical review on the 2 percent finding see Quah (1996).

The concepts of β– and σ–convergence are linked: β–convergence provides the necessary, but not the sufficient, condition for σ–convergence. As a consequence, σ–convergence can only be achieved with β–convergence, whereas this does not hold the other way round. Hence, even if β–convergence can be observed (poorer regions grow faster than richer ones), the dispersion between the income levels of regions may increase, so that there would be no σ–convergence.

Almost all econometric studies analyzing the growth effects of EU regional policy are based on a neoclassical growth model of the type Solow (1956) and Swan (1956), that is, equation (2) is augmented by further theory-driven variables. In this context, SF payments are assumed to correspond to investments (Ederveen, de Groot and Nahuis, 2006; Bähr, 2008; Mohl and Hagen, 2008). A regression equation for regional data may be specified as:

$$\begin{aligned} ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta_1 ln(y_{it-1}) + \beta_2 ln(sf_{it-1}) + \beta_3 ln(sav_{it-1}) + \\ \beta_4 (n_{it-1} + g + \delta) + \beta_5 ln(educ_{it-1}) + \mu_i + \lambda_t + u_{it}, \end{aligned} \tag{6}$$

where sav_{it-1} is the saving rate, n_{it-1} is the population growth rate, g and δ stand for the technological progress and the time discount factor. Most authors follow the seminal paper by Mankiw, Romer and Weill (1992) and assume that g and δ are constant over time and region and jointly amount to 5%. Furthermore, $educ_{it-1}$ measures the education level of the population (e.g., percentage share of population with higher education). Finally, equation (6) includes fixed-region effects (μ_i) as well as fixed time effects (λ_t). The reasons for their inclusion will be discussed in section 4.

The main variable of interest in this kind of literature is the SF variable (sf_{it-1}), which is expressed as payments as a share of nominal GDP (among others, Bähr, 2008) or as percent of persons employed (e.g., Esposti and Bussoletti, 2008). If the estimate of is positive and significantly different from zero, the SF payments positively affect the regions' steady-state growth rate, hence, they enhance the transitional growth rate of each region towards its own steady state (Dall'erba and Le Gallo, 2008).

Most papers only focus on the evaluation of the sign of the coefficient of SF and neglect the size of its impact. However, the latter should be of relevance since an expensive EU regional policy with a tiny size effect might

be effective but not "cost-efficient". Those authors who discuss the size effect usually interpret the short-term elasticity of the impact. Given that the variables of equation (6) are specified in logarithmic terms, a one percent increase of the SF variable increases the growth rate by $\widehat{\beta}_2$ percent. However, note that equation (6) equals the dynamic approach shown in equation (1), so that it is more convincing to interpret the long-term impact of variables, which can simply be calculated as $\widehat{\phi} = (\widehat{\beta}_2 / -\widehat{\beta}_1)$ in the case of SF payments. The long-term elasticity can be interpreted as showing that a one percent increase of SF payments (as percent of GDP) raises the real GDP per capita by $\widehat{\phi}$ percent. Unfortunately, most studies do not discuss the quantitative long-term impact.

Note that regressions of the type of equation (6) only allow for an estimation of the effect of SF payments on growth, and hence we cannot learn directly from $\widehat{\beta}_2$ whether or not a poor region A catches up with a rich region B. However, this is precisely one important aim of Cohesion Policy. What we learn from $\widehat{\beta}_2$ is "only" whether and to what extent SF promotes growth. Nevertheless, since the allocation criteria of the SF (in the case of Objective 1 payments, as well as total SF payments) imply a negative correlation between the level of GDP per capita and SF payments, a significantly positive $\widehat{\beta}_2$ can be interpreted as an indication for convergence at least.

In order to directly measure the effects of Cohesion Policy on convergence, Eggert, von Ehrlich, Fenge and König (2007) propose the following specification using regional data:

$$\begin{aligned} ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta_1 \, ln(y_{it-1}) + \beta_2 \, ln(sf_{it-1}) + \\ c \, ln(y_{it-1}) \, ln(sf_{it-1}) + ... + u_{it}. \end{aligned} \tag{7}$$

This equation states that the estimated effect of SF payments depends on the initial income level. In this case $\widehat{\beta}_2$ indicates the impact of SF payments given an initial income level (y_{it-1}) equalling zero, which is obviously of no use as there are no regions with a GDP of zero. Given a positive $\widehat{\beta}_2$, a negative $\widehat{c}$ implies that this positive effect declines with an increasing initial income level, which, in turn, may be interpreted as a sign of convergence. One possibility of deriving meaningful quantitative conclusions from equation (7) is to calculate the marginal effects of SF payments across the ob-

served range of initial income level (y_{it-1}) by: $\widehat{\beta_2} + \widehat{c}\, ln(y_{it-1})$. Subsequently, these marginal effects might be illustrated graphically including confidence intervals around the slope to show the statistical significance level (Brambor, Clark and Golder, 2006).

Several studies, especially those using country-level data (e.g., Ederveen, de Groot and Nahuis, 2006; Bähr, 2008), investigate whether the effectiveness of SF payments depends on institutional and economic aspects of the country, such as the quality of institutions,[10] the member states' federal structure (decentralisation) or the openness to trade. They use specifications similar to the following:

$$\begin{aligned} ln(y_{it}) - ln(y_{it-1}) = \alpha + \beta_1\, ln(y_{it-1}) + \beta_2\, ln(sf_{it-1}) + c_1\, cond_{it} + \\ c_2\, cond_{it}\, ln(sf_{it-1}) + ... + u_{it}, \end{aligned} \tag{8}$$

where $cond_{it}$ denotes a variable including the aspects of the country i in year t and $cond_{it}\, ln(sf_{it-1})$ is an interaction term. Solid results should again be derived by calculating and illustrating the marginal effects as indicated above.

A further issue is the question through which channel SF payments affect growth. The assumption underlying virtually all empirical studies is that the Cohesion Policy increases regional investments leading to a higher steady-state capital stock per capita and, ultimately, to a higher GDP. This may be justified by the nature of SF spending which consists predominantly of investments. However, as pointed out by Esposti and Bussoletti (2008) or Bouvet (2005), SF payments may influence long-run growth in two more ways within the neoclassical growth model. First, it may increase the initial level or the growth of the regional total factor productivity (TFP). Second, it may affect the labour market, that is, the growth rate of the initial workforce. One problem here concerns the many neoclassical growth specifications, which (implicitly) assume full employment or constant employment rates over time, as well as across regions. Since the employment rates differ between European states and evolve differently over time, and since SF payments are likely to affect employment, Esposti and Bussoletti (2008) pro-

[10] Ederveen, de Groot and Nahuis (2006) use, for example, the World Bank governance indicators "political stability", "government effectiveness" and "rule of law".

pose using growth of GDP per employment (which corresponds to average labour productivity) rather than growth of GDP per capita as a dependent variable. However, it may be argued that the goal of Cohesion Policy is to promote convergence of GDP per capita, implying that this variable is more appropriate. Nevertheless, Esposti and Bussoletti's argument points to the fact that it is necessary to evaluate the labour market effects of Cohesion Policy, an undertaking that has been neglected so far (exceptions are Becker, Egger, von Ehrlich and Fenge, 2008; Bouvet, 2005; Dall'erba and Le Gallo, 2007).

4 Main econometric issues and potential solutions

When estimating the effects of SF payments on economic growth and convergence, several methodological issues have to be considered.

The estimation of the relationship between SF payments and the growth rates in regions or countries is complicated by the potential endogeneity problem, i.e., the fact that within a regression model such as equation (6), the covariance between at least one of the explanatory variables (e.g., the SF variable) and the disturbance term is not equal to zero (Wooldridge, 2002). This endogeneity may be attributed to the following four issues:

First of all, there is the danger of biased estimates due to *reverse causality*, leading to an underestimation of the effectiveness. The allocation criteria of the SF commitments are likely to be correlated with the dependent variable "economic growth". First and foremost, the allocation of SF is based on the ratio of the regional GDP per capita (in PPS) and the EU-wide GDP. If this ratio is below 75 percent, the region is a so-called Objective 1 region, implying that it is eligible for the highest transfers relative to GDP. Furthermore, the allocation of Objectives 2 and 3 depends, inter alia, on the regional unemployment rate, the employment structure, and the population density. Moreover, the effective payments by the Commission to the regions depend on the regions' or countries' abilities to initiate and to co-finance these projects. This ability may be higher in times of higher economic growth rates, e.g., due

to higher tax revenues. Nevertheless, some authors argue that the problem of reverse causality might be mitigated by the multi-annual programme periods, in which the determination of the eligibility for EU funding is made several years before the actual flows of EU spending (see in section 2).

Second, there may be *unobserved variables* (unobserved heterogeneity) or (due to missing data availability) *omitted variables*, which have an impact on the regional growth rates, but which are not included in the equation and are thus part of the error term of the specification. If these omitted variables are correlated with one explanatory variable, this explanatory variable is endogenous. A special case of an omitted variable bias is the relevance of spillover effects: SF payments may increase the economic growth rate which, in turn, may affect the neighbour's growth positively. If these spillover effects cannot be separated from the "original" impulse, the estimated effect of SF payments is biased. This problem might be of less importance when using country data. By contrast, there is strong empirical evidence indicating that regional spillover effects do play a significant role at the regional level (Arbia, Le Gallo and Piras, 2008; Abreu, de Groot and Florax, 2005). Hence, the effects of Cohesion Policy in one region are obviously not limited to that region, since there are regional spillovers to other (neighbouring) regions. The fact that the European classification of regions is based on political, rather than on economic, criteria intensifies this problem.

Third, keeping the identity of equations (1) and (2) of section 2 in mind, it is obvious that equation (3) equals a dynamic approach. Hence, simply applying a fixed effects estimator in a dynamic setup leads to a correlation of the lagged dependent variable and the error term results in an underestimation of the lagged dependent variable which is well-known as the *Nickell bias* (Nickell, 1981; Magrini, 2004).

A fourth problem is related to *measurement errors*. This problem is of special concern with regard to the SF variable at the regional level. The annual reports on SF published by the European Commission only comprise regional commitments and payments for the period 1994-1999. Unfortunately, since 2000, these reports only contain data at the country level. Furthermore, before 1994, only SF commitments are available. However, using SF commitments instead of payments might lead to biased results. Depending

on the assumptions on how SF commitments and payments are correlated, SF commitments might be correlated with the error term. By contrast, the problem of data availability with regard to SF payments is less severe at the country level. Despite that, to the best of our knowledge, it is not possible to distinguish between the different objectives and funds for a long time period, there is at least information on the total EU regional policy payments for the time period 1976-2007 (European Commission, 2008).[11]

Apart from these endogeneity-related aspects, the estimations might be biased by a fifth issue. Although growth theory provides well-established suggestions for the estimation of growth relationships, it is ex ante not clear which economic growth model to use and which *functional form* is appropriate for the effect of SF payments (Durlauf, Kourtellos and Tan, 2008). There may be non-linearities and interactions with covariates, which may lead to biased estimates if they are not taken into account. Similarly, the "real" impact of EU regional policy on growth might be misspecified because the time structure of its effects is ex ante unknown. It may be argued that SF projects, such as infrastructure investments, only become effective for growth after some time lag.

Finally, a fundamental – but often ignored – sixth econometric problem is related to the choice of the *appropriate control variables*, i.e., which variables should be included in the right-hand side of the regression model. For example, one may derive from growth theory that growth of GDP per capita is affected by (private and public) investments and that an omission may bias the estimated results. However, the inclusion of the investment variable into the regression evaluating the growth effects of SF payments might lead to biased results. Since SF payments may stimulate growth through the channel

[11]With respect to further economic and socio-demographic control variables included in estimations using regional data, Eurostat provides a relatively large database with the most relevant variables. However, for a longer time period, there are, to the best of our knowledge, no high-quality education data at the regional level like those proposed at the country level by de La Fuente and Doménech (2006); Barro and Lee (2001); Cohen and Soto (2007). Instead, there is only data available since 1999, which measures the population aged 15 years and over with a high, medium or low level of education. For this reason, Mohl and Hagen (2008) use the number of patents per million inhabitants as a proxy for the education variable.

"investment" (leading to a higher steady-state capital stock per capita), the inclusion of the investment variable might render it impossible to evaluate the investment increasing effect of SF payments on growth. More generally: One should be careful not to include control variables which may also serve as a dependent variable of Cohesion Policy (Angrist and Pischke, 2009, call these variables "bad controls").

Obviously, given the current state-of-the-art econometric models and the available data, it is not possible to deal with all the problems mentioned above simultaneously. However, by taking into account the methodological issues and by comparing the results of several empirical approaches, one might hope to get an idea about the range of the "true effect" of SF payments on growth. There exist at least a few potential approaches to coping with the issues presented above individually, as will be illustrated in the following.

To start with, using panel data helps to solve some problems. If (un-) observed omitted variables affecting growth are constant over time, they are eliminated by including fixed effects or by first-differencing. If these unobserved variables are not constant, methods such as instrumental variable (IV) estimators are necessary. Moreover, unobserved time effects (such as common macroeconomic shocks) influencing growth might be relevant (Bond, Hoeffler and Temple, 2001). A very common and flexible approach to avoiding parametric assumptions is to use a set of common (e.g., annual) time dummies which can control for effects common to all regional units, such as pan-European business cycles (see equation (3)). This may also reduce the problem of regional spillovers (Bronzini and Piselli, 2009). In order to avoid that the use of time dummies leads to a significant loss of degrees of freedom (which is most relevant in case of popular general method of moments (GMM) estimators due to the matrix of instruments), one may transform the variables into deviations from time means (i.e., the mean across the N individual regions for each period) which is equivalent to the use of time dummies (Bond, Hoeffler and Temple, 2001). If necessary, time effects may be modeled in a more complex manner: For example, one may allow for country-time specific effects in regional data by defining country-specific annual dummies. Another approach is to define country-specific or region-specific time trends (Wooldridge, 2002; Hagen and Mohl, 2009).

In order to deal with the first and second problem, an IV estimator combined with fixed effects or first differences seems to be the right choice. However, to the best of our knowledge, no convincing external IV has been proposed in the literature (exceptions may be the studies by Dall'erba and Le Gallo, 2008; Bouvet, 2005, summarised in section 5). Hence, identification has to be based on internal instruments via the GMM estimators (Arellano and Bond, 1991; Roodman, 2009b). In addition, GMM estimators are also suitable for dealing with the third issue introduced above, by instrumenting the initial income level (as well as further variables) by lagged values. On the one hand, there is evidence that the first-differenced GMM (FD-GMM) estimator by Arellano and Bond (1991) has a large finite sample bias and poor precisions when the time series are persistent, so that the system GMM (SYS-GMM) estimator by Blundell and Bond (1998) should be preferred. On the other hand, some applications question the superiority of the SYS-GMM estimator because the additional instruments might not be valid (Lucchetti, Papi and Zazzaro, 2001). Hence, one might apply different estimators to draw well-founded conclusions. Note that the consistency of both GMM estimators is based on large N, which might not be given in the analyses using country-level data. However, there is preliminary evidence of Monte Carlo simulations showing that, given pre-determined explanatory variables, the SYS-GMM estimator has a lower bias and higher efficiency than the FD-GMM or the fixed effects estimator (Soto, 2006). Nevertheless, country-level data (such as EU-15 data) may still be too small for GMM estimations.

One should be careful as regards the use of instruments when applying GMM estimators: Using too many instruments can overfit instrumented variables (Roodman, 2009a), reduce the power properties of the Hansen test (Bowsher, 2002) and lead to a downward bias in two-step standard errors (Windmeijer, 2005).[12] One solution might be to include lag limits or to collapse the set of instruments.[13] Since an increasing number of studies on the effects of Cohesion Policy apply GMM estimators, these aspects are highly

[12]Roodman (2009a, p. 156): "Perhaps, the lesson to be drawn is that internal instruments, though attractive as a response to endogeneity, have serious limitations".

[13]However, the choice of the number of lags used as instruments or the possibility of collapsing the number of instruments might seem arbitrary.

relevant and should be taken into account in order to avoid misleading estimation results.

Applying spatial panel econometric techniques helps to control for spatial spillover effects, which is of special concern when using region-level data (for a survey see LeSage and Pace, 2009). The usual approach is to specify a weight matrix containing information on the number of or distance of neighbours (Anselin, Florax and Rey, 2004). This is done by focusing on the (i) contiguity of each region, (ii) its k-nearest neighbours, or (iii) the geographical distance (e.g., expressed in kilometers) to its neighbours. Sometimes the weight matrices are weighted by some economic variables (e.g., using trade data between regions). However, often geographical distance based weight matrices are preferred because they are strictly exogenous. Nevertheless, the right choice of the weight matrix is of fundamental concern as incorrectly specified weight matrices might lead to wrong conclusions (LeSage and Fischer, 2008).

Generally speaking, including a weight matrix does affect the efficiency and/or the consistency of the OLS estimator leading to biased results. Hence, the spatial econometric estimations are usually estimated by Maximum Likelihood (Anselin, 1988; Anselin and Hudak, 1992; Elhorst, 2010) or by GMM (Kelejian and Prucha, 1998, 1999; Bell and Bockstael, 2000). There are two predominant approaches to specifying the spatial model: One can either include a spatially weighted dependent variable (the so-called "spatial lag model") or a spatially autocorrelated error ("spatial error model") into the regression model. These approaches were originally focused on cross-sectional (Anselin, 1988; Anselin and Bera, 1998; Anselin, 2006) and static panel datasets (Elhorst, 2003) and they have been extended to the case of dynamic panel estimators (Badinger, Müller and Tondl, 2004; Yu, de Jong and Lee, 2008). Recently, further approaches have been introduced, such as including both spatial lag and spatial error simultaneously (Kelejian and Prucha, 1998; Lee, 2003) or including spatially weighted independent variables (the so-called spatial Durban model, see, e.g., Elhorst, Piras and Arbia, 2006; Ertur and Koch, 2007). Unfortunately, there is as yet no estimator which controls for both spatial spillover and endogeneity of further independent variables (besides the lagged dependent variable) within a panel data

framework.

The fourth problem should be addressed by using SF payments instead of commitments. As mentioned in section 2, the differences between payments and commitments can be sizable.

As regards the fifth problem, almost all studies are based on a neoclassical growth model. Despite some criticism due to its strict assumptions (Dall'erba and Le Gallo, 2008), the use of the neoclassical growth model might be explained by the limited data availability at the regional level.[14] Possible approaches to this problem have been proposed by Becker, Egger, von Ehrlich and Fenge (2008) as well as by Hagen and Mohl (2008), who avoid strict functional form assumptions by using treatment effect methods (for a recent survey for applied researchers see Austin, 2007). These studies will be summarised in section 5 in greater detail.

In order to take into account that SF payments might be effective after some time lag, Rodríguez-Pose and Fratesi (2004) as well as Mohl and Hagen (2008) include past values of the SF variable besides contemporaneous values. For example, Mohl and Hagen (2008) start their empirical analyses by excluding any SF variable, and then gradually add the lagged SF payments, beginning with a lag of one year and ending up with a specification comprising SF with a lag of one to five years ($\sum_{j=1}^{5} ln\, SF_{i,t-j}$).[15]

5 Empirical evidence

The main aspects of the previous literature on the impact of Cohesion Policy on economic growth are summarised in the following. We distinguish between studies using country-level data (Table 2), regional-level data in a multi-country framework (Table 3), and regional-level data within one county

[14] For a recent empirical comparison of different theoretical convergence models at the European regional level, see Arbia, Le Gallo and Piras (2008).

[15] Due to multicollinearity, the coefficients and standard errors of the SF variable cannot be interpreted if the variable is included into the regression with several lags. As a consequence, Mohl and Hagen (2008) calculate the joint sum of SF coefficients corresponding to the short-term elasticity and use a simple Wald test to determine whether this short-term elasticity is statistically different from zero. Based on this, it is possible to calculate the long-term elasticity as described above.

(Table 4).

Generally, EU regions are classified into three different groups by the European Commission according to the "Nomenclature des unites territoriales statistiques" (NUTS). These units refer to the country level (NUTS-0) and to three lower subdivisions (NUTS-1, NUTS-2 and NUTS-3) which are classified according to the size of population (Eurostat, 2007). The advantage of regional data for econometric analyses is the resulting large sample size which allows the application of methods based on a large number of cross sections (N). Furthermore, regions (as opposed to countries) are usually the unit of interest for Cohesion Policy. By contrast, using country-level data comes with the advantage of larger data availability but with the drawback of small sample sizes (EU-12, EU-15 etc.). Moreover, region-specific effects cannot be analysed by definition.

Apart from the choice of the appropriate sample, the studies differ in the time period covered, the econometric methods applied, the type of dataset used (cross-section versus panel) and the operationalisation of SF payments. With respect to the latter, theory does not provide an unambiguous indication. While most studies operationalize SF as a continuous variable, some studies use a dummy variable to indicate whether a region is an Objective 1 region or not. The latter case has the advantage that data on payments are not necessary, but it comes with the disadvantage that it is not possible to measure the real size effect of regional policy. If SF are operationalised as continuous variable, the studies differ with regard to the question of whether to express the SF as percent of GDP, in purchasing power parities (PPP) and/or in per capita terms. Moreover, not all studies use SF payments – some use data on SF commitments. From our point of view, using (nominal) SF payments as percent of (nominal) GDP is the most convincing approach since differences in purchasing powers are cancelled out in a very simple manner.[16]

With respect to the econometric methods used, there are various approaches to dealing with the issues described in the last section. Simple cross-sectional or pooled OLS estimators are based on the assumption that,

[16]Incidentally, this is the exact approach chosen in the empirical literature on the growth effects of foreign aid (Easterly, 2003).

after conditioning on further explanatory variables, many of the problems discussed in section 4 (reversed causality, omitted/unobserved variables) are not relevant. Thus, it seems to be more convincing to rely on panel data methods which, in fact, most studies do. As mentioned in the last section, using panel data enables the researcher to eliminate unobserved fixed effects affecting SF and growth simultaneously.

We start the survey with the studies based on country-level data (Table 2). Ederveen, Gorter, de Mooij and Nahuis (2002) analyse the effects at the national (EU-12) as well as at the regional (NUTS 2) level. The study only investigates the effects of the ERDF and applies a pooled OLS estimator: only conditionally positive growth effects for an EU-12 sample for the time period 1960-1995 are found (implemented via an interaction term, see equation (6)). In particular, cohesion support is more likely to be effective for member states with open economies (such as Ireland) and less likely to be effective in closed ones (such as Spain). According to the explanation of the authors, openness disciplines governments, which stimulates more productive investment of cohesion support.

Beugelsdijk and Eijffinger (2005) restrict their analysis to the programme period 1995-2001. They focus on the dependency of the effectiveness from moral hazard behaviour and substitution effects by interacting the SF variable with a corruption index. According to the authors, the moral hazard effect matters because countries might be inclined not to raise the welfare level of those regions which are close to the critical value of getting EU support, as this would possibly imply a reduction in future financial EU support. Hence, it is possible that the resources are not used for projects that would have the largest direct and indirect impact, so that the moral hazard effect might lead to an inappropriate use of SF. The substitution effect means that SF payments lead to a crowding out of national spending. Using EU-15 data and different dynamic panel data estimators (including an FD-GMM in order to take endogeneity into account) they find that the hypothesis that SF contribute to fewer interregional disparities within the current 15 European countries cannot be rejected. Furthermore, the results do not indicate that the more corrupt countries use their SF in a less efficient way.

Ederveen, de Groot and Nahuis (2006) analyse the effectiveness of the

ERDF for the period 1960-1995 using dynamic panel approaches for an EU-13 sample. Among other econometric techniques, they apply FD-GMM and SYS-GMM estimators, assuming, however, that the SF payments are strictly exogenous. They find that SF as such do not improve the countries' growth performance. However, they find evidence that they only enhance growth in those countries with the "right" institutions, that is, countries with a high economic openness and high direct measures of institutional quality (such as low inflation and low public debt). From these findings, Ederveen, de Groot and Nahuis (2006, p. 25) derive consequences for a redesign of the EU regional policy: In the light of the EU enlargement process, the funds should be allocated first and foremost toward institution building. Given institutions of a satisfactory quality, the EU regional policy may be effective in stimulating growth.

Recently, Bähr (2008) complemented these results by analyzing whether the degree of decentralisation within countries mattered in the EU-15 during the period of 1975-1995. The hypothesis is that, given the sensitivity of EU Cohesion Policy to specific regional needs, member states with a higher degree of decentralisation should be able to implement more effective programmes. An interaction variable comprising SF and a decentralisation measure is introduced to the model, which is estimated by various panel estimators. Robustness checks are performed, inter alia, by instrumenting the SF variable with its own lagged values. While SF cannot be said to be unambiguously growth promoting in itself, Bähr finds a significantly positive effect of SF on growth in more decentralised countries. This is explained by the fact that regional authorities have better information on specific growth inducing projects, so that there is a more effective regional implementation of the programs in traditionally decentralised countries.

Bradley and Untiedt (2008) criticise the approaches by Ederveen, Gorter, de Mooij and Nahuis (2002) as well as those by Ederveen, de Groot and Nahuis (2006), inter alia, for the following reasons: First, the time period used includes the time before the fundamental reform of Cohesion Policy in 1989, a period in which payments were relatively low. Second, they point to misspecifications in the regression (especially with regard to the interaction of SF payments and institutional variables). Third, they criticise the

assumption of exogeneity of Cohesion Policy and show that the econometric results are far from being robust (for the expression of fundamental concerns on the evaluation of growth effects of public policies see Rodrik, 2005).

Table 2 approximately here

Apart from these country analyses, some studies use more detailed data and focus on the regional level (Table 3).

The conclusions of the analysis of Ederveen, Gorter, de Mooij and Nahuis (2002) for 183 NUTS-2 regions from 1981 to 1996 using pooled OLS depend on the convergence model used. Assuming that all regions finally catch up to the same income level (absolute convergence, i.e., neither further explanatory variables nor country or regional dummies are included), they find a negative effect of SF on growth. By contrast, assuming that the convergence process is limited to convergence within countries (including country dummies and no further explanatory variables), they do not find a significant effect. Finally, when assuming region-specific steady-states, that is, including regional fixed effects, a significantly positive effect is found. The authors conclude from these results (p. 55) "...the more optimistic one is about convergence in the long run, the more pessimistic one should be about the impact of Cohesion Policy, and vice versa [...]. The somewhat grim conclusion must be: either Cohesion Policy is counterproductive, or regional differences will persist." However, one should keep in mind that there are good reasons to assume that omitting fixed effects (regional dummies) and further control variables results in biased estimates (see section 4).

Cappelen, Castellacci, Fagerberg and Verspagen (2003) focus on the question of whether the SF reform in 1989 has increased the effectiveness of Cohesion Policy by dividing their sample period into two time periods (1980-1988 and 1989-1997). Using these two cross-sections and applying OLS, they find a positive impact on regional growth. The authors find evidence that SF are most effective in more developed regions (measured in terms of the unemployment rate, R&D spending etc), whereas the effectiveness is limited in "poorer" regions. Furthermore, it turns out that the reform of 1989 has increased the effectiveness.

Esposti and Bussoletti (2008) analyse the impact of Objective 1 spending on regional growth using a data set with 206 NUTS-2 regions covering the time period 1989-2000. They apply different estimation techniques (such as DIFF-GMM, SYS-GMM). However, it seems that SF payments are treated as strictly exogenous and only the lagged dependent variable is instrumented. They find a positive impact of SF on Objective 1 regions over the whole EU area, even though its size and statistical significance vary across alternative estimators. Generally, the impact is quite limited and becomes negligible or even negative in some regional cases. For instance, when regions are grouped by country, a negative effect may be observed for German, Greek, and Spanish Objective 1 regions. By contrast, the French Objective 1 regions show the highest policy treatment effect.

The study by Puigcerver-Peñalver (2007) is based on 41 NUTS-2 regions in the EU-12. It analyses whether Objective 1 payments to these regions promoted growth in the period 1989-2000, with SF payments modeled as being affected by the total factor productivity. Using a fixed effects model it is shown that the effectiveness depends on the time period. While Cohesion Policy (Objective 1) had a positive impact in the funding period 1989-1993, no significantly positive impact can be detected during 1994-1999.

Using a cross-sectional approach, de Freitas, Pereira and Torres (2003) analyse whether Objective 1 regions grow faster than non-Objective 1 regions between 1990 and 2001, assuming strict exogeneity of the Objective 1 status. They find evidence of conditional convergence among EU regions. Moreover, the quality of national institutions has a positive impact, while there is no evidence of a correlation between the eligibility for Objective 1 payments and faster convergence.

Rodríguez-Pose and Fratesi (2004) also focus on Objective 1 regions. The study not only analyses the time lags of SF effects but also differentiates between categories of Cohesion Policy, such as (a) support to agriculture and rural promotion, (b) business and tourism support, (c) investment in human capital, (d) investment in infrastructure and environment. However, the analysis is based on SF commitments instead of on SF payments. Applying fixed effects as well as pooled GLS estimators, they cannot find significant effects of SF on infrastructure and, to a lesser extent, on business support. By

contrast, support for agriculture has positive short-term effects on growth, but these wane quickly; and only investments in education and human capital – representing only about one-eighth of the total commitments – show positive and significant returns.

The study by Bouvet (2005) goes one step further by not only investigating the impact of the ERDF spendings on economic growth but also by analyzing through which channels Cohesion Policy might work, i.e., investment, total factor productivity or employment (see section (3)). The data base consists of 118 NUTS-2 regions in the EU-8 from 1975 to 1999. The SF payments (ERDF) are instrumented with political variables.[17] It turns out that Cohesion Policy has a positive but modest effect on growth. The study does not find significant evidence that this positive effect works through an increase in regional investment. By contrast, it is found that Cohesion Policy increases TFP and employment growth and that these are the channels through which the policy affects GDP growth.[18]

As mentioned in section 4, a major econometric problem when using regional-level data results from omitting regional spillover effects, which may lead to biased results. Dall'erba and Le Gallo (2008)[19] is one of the few studies that try to cope with this problem. This, however, comes with the drawback that other econometric issues (regional fixed effects, among others) are not taken into account. The authors use spatial econometric techniques for cross-sectional data for 145 regions in 1989-1999. The SF payments are instrumented, inter alia, with the regions' distances to Brussels using two-stage least squares. The results from Dall'erba and Le Gallo (2008) indicate that significant convergence takes place, but that the SF have no impact on

[17]The following instrumental variables are used: the interaction term of the coincidence between local central governments and the coincidence between the central government and the president of the Commission, the interaction term of the local incumbent dummy and the coincidence between the central government and the president of the Commission, the coincidence between local central governments, the local-incumbent dummy and the national incumbent dummy.

[18]Bouvet (2005) also examines the determinants of fund allocation. While more funds are allotted to regions with lower per capita incomes and structural deficiencies, some evidence of political interference in the allocation process is found.

[19]In a preceding study, Dall'erba (2005) applies an exploratory spatial analysis and finds a positive relationship between SF payments and regional growth.

it.

Ramajo, Márquez, Hewings and Salinas (2008) apply cross-sectional spatial econometric techniques to estimate the speed of convergence for a sample of 163 regions in the EU-12 over the period 1981-1996. First of all, they find evidence in favour of the existence of two spatial convergence clubs among European regions, namely, the presence of two significantly different spatial clusters formed by regions belonging to Cohesion (Ireland, Greece, Portugal and Spain) and non-Cohesion countries. The estimations indicate that throughout the period analysed, there is a faster conditional convergence in relative income levels of the regions belonging to Cohesion countries (5.3 percent) than in the rest of the regions of the EU (3.3 percent). Hence, the results provide support for policies that are explicitly designed to promote regional growth in the less-developed regions located in Cohesion countries.

Based on a sample of 1084 NUTS-3 regions (EU-15) over the period of 1995-2004, Falk and Sinabell (2008) investigate the determinants of Objective 1 payments on the regional growth of GDP per capita in a cross-sectional analysis. As the Lagrange Multiplier test statistic does not hint at spatial spillover effects, they focus on robust OLS and weighted-least-squares procedures. The latter is used in order to control for outliers. In addition, Falk and Sinabell decompose the growth following the Blinder-Oaxaca decomposition (Oaxaca and Ransom, 1994) in order to check how much of the growth differential can be explained by observable differences between Objective 1 and non-Objective 1 regions. Their results indicate that there is a significant growth differential, which is, however, almost entirely due to the difference in characteristics such as initial GDP per capita, economic structure and population density. As a consequence, these results point to a low effectiveness of the EU funds.

Mohl and Hagen (2008) use a panel dataset of 124 NUTS-2 regions over the time period 1995-2005, extending the literature with regard to the following aspects: First of all, they use more precise measures of SF by distinguishing between Objective 1, 2, 3 and 1+2+3 payments and by a more thorough investigation of the impact of time lags. Second, the time period of the investigation is extended, using SF payments of the last financial framework 2000-2006 that have not been analysed before. Third, the paper examines

the robustness of the results by comparing various econometric approaches. Apart from SYS-GMM (which allows for endogeneity of SF payments as well as of further variables), spatial panel econometric techniques are applied. The results show that Objective 1 payments in particular promote regional economic growth, whereas Objectives 2 and 3 do not have a positive and significant impact on the EU regions' growth rates. Furthermore, Mohl and Hagen find that time lags substantially affect the results, i.e., the growth impact does not occur immediately, but rather with a time lag of up to five years.

Finally, there are two papers that use treatment effect methods in order to deal with the problem of unknown functional form and parameter heterogeneity (Wooldridge, 2002, Ch. 18). Becker, Egger, von Ehrlich and Fenge (2008) use up to 3301 NUTS-3 regions and apply "regression discontinuity design" techniques.[20] They make use of the relatively clear-cut rule that defines an Objective 1 region: NUTS-2 regions with a GDP per capita level below 75 percent of the EU average. This enables the authors to use regression discontinuity design techniques, which basically means estimating the effect by comparing "treated" and "non-treated" regions near the 75 percent threshold. On average, the Objective 1 status raises per-capita income by about 1.8 percent relative to similar "non-treated" regions. Since the authors do not find a positive employment effect, they conclude that the growth effect may work through an investment increasing effect. Furthermore, they provide a simple cost-benefit analysis: one euro spent on Objective 1 transfers leads to 1.21 euros of additional GDP in the eligible regions.

Hagen and Mohl (2008) interpret total SF payments (Objective 1+2+3) as a "continuous treatment" and apply the method of generalised propensity score which leads to the estimation of a dose-response function as proposed by Hirano and Imbens (2004). They use a sample of 122 NUTS-1 and NUTS-2 (EU-15) regions for the time period 1995-2005 and find a positive, but not statistically significant, impact on the regions' average three-year growth rates. This would imply that it does not matter which "dose" of SF payments a region receives.

[20] An introduction to regression discontinuity design can be found in the Journal of Econometrics 142 (2008); see especially Imbens and Lemieux (2008).

Table 3 approximately here

Besides the studies presented above, there are further studies focusing on regions within single countries (see Table 4). Since their focus may be too narrow to draw a conclusion with regard to European integration, we do not discuss them here.

Table 4 approximately here

6 Conclusions and remarks for future research

The Cohesion Policy of the European Union has gained importance over the recent decades, becoming the most important budget item and totaling 36 percent of the total EU budget in the period 2007-2013. With its rising relevance, the attempts to evaluate this policy field have increased. Despite its primary goal to "reduce disparities among the regions", surprisingly, the focus of these studies is not so much on the question if EU Cohesion Policy has decreased divergence, but rather on the question if EU support is growth enhancing. One reason for this might be that the question of convergence refers to a long-run concept, which is difficult to evaluate given the available empirical data.

This chapter shows that the econometric evaluation of EU Cohesion Policy is hampered by several econometric issues, namely reverse causality, measurement error, omitted variables (including spatial spillovers), Nickell bias, strict functional form assumptions and the potential inclusion of inappropriate control variables. Based on these issues we present potential solutions on how to cope with these problems individually. Unfortunately, given the econometric methods and the available data base, there is currently no method to control for all problems mentioned above simultaneously. As a consequence, by comparing the results of several approaches, one has to derive conclusions on the robustness of the results.

As the data availability for EU Cohesion Policy payments has improved significantly over the last years, we would argue that meaningful results should be based on panel data, which reduces some of the main econometric problems. Moreover, it is advisable to use studies taking fixed effects into

account and/or studies that attempt to solve the problem of reverse causality. With this in mind, we count 10 studies (including two papers applying treatment effects models) that consider these aspects.

At the country level, the most that can be concluded from empirical studies is that Cohesion Policy seems to be only conditionally effective. Given a good quality institutional setup (Ederveen, de Groot and Nahuis, 2006), or decentralised governmental structures (Bähr, 2008), Cohesion Policy has a positive impact on growth. However, the methodological problems discussed in section 4 should be kept in mind. For example, many studies do not allow for endogeneity of Cohesion Policy. Hence, one should be careful when interpreting the results.

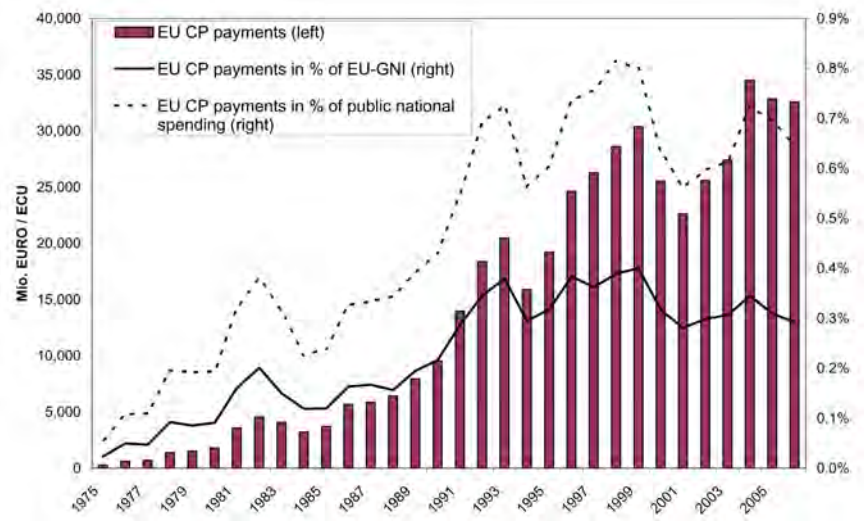
Using regional level data might be a preferable alternative because, first, EU Cohesion Policy focuses on the development and convergence of regions and, second, the robustness of the results is increased by the higher number of cross sections. One drawback is that structural funds data at the regional level is limited to the time period 1995-2006. There are four studies controlling for the endogeneity problem using regional level data, three of which find at least a limited positive impact of structural funds payments. Moreover, using regional data without controlling for spatial spillover effects increases the problem of an omitted variable bias. There are three papers applying spatial techniques that find, again, weak evidence for a positive impact of structural funds. However, the disadvantage of these methods is that it is currently not possible to control for both spatial spillover effects and the endogeneity of several independent variables.

One explanation for the weak results might be the fact that almost all studies are derived from a neoclassical growth model assuming that EU Cohesion Policy increases investments, which ultimately raises the economic growth rate. However, the results by Bouvet (2005) and Hagen and Mohl (2009) suggest that EU Cohesion Policy may only have a modest impact on investments. These results might simply indicate that the EU support crowds out national investments. Moreover, we know very little about the labour market impact of EU Cohesion Policy. Hence, one task for future studies will be to more thoroughly investigate the channels through which EU Cohesion Policy works.

Another reason for the inconclusive empirical results might be that the allocation of funds is at least partly determined by political-economic factors. In this context, Cohesion Policy is not solely based on clear criteria. Hence, there is room for political bargaining and/or side payments which might result in the funding of politically feasible, and less economically efficient, projects.

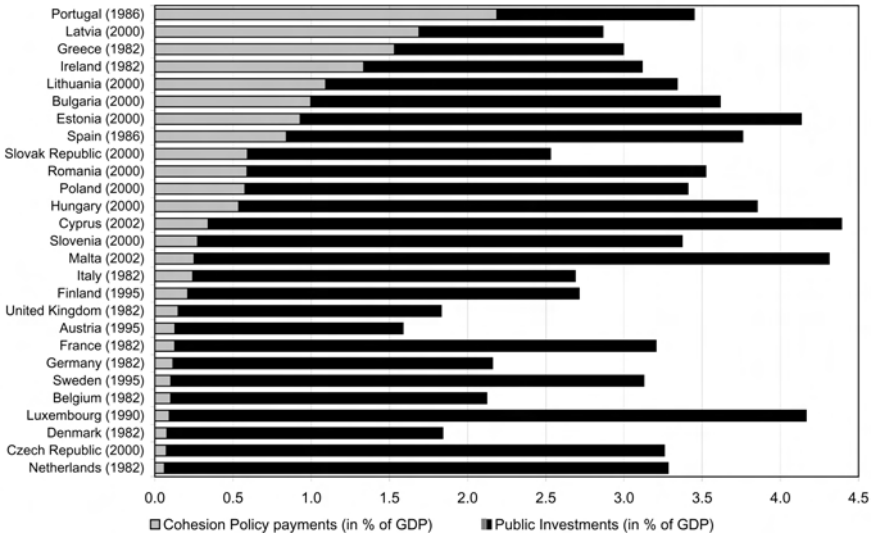
Appendix

Figure 1: Development of total EU Cohesion Policy payments



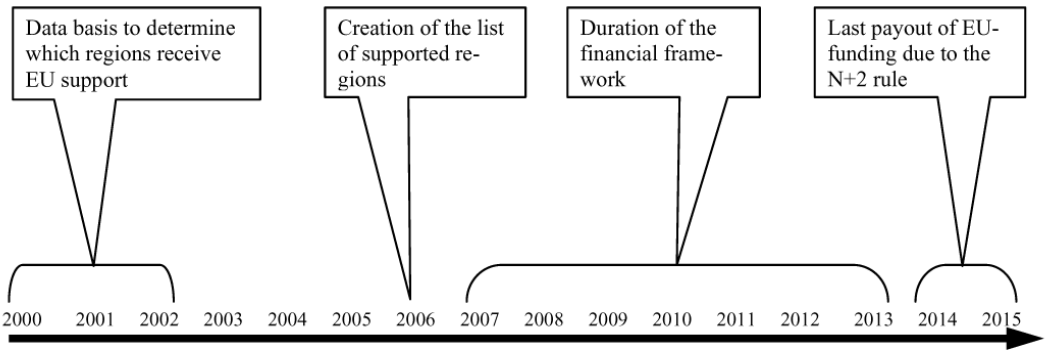
Source: European Commission (2008).

Figure 2: Cohesion Policy payments and public investments, as % of GDP



Note: The time periods of observations differ between countries. As a consequence, in brackets the first year of observation is listed.
Source: European Commission and AMECO.

Figure 3: Sluggish adaptation process to EU funding



Source: Heinemann, Hagen, Mohl, Osterloh and Sellenthin (2009).

Table 1: Structural funds Objectives, 1994–2006

1994-1999		**2000-2006**	
Definition	**share of total SF**	**Definition**	**share of total SF**
Obj. 1: To promote the development and structural adjustment of regions whose development is lagging behind the rest of the EU	67.6%	**Obj. 1**: Supporting development in the less prosperous regions	69.7%
Obj. 6: Assisting the development of sparsely populated regions (Sweden & Finland only)	0.5%		
Obj. 2: To convert regions seriously affected by industrial decline	11.1%	**Obj. 2**: To support the economic and social conversion of areas experiencing structural difficulties	11.5%
Obj. 5b: Facilitating the development and structural adjustment of rural areas	4.9%		
Obj. 3: To combat long-term unemployment and facilitate the integration of young people and of persons excluded from the labour market into working life	9.4%	**Obj. 3**: To support the adaptation and modernisation of education, training and employment policies in regions not eligible under Obj. 1	12.3%
Obj. 4: To facilitate the adaptation of workers to industrial changes and to changes in production systems	1.6%		

Source: European Commission.

Table 2: Econometric studies on the effects of Cohesion Policy using country-level data

Paper by	**Central results: Impact of SF on economic growth**	**Operationalisation of structural funds**	**Time period**	**Units**	**Econometric methods used**
Bähr (2008)	Only in countries with a high degree of decentralisation do SF have a positive impact on growth	ERDF payments (as % of GDP) [exogenous,endogenous]	1975-1995	13 EU Countries	Panel: Pooled OLS, FE, FE-IV
Ederveen, de Groot and Nahuis (2006)	SF promote growth and convergence given the "right" institutional set-up	ERDF payments (as % of GDP) [exogenous]	1975-1995	12/13 EU countries	Panel: Pooled OLS, FE, FD-GMM
Beugelsdijk and Eijffinger (2005)	SF promote growth. More "corrupt" countries do not gain less from CP with respect to growth	SF payments (as % of GDP) [endogenous]	1995-2001	15 EU countries	Panel: FD-GMM
Ederveen, Gorter, de Mooij and Nahuis (2002)	Only in open economies do SF have a positive impact on growth	ERDF payments (as % of GDP) [exogenous]	1960-1995	12 EU countries	Panel: Pooled OLS

Notes: OLS = ordinary least squares, FE = fixed effects model, IV = instrumental variable, FD-GMM = first difference generalised method of moments estimator (Arellano and Bond, 1991), SYS-GMM = system generalised method of moments estimator (Blundell and Bond, 1998).

Table 3: Econometric studies on the effects of Cohesion Policy using European-wide regional level data

Paper by	**Central results: Impact of SF on economic growth**	**Operationalisation of structural funds**	**Time period**	**Units**	**Econometric methods used**
Becker, Egger, von Ehrlich and Fenge (2008)	Positive and significant growth effect of Obj. 1 regions	Dummy variable = 1 for regions receiving Obj. 1 funding, 0 else [exogenous]	1989-1993, 1994-1999, 2000-2006	up to 3301 NUTS-3 regions (EU-12/25)	Panel: Regression discontinuity analysis
Dall'erba and Le Gallo (2008)	SF have no statistically significant impact on regional convergence	SF payments and remaining commitments from 1994-1999 (as % of GDP) [endogenous]	1989-1999	145 NUTS-2 regions (EU-12)	Cross-section: Spatial lag model with IV
Esposti and Bussoletti (2008)	Limited impact of SF on regional growth	Obj. 1 payments per capita (in PPS) [exogenous]	1989-1999	206 NUTS-2 regions (EU-15)	Panel: FD-GMM, SYS-GMM
Falk and Sinabell (2008)	SF have a marginal positive and significant growth impact	Dummy variable = 1 for regions receiving Obj. 1 funding, 0 else [exogenous]	1995-2004	1084 NUTS-3 regions (EU-15)	Panel: Pooled OLS, median regression approach, weighted least squares
Hagen and Mohl (2008)	SF have a positive, but not statistically significant impact on regional growth	Obj. 1+2+3 payments and remaining commitments from 1994-99 (as % of GDP) [exogenous]	1995-2005	122 NUTS-1/2 regions (EU-15)	Panel: Generalised propensity score approach
Mohl and Hagen (2008)	Obj. 1 payments promote growth, whereas Obj. 2 and 3 payments do not have a positive impact	Obj. 1,2,3,1+2+3 payments and remaining commitments from 1994-99 (as % in GDP) [endogenous,exogenous]	1995-2005	122 NUTS-1/2 regions (EU-15)	Panel: FE, SYS-GMM, spatial lag and error model

Table 3: Econometric studies on the effects of Cohesion Policy using European-wide regional level data

Paper by	**Central results: Impact of SF on economic growth**	**Operationalisation of structural funds**	**Time period**	**Units**	**Econometric methods used**
Ramajo, Márquez, Hewings and Salinas (2008)	Faster cond. convergence of relative income levels of regions belonging to Cohesion countries than in non-Cohesion regions	Separate regressions for regions belonging to Cohesion countries vs. non-Cohesion countries	1981-1996	163 NUTS-2 regions (EU-12)	Cross-section: Robust OLS, spatial lag model
Puigcerver-Peñalver (2007)	Positive effect of SF on growth rates of Obj. 1 regions in 1989-1993, but not in 1994-1999	Total SF (as % of GDP p.c.); total SF; SF of region i over total SF received by all regions [exogenous]	1989-1999, 1989-1993	41 NUTS-2 regions (EU-10)	Panel: Pooled OLS, FE
Bouvet (2005)	SF have a modest positive impact on regional growth rates; SF work by increasing the growth of TFP and employment	ERDF payments per capita [endogenous]	1975-1999	111 NUTS-1/2 regions (EU-8)	Panel: Pooled OLS, FE, IV
Dall'erba (2005)	Positive relationship between SF and regional growth	SF payments and remaining commitments from 1994-1999 (as % of GDP) [exogenous]	1989-1999	145 NUTS-2 regions (EU-12)	Cross-section Exploratory spatial data analysis
Cappelen, Castellacci, Fagerberg and Verspagen (2003)	SF have a positive and significant impact on the growth rates; they are more effective since 1988	Obj. 1, 2, 5b (as % of GDP) [exogenous]	1980-1997, 1980-1988, 1989-1997	105 NUTS-1/2 regions (EU-9)	Cross-section: OLS
Rodriguez-Pose and Fratesi (2004)	Limited impact of SF on growth; only SF funding on education and human capital have positive effects	Obj. 1 commitments (as % of GDP) [exogenous]	1989-1999	152 NUTS-2 regions (EU-8)	Cross-section & Panel: OLS, pooled GLS FE

Table 3: Econometric studies on the effects of Cohesion Policy using European-wide regional level data

Paper by	**Central results: Impact of SF on economic growth**	**Operationalisation of structural funds**	**Time period**	**Units**	**Econometric methods used**
de Freitas, Pereira and Torres (2003)	Obj. 1 regions do not show faster convergence than non-Obj. 1 regions	Dummy variable = 1 for regions receiving Obj. 1 funding, 0 else [exogenous]	1990-2001	196 NUTS-2 regions (EU-15)	Cross-section: OLS
Ederveen, Gorter, de Mooij Nahuis (2002)	Results depend on the assumptions underlying the convergence model	SF + Cohesion Fund (as % of GDP) [exogenous]	1981-1996	183 NUTS-2 regions (EU-13)	Panel: Pooled OLS

Notes: OLS = ordinary least squares, FE = fixed effects model, IV = instrumental variable, FD-GMM = first difference generalised method of moments estimator (Arellano and Bond, 1991), SYS-GMM = system generalised method of moments estimator (Blundell and Bond, 1998).

Table 4: Econometric studies on the effects of Cohesion Policy using regional level data within single countries

Paper by	**Central results: Impact of SF on economic growth**	**Operationalisation of structural funds**	**Time period**	**Units**	**Econometric methods used**
Eggert, von Ehrlich, Fenge and König (2008)	SF accelerate a region's convergence, but reduce the average growth rate	SF payments (as % of GDP) [exogenous]	1989-1993, 1994-1999,	16 NUTS-1 regions (Germany)	Cross-section: Pooled OLS, Regress average growth of 1994-99 (2000-04) on average SF of 1989-93 (1993-99)
Soukiazis and Antunes (2006)	SF promote convergence; small positive impact on growth; more effective in coastal than in interior regions	ERDF per capita [exogenous]	1991-1999	30 NUTS-3 regions (Portugal)	Panel: Pooled OLS, FE, Random Effects
Percoco (2005)	SF induce a high level of volatility in the level of growth rates	Obj. 1 payments (as % of GDP) [endogenous]	1994-1999	6 NUTS-2 regions (Italy)	Panel: GMM-IV
Garcia-Milà and McGuire (2001)	Grants are not effective in stimulating private investment or improving the overall economies of the poorer regions	Grants = Eur. + national grants; Dummy var. = 1 for regions receives above-average grants, 0 else [exogenous]	1977-1981, 1989-1992	17 NUTS-2 regions (Spain)	Panel: OLS and difference-in-difference approach

Notes: OLS = ordinary least squares, FE = fixed effects model, IV = instrumental variable, FD-GMM = first difference generalised method of moments estimator (Arellano and Bond, 1991), SYS-GMM = system generalised method of moments estimator (Blundell and Bond, 1998).

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