DOES COHESION FUNDING WORK? EVALUATING THE EMPLOYMENT EFFECTS OF OBJECTIVE 1 FUNDING UNDER THE EUROPEAN UNION’S COHESION POLICY

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By

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This thesis evaluates the effectiveness of Objective 1 funding, the largest funding program of EU cohesion policy, at reducing regional unemployment and long-term unemployment as well as at stimulating regional economic growth. EU cohesion policy is designed to promote regional convergence in a number of economic indicators. This thesis tests the hypothesis that regions receiving Objective 1 funding experienced more favorable changes in their unemployment and long-term unemployment rates as well as faster economic growth than regions without such funding. Using time series data from the Eurostat regional database for the period 2000-2007 and a differenced Ordinary Least Squares model with year dummies, this thesis finds that Objective 1 funding is associated with a reduction, or slower increase, in unemployment in recipient regions. No significant association is found between Objective 1 funding and long-term unemployment. The study also corroborates recent findings that Objective 1 funding has small, significant and positive effects on regional economic growth. The thesis concludes, therefore, that Objective 1 funding meets its stated objectives. It is most effective in recent accession countries. Questions remain, over potentially detrimental policy design features such as the additionality principle or co-financing requirements. Moreover, there is not enough data on essential aspects of cohesion policy, such as how much funding regions received. A central recommendation, therefore, is to improve data collection on cohesion policy in order to permit more conclusive empirical evaluations.
I am deeply grateful to Lenea Reuvers for her love and unwavering support throughout this process and beyond.

This thesis is dedicated to my late grandfather, Ernst Nowotny, who passed on a commitment to learning and good policy.

FELIX FALTIN
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INTRODUCTION

The purpose of this paper is to evaluate the effectiveness of European Union\(^1\) (EU) regional policy in advancing the economic development and employment opportunities in the least prosperous regions of its member states. Economic development and employment growth are important prerequisites for human flourishing, and central objectives of EU policy. While the promise of prosperity is one founding principle of the EU, its equitable distribution among the member states, their populations and regions is another. Disparities in the distribution of prosperity within the EU are large, however, and growing. This has prompted a large-scale policy response by the EU and its member states, aimed at improving cohesion within the EU by helping poorer regions catch up with richer regions. Given the political and economic importance of cohesion policy to the European project as a whole, it is worth evaluating its effectiveness.

Not only the EU is concerned with regional disparities. There is a global interest in helping less developed economies catch up. Unfortunately, it is unclear whether less developed economies are, in fact, catching up. On one hand, most people are economically better off today than they would have been several decades ago. The fraction of the world population with income below one dollar a day has decreased from 20 percent in 1970 to 7 percent in 2000 (Barro and Sala-i-Martin, 2004, 9). This economic progress has been paralleled by dramatic improvements in health and education (UNDP, 2010). On the other hand, prosperity remains unequally distributed, with many disparities widening (Davies, 2008). For example, it is estimated that the world’s richest

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\(^1\) References to the European Union refer both to the European Union, established in 1993 by the Treaty of Maastricht, as well as the European Communities, which the Maastricht Treaty replaced.
two percent, who are mostly concentrated in the industrialized North, own more than 50 percent of total global wealth. Paralleling this geographic concentration of wealth, income inequality is high within most countries and has increased over the past two decades (UNDP, 2010, 72).

The European Union has fared comparatively well in this highly uneven economic geography. Even the least prosperous regions in the EU are dramatically better off than the least prosperous regions globally. In 2006, for example, gross domestic product per capita (GDP) in the poorest EU member state, Poland, was $8,958 (measured in 2010 United States Dollars), compared to a mere $121 in Burundi, the poorest country in the world that year (World Bank, 2010). However, there also exist striking disparities of economic development within the EU. For example, Poland’s per capita GDP in 2006 was only $8,958 compared to $90,643 in Luxembourg (World Bank, 2010). The disparities are even greater when regions within member states are compared across countries. For example, in 2006, the Austrian region of Tirol had an unemployment rate of 2.0 percent compared to 26.3 percent in Lubuskie, Poland (Eurostat, 2010).

Thus, although the EU is situated at the upper end of the global distribution of economic prosperity it contains considerable economic inequality, especially at the regional level. Efforts to reduce this regional inequality, for moral, political and economic reasons, have been a cornerstone of the EU’s efforts to forge a common market in Europe. These efforts merit critical attention because they are central to the European ambition of attaining prosperity for all and because cohesion policy consumes approximately one third of the
total EU budget. From 2000 to 2006 alone, 201.4 billion Euros were spent on cohesion policy in order to reduce regional disparities in a number of measures (European Commission, 2008a). Of these funds, 126.6 billion were allocated to the least economically developed regions in the form of Objective 1 funding with the explicit aim of stimulating economic growth.

This thesis evaluates the effectiveness of Objective 1 funding in terms of growth and employment effects for the period 2000 to 2007. It proceeds as follows. First, it provides some background on the aims and structure of EU regional policy and the Objective 1 funding instrument. Second, the literatures on economic convergence and regional unemployment as well as the empirical evaluation literature on EU cohesion policy are reviewed. Third, three testable hypotheses are elaborated based on the theories and findings discussed in the literature review. Some preliminary analysis is undertaken using data extracted from Eurostat’s regional database. Fourth, the econometric model used in this study is introduced and defended in order to, fifth, undertake regression analysis of the effectiveness of Objective 1 funding in reducing unemployment and long-term unemployment, as well as in increasing economic growth. The thesis ends with some general conclusions and specific policy recommendations.
EUROPEAN UNION COHESION POLICY

History and Structure of EU Cohesion Policy

Since the 1970’s, EU regional policy has explicitly aimed to reduce economic and social disparities between and within EU member states. The resources and political attention dedicated to this goal have steadily increased over time, in an effort to “contribute to the harmonious, balanced and sustainable development of economic activities” of EU member state regions (European Commission [EC], 1999). The growing importance of regional policy stemmed from the recognition that regional disparities within the EU had become excessively large and that regions required assistance in adjusting to the adverse consequences of integrationist policies (Meeusen and Villaverde, 2002, 1).

The current structure of EU regional policy was established in 1988 when the extant regional policies and funds were unified under the umbrella of a new cohesion policy. The impetus for a comprehensive cohesion policy was the EU accession, in 1986, of the relatively poor regions of Greece, Spain and Portugal as well as the adoption of the single market program with the Single European Act. These developments necessitated a general strategy for reducing regional disparities and offsetting the burdens of economic integration on the most disadvantaged regions (EC, 2008).

The aims of EU cohesion policy have traditionally been formulated in terms of economic growth. However, there has always been a strong implicit focus on narrowing disparities in employment opportunities between regions. In the 1990’s there were concerted efforts
by Social Democrats, some national governments and parts of the EU bureaucracy to make employment a greater priority in the cohesion policy framework, and even to cast cohesion policy as primarily an employment policy (Hooghe, 1998, 473). These efforts were unsuccessful, but the main pillars of cohesion policy, introduced below, show that reducing unemployment still remains the most important second-order objective.

Structure of EU Cohesion Policy

EU cohesion policy consists of several funding mechanisms, a series of explicit objectives, eligibility criteria for different funding mechanisms as well as principles that govern the co-financing and management of funds. Cohesion policy programs are financed through the EU Structural Funds and the Cohesion Fund. The Structural Funds consist of the European Regional Development Fund (ERDF), the European Social Fund (ESF) and several smaller funds. The Cohesion Fund reserves additional means for the poorest regions. Additionally, cohesion policy programs receive funding from the European Investment Bank (EIB) and other financial instruments. Overall, as shown in Table 1 below, cohesion funding accounts for almost one third of overall EU expenditure.

Cohesion funding is allocated in six-year periods. To date, three funding periods have been completed: 1988-1993, 1994-1999 and 2000-2006. The 2007-2013 period is in progress. Eligible regions in countries that acceded to the EU during any of these funding periods, like Austria, Finland or Sweden in 1995 or the 10 countries that joined the EU in

2 Sometimes referred to jointly as the ‘Structural and Cohesion Funds’, ‘Structural Funds’ or ‘Cohesion Funds’.
2004, have typically received funding from the moment of accession. In the 2000 to 2006 funding period, which will be evaluated in this paper, funding was allocated according to three “objectives” with different and mutually exclusive eligibility criteria.

<table>
<thead>
<tr>
<th>Type of Spending</th>
<th>Amount</th>
<th>Percent of Total EU Budget</th>
</tr>
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<tbody>
<tr>
<td>Cohesion Policy</td>
<td>201.4</td>
<td>31.0</td>
</tr>
<tr>
<td>Objective 1</td>
<td>126.6</td>
<td>19.5</td>
</tr>
<tr>
<td>Objective 2</td>
<td>23.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Objective 3</td>
<td>20.0</td>
<td>3.1</td>
</tr>
<tr>
<td>Cohesion Fund</td>
<td>16.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Other Cohesion Spending</td>
<td>14.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Agricultural Policy</td>
<td>311.8</td>
<td>47.9</td>
</tr>
<tr>
<td>Other Spending</td>
<td>137.5</td>
<td>21.1</td>
</tr>
<tr>
<td><strong>Total EU Budget</strong></td>
<td><strong>650.7</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Source: European Commission 2009*

Objective 1 funding is intended to “promote the development and structural adjustment of regions whose development is lagging behind” and is targeted at the poorest regions in the EU (EC, 2008). Objective 1 funding is allocated at the NUTS 2 level, as defined by Eurostat’s Nomenclature of Territorial Units for Statistics (NUTS). Eligibility is restricted to NUTS 2 regions with per capita GDP lower than 75 percent of the EU average in the three years preceding the funding period (for example, 1996 to 1999 for the 2000-2006 funding period). Additionally, several regions have been granted Objective 1 funding in the 2000-2006 period on other grounds, such as the remote overseas regions belonging to France, Spain and Portugal, regions with very low

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3 Eurostat distinguishes between three levels of sub-national regions. NUTS 1 regions are large administrative units with a population of three to seven million. NUTS 2 regions include unitary administrative units or groups of counties with a population of 0.8 to three million. NUTS3 regions are districts with 150,000 to 800,000 inhabitants.

4 The EU does not specify whether the 75 percent threshold is measured in terms of real GDP or in purchasing power parity (see Council Regulation 2052/88).
population density in Scandinavia, or Northern Ireland, which received funds for reconciliation efforts (EC, 2005a). Table 1 shows that Objective 1 spending during that period amounted to 126.6 billion Euros, almost two-thirds of total cohesion policy funds and 19.5 percent of the total EU budget. These funds were allocated among infrastructure investments (28 percent), human capital investments including employment, education and training measures (30 percent), and aid for the production sector, including assistance in internationalization or in encouraging investment into small businesses (42 percent) (EC, 2008). Moreover, as shown in Figure 1 below, the proportion of regions receiving Objective 1 funding has increased over time, reaching 99 of 257 NUTS 2 regions, or 38.5 percent of all regions, in the 2000-2006 period.

Objective 2 funding supports the “economic and social conversion of areas facing structural difficulties” (EC, 2005b). The principal goal of Objective 2 funding is to tackle long-term unemployment in NUTS 2 or NUTS 3 regions with severe declines in
industrial employment and in depressed urban areas. As shown in Table 1, 23.5 billion Euros, or 3.6 percent of total EU expenditure, were spent on Objective 2 in 2000-2006.

Objective 3 funding supports “activities relating to the development of human resources. Its goal is to modernize education and training policy and systems and promote employment” (EC, 2005c). Eligibility for Objective 3 funds is restricted to NUTS 2 regions not already covered under Objective 1 that have high rates of long-term or youth unemployment. Between 2000 and 2006, 20 billion Euros, or 3.1 percent of overall EU expenditure was spent on programs under Objective 3.

In addition to the eligibility criteria described above there are limits to the proportion of a country’s population that can be covered by cohesion funding as well as the proportion of a region’s GDP that such funding can amount to. Regions that cease to be eligible for funding under the three main objectives, either because their economic situation has improved or if eligibility regulations have changed, qualify for “phase-out assistance” that provides reduced funding for an additional funding period.

A further element of cohesion policy funding is the additionality principle, which requires regions to match EU funding and limits the proportion of total program costs that can be covered by EU funds (EC, 2005d). Co-financing requirements vary by objective and with the economic situation of a particular region, allowing between 50 and 80 percent of total costs to be covered by EU funding.

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5 For example, funding for the EU 15 was reduced to accommodate ten new member states in 2004.
Three fields of research are relevant to an evaluation of the effectiveness of Objective 1 funding at reducing unemployment and increasing economic growth. First, general and regional labor market economics provides insights on the factors that affect regional unemployment rates and what role policy might play in improving them. Second, the literature on economic growth, particularly studies of regional convergence and divergence, offers a theoretical basis for evaluating the economic growth effects of cohesion policy. Third, the effectiveness of cohesion policy is explicitly scrutinized in a large number of empirical studies that focus primarily on economic growth. The theories discussed below are used to generate predictions about the different variables affecting regional unemployment and economic growth. These variables need to be accounted for in order to distinguish any employment and growth effects of Objective 1 funding from the effects other factors might have. The theories are also used to develop testable hypotheses for the subsequent econometric analysis. The summary of the empirical evaluation literature identifies gaps in the literature that will be addressed in this study.

Cohesion Policy and Employment

It was argued above that improving employment outcomes is the most important second-order aim of EU cohesion policy. In order to understand how cohesion policy might affect employment, this sub-section summarizes the theoretical accounts and literature on labor markets and regional unemployment.
The level of employment and unemployment in an economy depends on the interaction of labor supply with labor demand (Freeman, 1979; Ehrenberg and Smith, 2000; Cahuc and Zylberberg, 2004). Labor supply is determined by individuals’ decisions to give up leisure for work. The amount of labor that can be supplied to an economy for a given market wage depends on the size and composition of the population, the proportion of the population that is willing and able to work, the time worked by those willing to work, the intensity of the work effort, and the education and efficiency of workers. Firms’ demand for labor, in turn, depends on the demand for the goods and services they provide and on market wages. How strongly labor demand is affected by changes in the market wage depends primarily on the ability of firms to substitute capital for labor, the elasticity of demand for firms’ products and the proportion of total costs attributable to labor.

Theoretically, labor demand and labor supply interact until all those willing to work for the market wage are employed and those who are unwilling to work for that wage exit the labor force. In reality, there is likely to persist a certain level of unemployment at any given point in time. On one hand, there are costs to hiring or firing workers and imperfect information about the available vacancies or unemployed workers. This coexistence of job vacancies and unemployed workers constitutes frictional unemployment. On the other hand, several factors cause a baseline level of structural unemployment. For instance, wages are not completely flexible in the presence of minimum wage or employment protection laws, or if firms choose to pay above-market wages. There may also be imbalances between the demand and supplies of workers across regions, especially if labor mobility is costly.
A plethora of studies on regional labor markets have shown that the determinants of regional unemployment closely track the central elements of this simple wage determination theory (Elhorst, 2003). Understanding these determinants and their relationship with unemployment helps discern their impact on regional unemployment from the potential effect of Objective 1 funding. They are discussed below.

The relationship between the labor force participation rate, the proportion of the total population in employment or unemployment, and unemployment, the share of the labor force without employment, is contested. By definition, the participation rate may increase if unemployment increases. However, if increases in unemployment result primarily from reductions in employment (as opposed to the movement of persons from outside the labor force into unemployment), high unemployment may be consistent with an unchanging or low overall participation rate. In this case, which predominates empirically, low participation and high unemployment may be indicative of low investments in human capital and a poor work ethic (Fleisher and Rhodes, 1979; Elhorst, 2003). Conversely, higher labor force participation in a region may encourage the growth of local jobs as labor supply is high and wages adjust downward (Layard, 1997).

Population size also affects employment by determining the size of the labor force (Freeman, 1979; Elhorst, 2003, 726). It can be divided by the area of a region to yield a measure of population density. Population density is a useful proxy for agglomeration potential, the capacity of a region to concentrate industrial activity. New economic geography theories of economic growth, discussed in the next sub-section, argue that in
many circumstances low population density leads to less economic activity as industry and jobs move to areas where demand for goods and services and the supply of labor are higher (Krugman, 1991). This relationship is empirically robust (Elhorst, 2003, 733).

Another empirically observable relationship is that higher wages increase labor supply, as more people are willing to work, and decrease labor demand, as fewer firms are willing to pay higher wages, ultimately increasing unemployment (Freeman, 1979). Household income can be used as a proxy for wages, since economic decisions about whether to work or not are often made at the household level. The direction of causality between household income and unemployment is conceptually ambiguous, however, since low household income may be caused by unemployment, or households may be chose to work less if they have enough income. Moreover, household income includes non-wage income. Empirically, the former relationship predominates (Elhorst, 2003).

A further important factor determining regional labor demand is per capita gross regional product or per capita gross domestic product, if it is appropriately disaggregated at the regional level (Isserman et al., 1986, 562). The positive effect of output is captured in ‘Okun’s Law’, which stipulates that for a one percent increase in the unemployment rate, output growth will decrease by two percent, and vice versa (Ehrenberg, 2000, 593).

Previous period unemployment is frequently included in empirical studies of regional unemployment (Chalmers and Greenwood, 1985; Holzer, 1991; Blanchard and Katz, 1992). Since unemployment in a region during one period is likely to depend on
unemployment in that region in the previous period, there is likely to exist serial autocorrelation; the correlation of a variable with itself over time. A lagged unemployment variable can alleviate this concern (Elhorst, 2003, 739). While this approach does not actually explain the causes of unemployment, it still accounts for regional differences in employment levels while isolating the effect of other variables.

Finally, human capital is strongly and negatively related with unemployment (Freeman, 1979). High-skilled workers are in higher demand, more effective at finding jobs and seldom laid off (Elhorst, 2003, 738). They also ‘drain’ from underperforming regions into more developed ones, deepening disparities between the two and concentrating low-skilled workers in areas with high unemployment (Taylor, 1996).

The factors listed above demonstrably affect regional unemployment. They should be taken into account when evaluating the effectiveness of Objective 1 funding, to discern whether changes in unemployment are due to cohesion funding or merely the result of normal labor market dynamics. Moreover, these factors allow us to suggest hypotheses about the likely impact of Objective 1 funds on unemployment. First, if Objective 1 funding successfully promotes economic growth, Okun’s Law posits that it should also decrease unemployment (Walterskirchen, 1999; Ehrenberg, 2000). Second, cohesion funding may affect regional unemployment directly through measures that increase human capital or by improving the match between labor demand and supply in regions through investments in transport infrastructure.
Cohesion Policy and Theories of Economic Growth

The theoretical literature on economic growth helps identify the determinants of economic growth, which need to be distinguished from any possible impacts of Objective 1 funding. Moreover, they provide counterfactuals of what might happen to regional economies without policy intervention.

Neoclassical growth theories argue that poorer regions will converge with richer regions if both have similar preferences, technology and structural properties, such as the human capital stock or population growth (Solow, 1956; Barro, 1991; Barro and Sala-i-Martin, 1991; Barro and Sala-i-Martin, 2004). Convergence is driven by diminishing returns to capital, which leads capital to migrate from rich regions, where returns are low, to poor regions, where returns are higher. Since neoclassical scholars have shown poor and rich economies to converge at a rate of about two percent per year, they see no need for cohesion funding (Sala-i-Martin, 1996, 1342; Gripaios et al, 2008; Mohl and Hagen, 2010). Fresh capital would only raise the growth rates of capital-deprived regions in the short run. In the long run, it also exhibits diminishing returns, so growth rates will return to the level implied by a region’s structural characteristics. EU integration may facilitate convergence through a more efficient allocation of capital and labor, and by improving access to technology, but cohesion funding is unlikely to lead to greater convergence.

Endogenous growth theories, by contrast, contend that economic growth depends on the rate of technological change in an economy, which can be raised by increasing human
capital through research and development as well as education (Hirschman, 1958; Romer, 1990; Temple, 1999). Convergence occurs if poor economies are able to increase their human capital stock. However, if the return on investment in technology increases with a growing human capital stock, rich economies might also enter a virtuous cycle in which existing wealth in these assets begets faster growth (Ederveen et al, 2002). The long-run empirical trend, therefore, is one of regional economic divergence (Quash, 1993; Quah, 1997; Temple, 1999; Cheshire and Magrini, 2000; Ezcurra et al, 2005).

Endogenous growth theory holds mixed implications for cohesion policy. Greater market integration is desirable because it improves access to human capital (Romer, 1990). Public infrastructure investments, like those funded under Objective 1, may yield higher growth in poor regions if they facilitate technological exchange (Romer, 1990; Temple, 1999). Moreover, policy interventions targeting the accumulation of human capital, such as Objective 1 and Objective 3 funding, can help less developed regions with sufficient initial human capital converge upward (Gripaios et al, 2008). However, regions with little initial human capital may not profit from such investments and still fall behind.

The related ‘new economic geography’ theories emphasize the tendency of manufacturing to concentrate in ‘core’ regions while other regions become part of an agricultural ‘periphery’ (Krugman, 1991; Cheshire and Magrini, 2000). Industry concentrates geographically, by this account, if transport costs are low and the benefits from agglomeration are high, for example by improving access to demand and skilled labor. Such agglomeration need not materialize, however, especially if high transport
costs deter the movement of goods and labor to the core and all regions are economically self-sufficient. However, once a ‘tipping point’ level of concentration is achieved labor and demand will follow, commuting or moving from the periphery to the core and causing regions to diverge (Krugman, 1991). These theories support several assessments of cohesion funding. On one hand, policy that allows regions to diversify economically while focusing on regional comparative advantages – the kind of policies supported with Objective 2 funding – may prevent the development of core-periphery divergence. On the other hand, investments into transportation infrastructure under Objective 1 may raise agglomeration benefits and contribute to a further spatial polarization, ultimately relegating poor regions to the periphery of a rich core (Mohl and Hagen, 2010, 354).

In sum, neoclassical approaches are the most pervasive in the empirical evaluation literature, partly because they have produced provide reliable theoretical templates for econometric analyses (Mohl and Hagen, 2010, 354). There are also good reasons to integrate central insights of rival theories. First, a region’s human capital stock has a strong impact on economic growth (Temple, 1999). Second, structural funding is frequently used for investments in transport infrastructure, so spatial spillover effects merit explicit attention (Dall’erba and Le Gallo, 2008; Mohl and Hagen, 2010).

*Empirical Evaluations of EU Cohesion Policy*

Having established a theoretical basis for the potential impact of cohesion policy on economic growth and employment, the remainder of this section summarizes the
empirical evaluation literature on EU Cohesion Policy, which focuses mainly on economic growth.

On the overarching question of whether EU regions are converging or diverging economically, the literature is inconclusive. Barro (1990) and Sala-i-Martin (1996) have influentially argued for convergence, but Quah (1993; 1997) identifies a pattern of countries catching up with one another within particular subgroups of the larger income distribution in so-called ‘convergence clubs’. These clubs trend along diverging paths. The middle ground is defended by Ezcurra et al (2005), who identify convergence towards two poles of rich and poor European regions, respectively. Dall’erba (2005) finds distinct core-periphery patterns, with poor regions clustering around rich regions.

The literature on the effectiveness of EU cohesion policy presents a similarly heterogeneous picture. Covering the period between 1990 and 2005 and looking at samples ranging from 17 Spanish NUTS 1 regions to 196 European NUTS 2 regions, several studies found no impact for EU funding or national co-financing, though the quality of national institutions matters (Garcia-Milà and McGuire, 2001; De Freitas et al, 2003; Hagen and Mohl, 2008). The quality of institutions will be operationalized below using the length of EU membership. Dall’erba and Le Gallo (2008) also argue that structural funding has no effect after controlling for the spatial spillover of funding.

By contrast, several recent studies have found small but significant positive effects of structural funding on regional economic development in the EU (Beugelsdijk and
Eijffinger, 2005; Dall’erba, 2005; Bouvet, 2006; Soukiazis and Antunes, 2006; Espositi and Bussoletti, 2008; Falk and Sinabell, 2008; Becker et al, 2010; Mohl and Hagen, 2010). These studies cover a range of regions, from the national to the NUTS 3 level and with sample sizes from 145 to over 2000 observations, and look at different funding instruments. For example, recent panel studies by Espositi and Bussoletti (2008) and Mohl and Hagen (2010) found a one percent rise in Objective 1 funding to be associated with up to a quarter percentage point increase in regional growth rates at the NUTS 2 level.

Many studies reached ambiguous conclusions, arguing that the effectiveness of EU cohesion spending varies with funding period (Puigcerver-Penalver, 2007) or the specific funding program under investigation (Rodriguez-Pose and Fratesi, 2004). Some authors found simultaneous positive and negative effects associated with structural funding, such as an acceleration of regional convergence that came with lowering of average growth rates associated with structural funding (Eggert et al, 2007).

The discrepancies in the empirical literature can be traced back to a number of sources. First, the competing theories that underlie any empirical evaluation give rise to different counterfactuals, assumptions and conceptual models. Second, the choice of statistical instruments matters. Many early studies used standard cross-section OLS regressions (for example Garcia-Milà and McGuire 2001 and Ederveen et al, 2002). The more recent literature has adopted Temple’s (1999) view that panel data are most likely to provide the analytic richness required to make statements about growth trajectories.
A third factor explaining the variation in empirical findings is the poor quality of European regional data (Gripaios, 2008). One obstacle is the lack of detailed data on actual expenditure levels. Only Mohl and Hagen (2010) have obtained actual expenditure data, albeit only for 122 NUTS 2 regions in the period 2000 to 2006. Most studies operationalize cohesion funding with dummy variables indicating receipt or non-receipt (Becker et al, 2010). Others use data on appropriated funds rather than actual expenditure levels (Rodriguez-Pose and Fratesi, 2004). However, only a fraction of appropriations are actually spent (EC, 2009). For example, the additionality principle has the inegalitarian effect of excluding poorer regions that are unable to co-finance programs (Bouvet and Dall’erba, 2010). Meanwhile, richer regions can match EU funds at higher rates, resulting in large differences in the level of funding regions receive. Regions also differ significantly in their capacity to absorb and administer cohesion funding.

A second data problem is the lack of complete data at the appropriate level of regional disaggregation. In order to obtain complete data, some studies restrict themselves to specific countries (for example Eggert et al, 2007 or Soukiazis and Antunes, 2006) or to regions for which structural spending data are available (for example Hagen and Mohl, 2008; Mohl and Hagen, 2010). This creates small and non-random samples. Panel data at the NUTS 3 level, as used by Becker et al (2010) or Falk and Sinabell (2008), only became available recently and are not publicly available, making replication impossible. These data have also been criticized for representing “little more than approximations,” given the inconsistencies in the data collection process (Gripaios et al, 2008, 504).
Despite a growing empirical literature on EU cohesion policy, several important questions remain. First, there have only been two evaluations of the 2000-2006 funding period (Becker et al, 2010; Mohl and Hagen, 2010). Second, although the European Commission boasts that “over the whole [2000-2006] period and for all the regions covered by the study, almost 700 000 jobs are benefiting from Community support” (EC, 2005d), there is no econometric analysis to support this claim. Only one study (Becker et al, 2010) has evaluated the effect of Objective 1 funding on unemployment rates and found no effect. The data for this study, however, are not publicly accessible and the results not replicable. This is unfortunate, given serious irregularities of the data, such as a discrepancy between the number of NUTS 2 regions that received funding listed by Becker et al and the European Commission (2001). Moreover, Becker et al used the same model to evaluate economic growth outcomes, their primary focus, and unemployment, raising the concern that their model for unemployment is misspecified. Finally, the study uses NUTS 3 data, which has been challenged for its poor quality as well as its policy relevance; since Objective 1 funds are allocated at the NUTS 2 level, the NUTS 2 level is the appropriate level of evaluation. Furthermore, as Mohl and Hagen (2010) note, the employment impact of cohesion policy has not been studied using panel methods nor in relation to different cohesion policy objectives.

This study will address some of these gaps in the literature by focusing explicitly on the impact of Objective 1 funding on unemployment in the 2000-2006 period as well as the year 2007 using time series data. It will also add to the literature by attempting to replicate previous findings in this area with publicly available data.
HYPOTHESES AND DATA DESCRIPTION

Hypotheses

Based on the literature summarized above, this study will test the broad hypothesis that economic growth rates and employment outcomes have improved in regions that received EU structural funding. ‘Improvement’ is understood broadly here and can mean that unemployment rates either dropped or simply increase more slowly in recipient regions. Specifically, the following hypotheses will be tested:

H1: Unemployment rates will change more favorably in regions receiving Objective 1 funding than in regions without funding.

H2: Long-term unemployment rates will change more favorably in regions receiving Objective 1 funding than in regions without funding.

H3: The growth rate of Gross Value Added (GVA) will be higher in regions receiving Objective 1 funding than in regions without funding.

There is reason to believe, theoretically as well as practically, that cohesion policy funding will be associated with an increase in the economic growth rate. With respect to unemployment, the question is whether the explicit aim of EU cohesion policy to spur regional economic development translates into more employment opportunities.
Description of Data

The data for this study are from the regional database of Eurostat, which collects regional data from regional administrations. The database contains all dependent and independent variables for the period 2000-2006 and the year 2007, which is included to make full use of the available data. For this period, data are available for most of the 257 NUTS 2 regions that were part of the EU in 2000 or joined the EU in the 2004 enlargement. Funding data was compiled from the relevant EU regulations and official journals.

This dataset has several limitations. First, it only provides information on funding status under Objective 1, not funding levels, so the receipt of structural funds is operationalized as an indicator variable. Second, there is a range of missing observations for different variables, years and regions. Most of the missing observations are incidental. In some instances, missing data are of greater concern. For example, regional data for the French overseas departments are missing, several Danish regions have not reported employment or GVA growth rates for the period under investigation, and various regions are consistently missing observations for certain variables. Third, regional administrations differ in their capacity to collect accurate data, which may cause measurement error in some variables and biased regression estimates. Finally, a number of variables that would ideally be included in this evaluation, such as measures of regional administrative qualities, geographic location or the receipt of other EU funding are not available.
Preliminary Analysis

Some general unemployment trends for the EU-25 the period 2000-2007 are shown in Figure 2 below. After a steep decline between 1999 and 2000, unemployment in the EU 25 rose gradually over the period from 2000 to 2008, with a peak of around nine percent in 2004, a gradual decline thereafter and a sharp rise caused by the economic crisis of 2007. Figure 2 also shows unemployment rates in Objective 1 recipient and non-recipient regions, respectively, and suggests that these two groups did not converge with respect to unemployment. Recipient regions’ unemployment rates display greater volatility than that of non-recipients, first decreasing rapidly in 2000 and 2001, and then peaking in 2004, probably due to the accession of ten new states to the EU, most of whom contained Objective 1 funding regions.

![Figure 2: Unemployment Rates for the EU 25, Objective 1 Funding Recipients and Non-Recipients, 1999-2008](image)

Source: Eurostat 2010
The disparity between the new accession countries and the EU-15, but also among members of the EU-15, can be seen in Table 2, which shows GDP per capita at the outset of the 2000-2006 funding period for the EU 25 as well as for their richest and poorest regions. There were dramatic differences between states. For example, Latvian GDP per capita amounted to only 35 percent of the EU-25 average of 20,000 Euros, whereas that of Luxembourg was 2.32 times the EU average. These differences also exist within countries. For example, per capita GDP for the richest region in the Czech Republic was 130 percent of the EU average whereas that of the poorest region was only half of the EU average.

Table 2: Regional disparities in the EU-25 in 2000 (ranked by GDP per capita to nearest 100, purchasing power standards, 2010 prices)

<table>
<thead>
<tr>
<th>Country</th>
<th>Country Average (Euro PPS)</th>
<th>Highest Region (Euro PPS)</th>
<th>Lowest Region (Euro PPS)</th>
<th>Country Avg. relative to EU25</th>
<th>Highest Region relative to EU25</th>
<th>Lowest Region relative to EU25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latvia*</td>
<td>7,000</td>
<td>-</td>
<td>-</td>
<td>0.35</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lithuania*</td>
<td>7,500</td>
<td>-</td>
<td>-</td>
<td>0.38</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Estonia*</td>
<td>8,600</td>
<td>-</td>
<td>-</td>
<td>0.43</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Poland</td>
<td>9,200</td>
<td>13,900</td>
<td>6,400</td>
<td>0.46</td>
<td>0.70</td>
<td>0.32</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>9,500</td>
<td>20,700</td>
<td>7,200</td>
<td>0.48</td>
<td>1.04</td>
<td>0.36</td>
</tr>
<tr>
<td>Hungary</td>
<td>10,500</td>
<td>16,100</td>
<td>6,800</td>
<td>0.53</td>
<td>0.81</td>
<td>0.34</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>13,000</td>
<td>26,000</td>
<td>10,200</td>
<td>0.65</td>
<td>1.30</td>
<td>0.51</td>
</tr>
<tr>
<td>Portugal</td>
<td>14,900</td>
<td>21,100</td>
<td>12,000</td>
<td>0.75</td>
<td>1.06</td>
<td>0.60</td>
</tr>
<tr>
<td>Slovenia</td>
<td>15,200</td>
<td>18,000</td>
<td>12,800</td>
<td>0.76</td>
<td>0.90</td>
<td>0.64</td>
</tr>
<tr>
<td>Malta*</td>
<td>15,900</td>
<td>-</td>
<td>-</td>
<td>0.80</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Greece</td>
<td>16,000</td>
<td>20,200</td>
<td>11,100</td>
<td>0.80</td>
<td>1.01</td>
<td>0.56</td>
</tr>
<tr>
<td>Cyprus*</td>
<td>16,900</td>
<td>-</td>
<td>-</td>
<td>0.85</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spain</td>
<td>18,500</td>
<td>25,200</td>
<td>11,800</td>
<td>0.93</td>
<td>1.26</td>
<td>0.59</td>
</tr>
<tr>
<td>France</td>
<td>22,000</td>
<td>34,400</td>
<td>10,100</td>
<td>1.10</td>
<td>1.72</td>
<td>0.51</td>
</tr>
<tr>
<td>Finland</td>
<td>22,300</td>
<td>28,800</td>
<td>16,000</td>
<td>1.12</td>
<td>1.40</td>
<td>0.80</td>
</tr>
<tr>
<td>Italy</td>
<td>22,300</td>
<td>29,600</td>
<td>13,700</td>
<td>1.12</td>
<td>1.48</td>
<td>0.69</td>
</tr>
<tr>
<td>Germany</td>
<td>22,600</td>
<td>38,200</td>
<td>14,500</td>
<td>1.13</td>
<td>1.91</td>
<td>0.73</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>22,700</td>
<td>61,000</td>
<td>13,200</td>
<td>1.14</td>
<td>3.05</td>
<td>0.66</td>
</tr>
<tr>
<td>Belgium</td>
<td>24,000</td>
<td>48,800</td>
<td>15,900</td>
<td>1.20</td>
<td>2.44</td>
<td>0.80</td>
</tr>
<tr>
<td>Sweden</td>
<td>24,100</td>
<td>33,500</td>
<td>20,700</td>
<td>1.21</td>
<td>1.68</td>
<td>1.04</td>
</tr>
<tr>
<td>Ireland</td>
<td>24,900</td>
<td>27,800</td>
<td>17,000</td>
<td>1.25</td>
<td>1.39</td>
<td>0.85</td>
</tr>
<tr>
<td>Austria</td>
<td>25,000</td>
<td>35,300</td>
<td>16,100</td>
<td>1.25</td>
<td>1.77</td>
<td>0.81</td>
</tr>
<tr>
<td>Denmark</td>
<td>25,100</td>
<td>31,300</td>
<td>18,600</td>
<td>1.26</td>
<td>1.57</td>
<td>0.93</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25,600</td>
<td>32,100</td>
<td>18,500</td>
<td>1.28</td>
<td>1.61</td>
<td>0.93</td>
</tr>
<tr>
<td>Luxembourg*</td>
<td>46,400</td>
<td>-</td>
<td>-</td>
<td>2.32</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta only consist of one NUTS 2 region. Source: EUROSTAT 2010
Table 3 corroborates the picture presented in Table 2, of large disparities among countries as well as within them, with respect to unemployment. In 2000, the Netherlands had an average unemployment rate of only 2.8 percent whereas Spain’s was 11.3 percent. The disparities between regions were even greater. For example, whereas the region with the lowest unemployment in the Czech Republic only had an unemployment rate of 1.9 percent, the highest such rates in France and Belgium were 24.4 percent and 15.9 percent, respectively. Overall, more countries had unemployment rates below the EU-25 average (7.1 percent) than above that level.

Table 3: Regional unemployment disparities in the EU-25 in 2000 (ranked by unemployment rates in percent)

<table>
<thead>
<tr>
<th>Country</th>
<th>Country Average (%)</th>
<th>Regional maximum</th>
<th>Regional minimum</th>
<th>Maximum Difference between regions (% pts.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>2.8</td>
<td>4.0</td>
<td>2.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>3.3</td>
<td>3.6</td>
<td>3.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Cyprus*</td>
<td>3.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Austria</td>
<td>3.8</td>
<td>6.7</td>
<td>2.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>4.4</td>
<td>7.8</td>
<td>1.9</td>
<td>5.9</td>
</tr>
<tr>
<td>Slovenia</td>
<td>4.4</td>
<td>5.2</td>
<td>3.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Luxembourg*</td>
<td>5.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Estonia*</td>
<td>5.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>5.6</td>
<td>9.4</td>
<td>2.8</td>
<td>6.6</td>
</tr>
<tr>
<td>Lithuania*</td>
<td>5.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ireland</td>
<td>6.0</td>
<td>7.0</td>
<td>5.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Malta*</td>
<td>6.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sweden</td>
<td>6.2</td>
<td>7.4</td>
<td>5.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Finland</td>
<td>6.4</td>
<td>9.0</td>
<td>2.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Italy</td>
<td>6.7</td>
<td>13.8</td>
<td>2.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>7.0</td>
<td>15.9</td>
<td>2.7</td>
<td>13.2</td>
</tr>
<tr>
<td>EU25</td>
<td>7.1</td>
<td>7.1</td>
<td>7.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Poland</td>
<td>7.1</td>
<td>9.5</td>
<td>5.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Germany</td>
<td>7.5</td>
<td>15.1</td>
<td>3.3</td>
<td>11.8</td>
</tr>
<tr>
<td>Latvia*</td>
<td>7.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Portugal</td>
<td>7.6</td>
<td>9.0</td>
<td>5.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Greece</td>
<td>7.7</td>
<td>12.5</td>
<td>4.5</td>
<td>8.0</td>
</tr>
<tr>
<td>France</td>
<td>7.8</td>
<td>24.4</td>
<td>5.6</td>
<td>18.8</td>
</tr>
<tr>
<td>Hungary</td>
<td>7.8</td>
<td>13.4</td>
<td>4.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>9.5</td>
<td>13.2</td>
<td>3.4</td>
<td>9.8</td>
</tr>
<tr>
<td>Spain</td>
<td>11.3</td>
<td>20.7</td>
<td>6.4</td>
<td>14.3</td>
</tr>
</tbody>
</table>

* Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta only consist of one NUTS 2 region. Source: EUROSTAT Regional Database 2010
Figure 3 classifies regions with and without Objective 1 funding into three categories according to their unemployment rates in 1999, the year in which eligibility was determined. As expected, few recipient regions with low unemployment rates received funding. However, a surprising number (168) of non-recipient regions had medium to high unemployment (defined here as a 7 to 12 percent unemployment rate). Clearly, there are recipient regions in each of the three categories, implying a much less stringent allocation process than expected. This supports the argument by Bodenstein and Kemmerling (2008) as well as Bouvet and Dall’erba (2010) that access to EU structural funds is a political as well as a technical question, despite clear eligibility thresholds.

![Figure 3: NUTS 2 Regions by Objective 1 Status and Unemployment Rates](image)

Although GDP per capita increased for both groups, Figure 4 shows that Objective 1 recipient regions did not converge with non-recipient regions between 1999 and 2007. Whereas the average difference between recipient and nonrecipient regions in GDP per capita in 1999 was approximately five thousand Euros, this gap grew to approximately 7.5 thousand Euros in 2006.
This picture is at odds with Figure 5, which compares gross value added (GVA) growth rates for recipient and non-recipient regions from 2000 to 2007. Except for a brief period between 2004 and 2005 and following the financial crisis, growth rates in regions receiving Objective 1 funding appeared higher than those of non-recipient regions. This suggests that convergence has not occurred, despite fragile progress in that direction.
In summary, this preliminary analysis does not suggest that Objective 1 funding has had any substantial impact on unemployment or economic growth in the affected regions. Descriptive statistics are insufficient, however, to assess the effectiveness of Objective 1 funding. The absence of convergence is not evidence that Objective 1 funding was ineffective; it may simply reflect an underlying economic trend towards greater divergence. Even if Objective 1 funding had a positive impact, for example by slowing or reducing divergence relative to what would have happened without funding, the above analysis could not show this conclusively. Omitted factors, like the structural or demographic properties of regions, may have caused higher unemployment or lower economic growth in recipient regions even if Objective 1 worked. Economic developments in particular years could also have affected recipient regions differently than non-recipient regions, masking any impact Objective funding might have had in the former. Finally, the effects of Objective 1 funding may be too small to capture with descriptive statistics alone. The following section applies regression analysis to the data described above, therefore, in order to address these analytic challenges and isolate the impact of Objective 1 funding.
This section describes how multivariate regression analysis can be applied to the data described above. Regression analysis is designed to isolate the relationships between several independent variables and one dependent variable and to hold these relationships constant in order to facilitate their individual analysis. This makes it possible to control for structural and demographic factors as well as trends over time that affect regional unemployment and economic growth while isolating the hypothesized effects of Objective 1 funding.

Recent empirical evaluations of cohesion funding have emphasized the benefits of regression analysis using panel models that control for fixed region- and year-effects; effects that are specific to and unchanging for a particular region or time (Temple, 1999; Mohl and Hagen, 2010). Panel models control for these effects by subtracting a region’s or period’s mean value for a variable from the value of that variable for all the individual observations of that region and period. A panel model cannot be used with the available data, however, because the available data do not include funding levels, but funding status. Funding status does not vary between 2000 and 2007 for a large number of regions, meaning that an indicator for funding status would produce a variable that does not vary over time. Hence, the panel model would treat Objective 1 funding as a regional fixed effect that cannot be estimated explicitly and eliminate it.
To avoid this problem while retaining the advantages of time-series data, the relationship between regional unemployment (or economic growth) and Objective 1 funding is formally modeled with an Ordinary Least Squares (OLS) regression, as follows:

\[
\Delta u_{r,t} = \beta_0 + \beta_1 F_{r,t} + \beta_2 EU_{r,t} + \beta_3 X_{r,t} + \lambda_t + \epsilon_{r,t}
\]

The dependent variable, $\Delta u$, is the change in unemployment, in region $r$ and period $t$. The regressions for GVA growth use the same general model with GVA growth ($\Delta y$) as the dependent variable. In both cases, the change or growth rate is obtained by subtracting the unemployment or GVA growth rate of the previous year from that of the current year:

\[
\Delta u_{r,t} = u_{r,t} - u_{r,t-1}
\]

In equation (1), $F$ represents an indicator variable that equals one if a region $r$ received funding in period $t$ and zero otherwise. $EU$ represents a set of different indicator and interval-ratio variables that operationalize whether a region $r$ was an EU member in period $t$ and for how long. $X$ is a set of control variables for each region $r$ in period $t$, described in exhibit 1 below. $\lambda$ is an indicator for the years 2001 to 2007, with 2000 as the excluded baseline category, which controls for year-fixed effects. $\epsilon$ is the error term.

By using the change in unemployment and GVA as the dependent variable, this model implicitly controls for some regional fixed effects, since $\Delta u$ only captures changes in $u$ over time and not its absolute level, which is given by $u_{r,t}$. To illustrate this formally,
consider equations (3) and (4) below in which regional unemployment in region \( r \) and periods \( t \) as well as \( t-1 \) is assumed to depend only on a baseline level of unemployment \((\beta_0)\), the receipt or non-receipt of funding \((F \text{ equals } 1 \text{ or } 0)\), and a region fixed effect \((\alpha_r)\):

\[
\begin{align*}
(3) & \quad u_{r,t} = \beta_0 + \beta_1 F_{r,t} + \alpha_r + \varepsilon_{r,t} \\
(4) & \quad u_{r,t-1} = \beta_0 + \beta_1 F_{r,t-1} + \alpha_r + \varepsilon_{r,t-1}
\end{align*}
\]

Subtracting equation (4) from equation (3) to obtain \( \Delta u_{r,t} \), as defined in equation (2) above, eliminates the region fixed effect as well as the baseline level of unemployment:

\[
\begin{align*}
(5) & \quad u_{r,t} - u_{r,t-1} = \beta_1 (F_{r,t} - F_{r,t-1}) + (\varepsilon_{r,t} - \varepsilon_{r,t-1})
\end{align*}
\]

Unlike the model in equation (5), the OLS model defined in equation (1), which is used in the subsequent analysis, does not have differenced independent variables or a differenced error term. It does not have to, since regressing \( u \) on a covariate \( X \) for the same region over several consecutive time periods is equivalent, with respect to the relationship between \( u \) and \( X \), to regressing \( u \) on a differenced covariate \( \Delta X = X_t - X_{t-1} \).

While the absolute magnitude of \( X_t \) will differ from that of \( \Delta X_t \), yielding different coefficients and interpretations for each of the two covariates, their relationship with \( u \) is substantively the same.
The variables, their predicted effects and data sources are described in exhibit 1. Predicted signs are given for each independent variable. Dependent variables include the unemployment and long-term unemployment rates, and economic growth. Economic growth is measured in terms of GVA, the variable used in most evaluation literature because it is available on Eurostat at the NUTS 2 level. This analysis contributes to the literature by adding an indicator for receipt of Objective 1 funding, operationalizing EU membership, and focusing on two distinct employment outcomes.

This model has several limitations. First, it is to be expected that the model violates the assumption of zero spatial autoregression – the assumption that the errors of observations from adjacent regions are independent from each other – since unemployment and growth in one NUTS 2 region is likely to depend partly on employment and growth in adjacent regions. Also, Objective 1 funding may ‘spill’ into neighboring regions, an effect that cannot be analyzed without geographic data. Second, the models described above may suffer omitted variable bias. Factors that might influence unemployment or GVA growth, such as the receipt of other funding from the EU, are not considered. Moreover, EU membership is an imperfect proxy for local administrative capacity. Third, missing data, though largely incidental, may bias the regression estimates.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Predicted Relationship</th>
<th>Previous Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>∆ Unemployment Rate</td>
<td>Change in percentage of labor force in unemployment</td>
<td>∆u, ∆lu</td>
<td>Becker et al., 2010</td>
</tr>
<tr>
<td>∆ Long-Term Unemployment Rate</td>
<td>Change in percentage of labor force in unemployment for more than 12 months</td>
<td>∆u, ∆lu</td>
<td>NA</td>
</tr>
<tr>
<td>GVA Growth</td>
<td>Annual growth in Gross Value Added, in percent</td>
<td>GVA</td>
<td>Gripaios et al., 2008</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population Density</td>
<td>1000 inhabitants per square Kilometer</td>
<td>-,-,+</td>
<td>Krugman, 1991</td>
</tr>
<tr>
<td>Household Income</td>
<td>Average household income, purchasing power adjusted 2007 prices</td>
<td>+,+,-</td>
<td>Freeman, 1979</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>GDP per capita, purchasing power standards at 2007 prices</td>
<td>-,-,-</td>
<td>Isserman et al., 1986</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>People with completed secondary education, 1000s</td>
<td>-,-,+</td>
<td>Elhorst, 2003</td>
</tr>
<tr>
<td>Tertiary Education</td>
<td>People with completed tertiary education, 1000s</td>
<td>-,-,+</td>
<td>Elhorst, 2003</td>
</tr>
<tr>
<td>Participation Rate</td>
<td>Percentage of population that is economically active</td>
<td>-,-,+</td>
<td>Fleishman and Rhodes, 1979</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>Percentage of labor force currently unemployed</td>
<td>+,+,-</td>
<td>Elhorst, 2003</td>
</tr>
<tr>
<td>Funding</td>
<td>Indicator =1 if a region received funding</td>
<td>0, NA,+</td>
<td>Becker et al., 2010</td>
</tr>
<tr>
<td>Years of Funding, pre-2000</td>
<td>Number of years a region received funding prior to 2000</td>
<td>NA, NA,+</td>
<td>NA</td>
</tr>
<tr>
<td>EU Member</td>
<td>Indicator = 1 if in EU</td>
<td>NA, NA,+</td>
<td>NA</td>
</tr>
<tr>
<td>Years in EU</td>
<td>Number of years in EU</td>
<td>NA, NA, NA</td>
<td>NA</td>
</tr>
<tr>
<td>Years in EU Squared</td>
<td>Number of years in EU squared</td>
<td>NA, NA, NA</td>
<td>NA</td>
</tr>
<tr>
<td>Funding x Years in EU</td>
<td>Funding indicator multiplied with number of years in EU</td>
<td>NA, NA, NA</td>
<td>NA</td>
</tr>
<tr>
<td>Lagged Long-Term Unemployment</td>
<td>Prior year percentage of labor force in unemployment for more than 12 months</td>
<td>+,+,-</td>
<td>Elhorst, 2003</td>
</tr>
<tr>
<td>Industrial Activity Share</td>
<td>Industrial employment as percent of total</td>
<td>-,-,+</td>
<td>Elhorst, 2003</td>
</tr>
<tr>
<td>Agricultural Activity Share</td>
<td>Agricultural employment as percent of total</td>
<td>+,+,-</td>
<td>Elhorst, 2003s</td>
</tr>
</tbody>
</table>

*Note: NA indicates that no predicted relationship is hypothesized in the literature. All data obtained from EUROSTAT Regional Database, except Funding and EU variables (author’s calculations).*
REGRESSION ANALYSIS

Unemployment Rate

Table 3 below presents the regression estimates for five variations of model A, which uses the change in the unemployment rate for the population aged 15 and older as the dependent variable. All five variants of model A use the same control variables to account for differences in the unemployment rate that are due to factors other than the receipt of Objective 1 funding. The different variants differ in the specification of Objective 1 funding and EU membership. Control variables include population density, household income, the number of people with completed secondary education and the labor force participation rate, which represents the share of the total population that is economically active. Model A also controls for the unemployment rates for each region in each year from 2000 to 2007 because preliminary tests show the current-year rate to be a statistically highly significant predictor of the change in unemployment whereas the lagged rate is not. Model A also includes indicator variables to control for fixed effects. For 2001 to 2007 (with 2000 the excluded year), year indicators are included to control for year-specific effects. All columns also include an indicator variable for EU membership, which controls partially for differences between countries (because the indicator will have the same value for all regions of one country in a given

---

6 These findings are robust to standard diagnostic tests (Appendix A). Multicollinearity is not a concern. The model is heteroscedastic but robust standard errors do not change the significance or signs of the estimated effects (table 6 in Appendix B). Neither does the adjustment for serial autoregression (column (7) of table 6). However, there may be omitted variable issues. Because of the lack of geographic data, models A and B do not control for spatial autocorrelation; the correlation of regions’ error terms with error terms of neighboring regions, which may arise if funding in one region spills over into other regions. This caveat implies that marginally statistically significant coefficients should be interpreted with caution.
year) as well as for possible effects of EU accession by ten member states in 2004 on the change in unemployment rates in these countries. Columns (1) to (5) include the hypothesized funding variable, which equals one if a region received funding in a given year and zero otherwise.

Table 3: Model A – Regression Coefficients for the Change in the Unemployment Rate for Males and Females over 15

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>-0.000277***</td>
<td>-0.000277***</td>
<td>-0.000291***</td>
<td>-0.000288***</td>
<td>-0.000286***</td>
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<tr>
<td></td>
<td>(-7.612)</td>
<td>(-7.598)</td>
<td>(-7.889)</td>
<td>(-7.845)</td>
<td>(-7.778)</td>
</tr>
<tr>
<td>Household Income</td>
<td>-9.98e-06</td>
<td>9.14e-06</td>
<td>1.90e-05</td>
<td>2.58e-05**</td>
<td>2.03e-05</td>
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<tr>
<td></td>
<td>(-1.008)</td>
<td>(1.484)</td>
<td>(1.999)</td>
<td>(1.470)</td>
<td></td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>2.76e-05***</td>
<td>2.59e-05***</td>
<td>2.72e-05***</td>
<td>2.34e-05***</td>
<td>2.37e-05***</td>
</tr>
<tr>
<td></td>
<td>(4.150)</td>
<td>(3.884)</td>
<td>(3.480)</td>
<td>(3.524)</td>
<td></td>
</tr>
<tr>
<td>Secondary Education</td>
<td>1.70e-05</td>
<td>-2.41e-05</td>
<td>-4.42e-05</td>
<td>-3.41e-05</td>
<td>-3.52e-05</td>
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<tr>
<td></td>
<td>(0.294)</td>
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<td>(-0.734)</td>
<td>(-0.568)</td>
<td>(-0.586)</td>
</tr>
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<td>Participation Rate</td>
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<td>0.000798</td>
<td>0.00179</td>
<td>0.00262</td>
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</tr>
<tr>
<td></td>
<td>(1.011)</td>
<td>(0.151)</td>
<td>(0.338)</td>
<td>(0.497)</td>
<td>(0.431)</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>0.132***</td>
<td>0.132***</td>
<td>0.133***</td>
<td>0.134***</td>
<td>0.135***</td>
</tr>
<tr>
<td></td>
<td>(16.96)</td>
<td>(16.95)</td>
<td>(17.04)</td>
<td>(17.20)</td>
<td>(17.16)</td>
</tr>
<tr>
<td>Funding</td>
<td>-0.201**</td>
<td>-0.189**</td>
<td>-0.157*</td>
<td>-1.463***</td>
<td>-1.568***</td>
</tr>
<tr>
<td></td>
<td>(-2.304)</td>
<td>(-2.163)</td>
<td>(-1.774)</td>
<td>(-4.241)</td>
<td>(-4.372)</td>
</tr>
<tr>
<td>Years of Funding, pre-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.0127</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-1.067)</td>
</tr>
<tr>
<td>EU Member</td>
<td>-0.485***</td>
<td>-0.375**</td>
<td>-0.347**</td>
<td>0.329</td>
<td>0.368</td>
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<tr>
<td></td>
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<td>(-2.331)</td>
<td>(-2.156)</td>
<td>(1.397)</td>
<td>(1.543)</td>
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<tr>
<td>Years in EU</td>
<td>-0.0234***</td>
<td>-0.162***</td>
<td>-0.314***</td>
<td>-0.312***</td>
<td></td>
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<tr>
<td></td>
<td>(-2.756)</td>
<td>(-2.727)</td>
<td>(-4.437)</td>
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</tr>
<tr>
<td>Years in EU Squared</td>
<td>0.00442**</td>
<td>0.00786***</td>
<td>0.00786***</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(2.358)</td>
<td>(3.810)</td>
<td>(3.812)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding x Years in EU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0644***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0728***</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.463***</td>
<td>-2.055***</td>
<td>-1.344***</td>
<td>-0.438</td>
<td>-0.438</td>
</tr>
<tr>
<td></td>
<td>(-7.575)</td>
<td>(-5.744)</td>
<td>(-2.875)</td>
<td>(-0.842)</td>
<td>(-0.842)</td>
</tr>
</tbody>
</table>

Notes: t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.

Column (1) shows the estimation results for the basic unemployment model. Holding other factors equal, the relationship between Objective 1 funding and the change in the unemployment rate is negative and statistically significant at the five percent level. This
finding supports hypothesis H1; that receipt of Objective 1 funding is associated with smaller increases, or larger decreases, in the unemployment rate. Since the dependent variable is the change in unemployment and not the level of the unemployment rate, this finding is consistent with Figure 2 above, which shows that Objective 1 regions have higher unemployment levels. Indeed, it is expected that regions receiving funding have higher absolute levels of unemployment. EU membership is also negatively and highly statistically significantly related with the change in regional unemployment rates, indicating that, on average and holding other factors constant, EU membership is associated with reductions or smaller increases in unemployment. Of the control variables, population density is highly statistically significantly and negatively related with the change in unemployment. This supports the agglomeration hypothesis, which holds that areas with high population density are more likely to attract economic activity and, by extension, employment opportunities. The unemployment rate is positively related with the change in unemployment and highly statistically significant, which suggests that higher unemployment in a given year is associated with a further increase in unemployment, or – more plausibly – less rapid reductions in unemployment. GDP per capita is also highly statistically significantly but, against expectations, positively related with the change in unemployment. One possible explanation for this is that richer regions experience a slow-down in economic growth, as the convergence literature would suggest, which would in turn translate into an increase, or slower decrease, in unemployment, as posited by Okun’s Law. The other control variables are not statistically significant. Overall, Column (1) of model A explains 38.4 percent of the variation of the change in
regional unemployment rates. The other variants of model A, shown in columns (2)-(5) have very similar predictive power.

Columns (2) to (5) test different specifications of the funding and EU membership variables. Column (2) accounts for the number of years a region has been in the EU to determine whether the findings in (1) may, in fact, depend on some of the long-term economic and institutional changes that accompany EU membership. Indeed, the number of years in the EU is highly statistically significant and negatively related with the change in unemployment rates, suggesting that unemployment decreases further, or increases less, the longer a region has been an EU member. The signs and significance of the estimates in column (1) are not affected by including the length of EU membership. The indicator for EU membership is now only statistically significant at the five percent level.

The inclusion of a squared term for the length of EU membership in column (3) improves the specification of the length of EU membership. The square term is statistically significant at the five percent level with a positive sign. Thus, while the length of EU membership appears negatively related with the change in unemployment, this relation seems to become weaker over time. This would suggest that while every additional year of EU membership is associated with greater reductions, or smaller increases, in the unemployment rate, this association becomes less pronounced over time. The addition of the square term reduces the statistical significance of the funding variable, which retains a negative sign and marginal statistical significance at the ten percent level. There is reason to believe, therefore, that the funding indicator had previously soaked up some of the
effect actually attributable to EU accession and, more significantly, the length of EU membership. The other controls remain unaltered by the additions in columns (2) and (3).

Column (4) adds an interaction term that multiplies the receipt of funding with the length of years in the EU. This variable captures how the relationship between funding and the change in unemployment is conditioned by the length of EU membership. The term is highly statistically significant and positive. It appears, therefore, that while Objective 1 funding is negatively related with changes in unemployment, this relationship becomes weaker the longer a region has been in the EU. Thus, there might be diminishing marginal returns to Objective 1 funding, with potentially greater reductions of unemployment in regions that only recently joined the EU. More importantly, including the interaction term in specification (4) substantially increases the magnitude and statistical significance of the coefficient on funding. It also changes the interpretation of the coefficients on funding and the length of EU membership. They now measure the strength of the relationship between funding and the number of years in the EU conditional on how long a region has been in the EU. For example, on average and holding all other variables constant, in regions that have been in the EU for one year the receipt of funding is associated with an 1.7 percentage point reduction in the growth of unemployment or, if unemployment is falling, an additional the drop in unemployment of 1.7 percentage points than if no funding were received.7 Adding the interaction term

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7 This estimate is obtained by adding the coefficients of the interaction term and its constituent factors, conditional on the length of EU membership. Thus, if a region receives funding and has been in the EU for one year, the estimate is the sum of (β_funding x 1) + (β_Years in EU x 1) + (β_interaction x 1). Using the coefficients in specification (4) this yields an estimated effect of -1.713 percentage points (-1.463 + -0.314 + 0.0644) compared to a region that has been in the EU for one year but not received funding.
leaves the other variables largely unchanged; only the indicator for EU membership loses its statistical significance.

To ensure that the negative association between the receipt of funding and the change in unemployment is not just a function of funding received prior to the 2000-2007 period analyzed here, column (5) includes a variable for the number of years a region received funding prior to 2000. This inclusion increases the magnitude of the coefficient on funding and leaves it highly statistically significant, indicating that model A captures the effects of funding received between 2000-2007, rather than that of earlier funding. All other coefficients change only very slightly and retain their statistical significance.

In sum, the results for model A appear to offer support for hypothesis H1. The receipt of Objective 1 funding is associated with more favorable changes in the general unemployment rate.

*Long-Term Unemployment Rate*

Model C, presented in Table 4 below, estimates regression coefficients for the change in the long-term unemployment rate, which measures the share of total unemployed persons who have been unemployed for 12 months or longer. The basic model, described in

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These findings are robust to diagnostic tests and do not change with robust standard errors or adjustments for serial autocorrelation, as shown in table 7 of appendix D. However, the model does suffer from omitted variable problems and, possibly, specification error due to the presence of important unmeasured factors in the error term. These factors might include: a region’s capacity to administer labor market reintegration programs for the long-term unemployed; regional differences in the labor force that produce high long-term unemployment in some areas but not in others; spatial autocorrelation; and the effects of programs like Objective 2 funding, which are targeted explicitly at long-term unemployment.
column (1), controls for the same variables as models A and B above, except that current year unemployment is replaced by the lagged long term unemployment rate. A lagged rate is more appropriate than the current-year rate in this model because, by definition, changes in the long-term unemployment rate at time $t$ affect the cohort of persons that entered unemployment at least 12 months earlier, in $t-1$. Indeed, preliminary tests, not shown here, confirm the high statistical significance of the lagged variable compared to the statistically insignificant current-year rate.

Column (1) in Table 4 includes indicators for Objective 1 funding and EU membership. EU membership is highly statistically significantly and negatively related to the change in the long-term unemployment rate, whereas the coefficient on funding is not significant and positive. Thus, the hypotheses relating Objective 1 funding to an improved long-term unemployment rate is not supported.

Of the controls, population density, household income and the lagged long-term unemployment rate are highly statistically significant. The expected signs on all statistically significant coefficients are in the expected directions, except for population density, which is positive, and lagged long-term unemployment, which has a negative sign. The negative sign on the lagged term suggests that the higher long-term unemployment is in one year, the less it will increase, or the more it will decrease, in the following year. One possible explanation for this is that there are ‘ceilings’ to regional long-term unemployment rates, above which regional authorities either undertake greater efforts to reduce long-term unemployment or re-classify the long-term unemployed as no
longer belonging to the labor-force. Overall, the model explains 19.1 percent of the variation in the change of the long-term unemployment rate, about half of model A.

### Table 4: Model C - Estimated Regression Coefficients for the Change in the Long-Term Unemployment Rate

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>8.69e-05***</td>
<td>8.72e-05***</td>
<td>9.68e-05***</td>
<td>9.60e-05***</td>
<td>9.62e-05***</td>
</tr>
<tr>
<td></td>
<td>(3.288)</td>
<td>(3.307)</td>
<td>(3.640)</td>
<td>(3.609)</td>
<td>(3.613)</td>
</tr>
<tr>
<td>Household Income</td>
<td>2.01e-05***</td>
<td>7.46e-07</td>
<td>-6.62e-06</td>
<td>-8.69e-06</td>
<td>-9.43e-06</td>
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<td></td>
<td>(2.722)</td>
<td>(0.0806)</td>
<td>(-0.684)</td>
<td>(-0.888)</td>
<td>(-0.895)</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>-1.29e-05***</td>
<td>-1.12e-05**</td>
<td>-1.21e-05**</td>
<td>-1.10e-05**</td>
<td>-1.09e-05**</td>
</tr>
<tr>
<td></td>
<td>(-2.649)</td>
<td>(-2.293)</td>
<td>(-2.476)</td>
<td>(-2.226)</td>
<td>(-2.212)</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>4.02e-05</td>
<td>8.16e-05*</td>
<td>9.33e-05**</td>
<td>9.09e-05**</td>
<td>9.06e-05**</td>
</tr>
<tr>
<td></td>
<td>(0.938)</td>
<td>(1.832)</td>
<td>(2.086)</td>
<td>(2.032)</td>
<td>(2.023)</td>
</tr>
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<td>Participation Rate</td>
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<td>0.00805**</td>
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<td>0.00735*</td>
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<td>(1.880)</td>
<td>(1.831)</td>
<td>(1.825)</td>
</tr>
<tr>
<td>Lagged Long-Term Unemployment</td>
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<td>-0.0885***</td>
<td>-0.0876***</td>
<td>-0.0879***</td>
<td>-0.0876***</td>
</tr>
<tr>
<td></td>
<td>(-11.16)</td>
<td>(-11.41)</td>
<td>(-11.30)</td>
<td>(-11.34)</td>
<td>(-11.03)</td>
</tr>
<tr>
<td>Funding</td>
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<tr>
<td></td>
<td>(1.347)</td>
<td>(1.079)</td>
<td>(0.633)</td>
<td>(1.546)</td>
<td>(1.431)</td>
</tr>
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<td>Years of Funding, pre-2000</td>
<td>0.00170</td>
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<td></td>
<td>(-0.191)</td>
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<tr>
<td>EU Member</td>
<td>-0.821***</td>
<td>-0.904***</td>
<td>-0.924***</td>
<td>-1.106***</td>
<td>-1.100***</td>
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<td>(-7.752)</td>
<td>(-6.354)</td>
<td>(-6.224)</td>
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<td>Years in EU</td>
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<td>0.133***</td>
<td>0.173***</td>
<td>0.174***</td>
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<td>(2.996)</td>
<td>(3.297)</td>
<td>(3.301)</td>
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<tr>
<td>Years in EU Squared</td>
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<td>-0.00445***</td>
<td>-0.00445***</td>
<td>-0.00445***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.530)</td>
<td>(-2.895)</td>
<td>(-2.897)</td>
<td>(-2.897)</td>
<td></td>
</tr>
<tr>
<td>Funding x Years in EU</td>
<td>0.456*</td>
<td>0.123</td>
<td>-0.472</td>
<td>-0.714*</td>
<td>-0.716*</td>
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<tr>
<td></td>
<td>(1.831)</td>
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<tr>
<td>Observations</td>
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<td>1.730</td>
<td>1.730</td>
<td>1.730</td>
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<tr>
<td>R-squared</td>
<td>0.191</td>
<td>0.195</td>
<td>0.198</td>
<td>0.199</td>
<td>0.199</td>
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<tr>
<td>F-Stat</td>
<td>27.10</td>
<td>25.91</td>
<td>24.84</td>
<td>23.59</td>
<td>22.33</td>
</tr>
</tbody>
</table>

*Notes: t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.*

Columns (2) and (3) add years of EU membership and the square of that term, respectively. Both coefficients are statistically significant and have the additional effect of making the controls for secondary education and participation rate statistically significant while, on the other hand, making household income lose its statistically significant association with changes in the long-term unemployment rate. The
significance of the square term suggests that, as for the general unemployment rate, the length of EU membership is negatively associated with changes in the long-term unemployment but a decreasing rate. Put simply, EU membership is associated with improvements in the long-term unemployment rate, especially if a country joined the EU recently.

Column (4) adds the interaction of Objective 1 funding with the length of EU membership to the model, but unlike in Model A, this variable is not statistically significant. Neither does the inclusion of the interaction term affect the significance or signs of any other variables in the model, though it does increase the t-value of the funding indicator substantially. Funding remains statistically insignificant, however. Controlling for the number of years during which funding was received prior to the 2000-2007 period, in column (5), does not affect these results in any substantial way.

In sum, Model C does not support the hypothesis that Objective 1 funding has a favorable effect on regional long-term unemployment rates. None of the specifications of funding or EU membership included in Model C reveal a statistically significant association between the dependent variable and Objective 1 funding.

\textit{GVA Growth Rate}

Evaluating the impact of Objective 1 funding on the growth rate of Gross Value Added is not a primary focus of this thesis but helps to compare the consistency of the methods,
data and results used here with those found in the empirical literature. To this end, model E in table 5 below includes the most prevalent control variables found in the literature: population density, GDP per capita, human capital as measured by the number of people with completed secondary and tertiary education, and a breakdown of the economic structure as captured by the shares of the economically active population working in industry and agriculture.\(^9\)

Column (1) shows the basic model, including controls as well as indicator variables for Objective 1 funding and EU membership. Except for the secondary education rate, all included variables are statistically significant estimators of regional GVA growth rates. Objective 1 funding is highly statistically significantly and positively associated with GVA growth. This supports hypothesis H3 and replicates a frequent finding in the empirical evaluation literature, namely that Objective 1 funding is associated with higher GDP growth rates.\(^10\) The relationship between EU membership and GVA growth is negative and also highly statistically significant, which would suggest, surprisingly, that EU membership slows rather than accelerates economic growth. The signs on industrial activity and population density suggest a negative but statistically significant association with the growth in GVA. Overall, the model in column (1) explains 15.3 percent of the variation in GVA growth rates between regions.

\(^9\) The results of Model E are robust to standard diagnostic tests and do not change significantly when adjusted for heteroskedasticity or serial autocorrelation (table 8 in Appendix F). The model is well specified and does not suffer of any obvious omitted variable bias (see Appendix F). Of course, important variables are still likely to be missing, such as the efficacy with which funding was implemented or the actual amount of funding received by regions.

\(^10\) GDP growth and GVA growth are not identical but very closely related measures of economic growth.
Table 5: Model E - Regression Coefficients for the Growth Rate of Gross Value Added

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
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<td>Population Density</td>
<td>-0.000155**</td>
<td>-0.000167**</td>
<td>-0.000242***</td>
<td>-0.000260***</td>
<td>-0.000242***</td>
<td>-0.000249***</td>
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<td></td>
<td>(-2.198)</td>
<td>(-2.460)</td>
<td>(-3.500)</td>
<td>(-3.753)</td>
<td>(-3.505)</td>
<td>(-3.597)</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>4.39e-05***</td>
<td>5.01e-05***</td>
<td>6.54e-05***</td>
<td>6.87e-05***</td>
<td>6.38e-05***</td>
<td>6.51e-05***</td>
</tr>
<tr>
<td>Tertiary Education</td>
<td>0.000581*</td>
<td>0.00134***</td>
<td>0.00138***</td>
<td>0.00133***</td>
<td>0.00136***</td>
<td>0.00133***</td>
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<tr>
<td>Secondary Education</td>
<td>9.29e-05</td>
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<td>-0.000788***</td>
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<td>0.00383***</td>
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<td>(2.986)</td>
<td>(2.584)</td>
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<td>(4.383)</td>
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<td>29.54</td>
<td>28.32</td>
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</table>

Notes: t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.

Column (2) adds a variable for the length of EU membership, which is highly statistically significantly and negatively associated with regional GVA growth. The addition makes the indicator for EU membership lose its statistical significance and increases the overall explanatory power of the model, which now explains 21.4 percent of the variation in GVA growth rates across regions. Column (3) adds the square term of the number of years a region has been in the EU, which is highly statistically significant and positively
related with GVA growth suggesting that the growth-slowing association with the length of EU membership becomes weaker over time. If we grant that EU membership serves as a proxy for general economic and institutional development, columns (2) and (3) appear to support the neo-classical argument that economies grow at a slower rate the more advanced they are once diminishing returns to capital set in.

Column (4) includes a variable for the number of years a region received Objective 1 funding prior to the 2000-2007 funding period evaluated here. The coefficient is positive and statistically significant at the five percent level. Its inclusion in the model reduces the statistical significance of the funding dummy to the ten percent level while leaving all other controls, except for the industrial activity share, highly statistically significant. The addition suggests that the funding dummy had previously soaked up effects of prior funding, thereby overstating the impact of Objective 1 funding in the years it is allocated. This finding indicates a positive and significant association between Objective 1 funding and growth, which is cumulative over time. Since Objective 1 funding is to a significant degree invested in infrastructure projects, which frequently require a long time to be completed and deliver return on investment, it is plausible that funding in a given year compounds the effects of funding in prior years and that overall effects only materialize after several years have passed.

Column (5) extends the model in (3) in a different direction, by including the interaction between the receipt of funding and the length of EU membership. The interaction term is marginally statistically significant and positively related to the GVA growth rate. Its
inclusion changes the sign of the funding dummy and makes it statistically insignificant. Whereas in the previous models the interaction term strengthened the significance of the funding and EU membership indicators, in relation to the GVA growth rate the narrative becomes less clear. One possible explanation is that the interaction effect is not as pronounced as in the case of unemployment, and that its inclusion simply picks up variance normally explained by its factor components. This reading is confirmed by column (6), which operationalizes funding in terms of the total number of years a region received. This coefficient is positively and highly statistically significantly associated with GVA growth rates. Its inclusion also makes the EU membership dummy marginally statistically significant and positively related to GVA growth. The results of columns (4) and (6) should not be overstated given their marginal statistical significance, but they do suggest that the positive relationship between funding and GVA growth strengthens over time.

Although these findings confirm the empirical literature surveyed above that has found a positive association between funding and economic growth, there is less correspondence between the existing literature and the results presented here on the magnitude of effects. For example, Becker et al (2010) conclude that, on average, Objective 1 funding raises GDP per capita growth by about 1.6 percentage points in recipient regions compared to non-recipient regions. By contrast, column (4) suggests that, on average and holding constant other variables in the model, Objective 1 funding is associated with a 0.36 percentage point increase in GVA growth. Column (6) of the same model, which uses total years of funding, indicates that for every additional year of funding GVA growth is
0.05 percentage points higher, on average, than without funding. The divergent magnitudes of these relationships may be due to differences in model specification or the underlying data. Fundamentally, however, the results presented above conform to the broad expectations derived from a significant part of the literature.

In sum, there is reason to believe that Objective 1 funding and GVA growth are significantly and positively associated. This finding adds to the empirical literature that has found such effects for previous funding periods and suggests that the positive relationship between economic growth and Objective 1 funding persisted throughout the most recent funding period.
CONCLUSIONS AND POLICY RECOMMENDATIONS

Summary and Conclusions

This thesis aimed to evaluate the effectiveness of Objective 1 funding in reducing unemployment and long-term unemployment as well as in increasing economic growth. With respect to the unemployment rate, the analysis conducted above provides support for the hypothesis that Objective 1 funding reduces unemployment, or at least slows its increase, in recipient regions. The analysis also suggests that regional unemployment rates are more favorable the longer a region has been in the EU, but that this effect wears off over time. Contravening this finding, Objective 1 funding is more effective the more recently a region has entered the EU. In combination, these findings suggest that EU membership is associated with long-term reductions in unemployment and that Objective 1 funding can help narrow the initial gap between EU members and non-members. This indicates that Objective 1 funding achieves its stated purpose. The overall finding that Objective 1 funding and unemployment are negatively associated contradicts the only comparable study, by Becker et al (2010), which found no such effect.

No association was found between Objective 1 funding and long-term unemployment. However, this finding may be driven by the lack of control variables for whether regions received funding specifically to reduce long-term unemployment, for example under Objective 2 funding.
With respect to the effect of Objective 1 funding on economic growth, this study corroborates the findings of many recent empirical evaluations that have found small, significant and positive effects of Objective 1 on GVA and GDP growth. Little correspondence exists between this study and the literature, though, regarding the specific size of the effect.

The findings of this thesis are subject to at least two important caveats. First, all econometric models employed here likely omit important variables, such as those for local administrative capacity, receipt of other EU funding programs, spatial spillover, and, most importantly, the amount of funding received. Including these variables would allow firmer judgments on the effect of Objective 1 funding, since it would be easier to discern the effects of this particular policy from the many other influences and policies that affect regional unemployment and economic growth in the EU. Second, this study employed publicly available Eurostat data, which has been criticized for its inaccuracy. In so far as this data was, in fact, inaccurate, the present findings will be biased.

*Policy Recommendations*

This study is only the second to investigate the unemployment effects of cohesion funding and is subject to methodological caveats. Still, the fact that Objective 1 funding accounts for almost 20 percent of the EU’s budget in any given year lends even nuanced conclusions important policy implications.
A first policy recommendation is that further research on the various effects of Objective 1 funding, and cohesion policy in general, is needed. There is surprising ambiguity in the empirical literature on the economic growth effects of Objective 1, and an even more startling lack of analysis on the employment effects of cohesion funding. This is particularly worrisome given that improving employment opportunities is most important second-order objective of EU cohesion policy.

Second, a prerequisite for further research is the collection and provision, by Eurostat, of better and more comprehensive data. One third of the EU’s budget is spent on cohesion policy, yet there is no publicly available data on how much funding regions receive. Such data should not only be made available for Objective 1 but all other cohesion policy funding programs as well. Without it, the most appropriate statistical techniques for evaluating the impact of cohesion policy cannot be applied. There is also a public interest in knowing how, where and how much money is spent. The lack of such data casts some doubt over the EC’s expressed confidence in the benefits of cohesion policy.

Third, this study corroborates a body of research that argues in favor of maintaining Objective 1 funding. Although more research is needed, the evidence presented in this thesis should at least caution against a dismantling of cohesion funding in general, or Objective 1 funding in particular. This is an important conclusion in times of widespread fiscal duress. Objective 1 funding appears to yield some return on investment, at least with regard to economic growth but also with respect to employment. The magnitude of this effect remains unclear.
Fourth, the findings presented above suggest that there are diminishing returns to Objective 1 funding over time with respect to unemployment and economic growth. This may speak in favor of concentrating funding on regions that have recently acceded to the EU, that remain the most underdeveloped, or that suffer high unemployment. Perhaps there is also a case to be made for phasing out funding sooner, as the highest returns are achieved in the early stages of Objective 1 funding.

Fifth, national and local administrative capacity plays an important role in transforming cohesion funding into tangible results. More developed countries are likely to be better at absorbing cohesion funding in their poorer regions than less well developed countries. The additionality requirement, which requires that national governments match EU funding contributions in order to incentivize good program governance, may reinforce this inegalitarian aspect of cohesion policy. More research is needed on the impact of these features on cohesion policy outcomes, but raising regional administrative capacity is almost certainly a central ingredient to successful cohesion policy implementation.

Finally, the discrepancy between the results for unemployment and those for long-term unemployment merits further investigation. These are two different but closely related phenomena. Apparently, Objective 1 funding and the programs it supports do not benefit the long-term unemployed. This may imply good targeting, since tackling long-term unemployment is the explicit target of Objective 2 funding. It may also imply, however, that some of the most vulnerable labor market participants are not benefiting from a
program that costs the EU one-third of its entire budget. More research and evaluation of Objective 2 funding is necessary, therefore, to address this concern.

In summary, this thesis has found that Objective 1 funding works. In recipient regions, it reduces unemployment rates and increases economic growth rates relative to non-recipient regions. Objective 1 does not, however, have any measurable impact on regional long-term unemployment.
APPENDIX A – DIAGNOSTICS FOR MODEL A

Multicollinearity Diagnostics

STATA output for diagnostic tests of multicollinearity in model A4.

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Pairwise correlation matrix to identify collinearity in model A4

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(corr-17/6)

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<th>gdpcapita</th>
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Heteroscedasticity Diagnostics

STATA RVF-plot for model A4.

![Residuals vs Fitted Values Plot](image)

STATA output for the IM-test and Het-tests of Model A4

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Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of d_unemp_rt_5saver_mf

chi2(1) = 0.01
Prob > chi2 = 0.9121
APPENDIX B – MODEL B AND DIAGNOSTICS

Model Specification Diagnostics

Diagnostic tests for model misspecification in model B (robust model A).

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. linktest //linktest OK

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Heteroscedasticity Diagnostics

STATA plot of robust residuals against the dependent variable for B4 (robust model A4).

```

Heteroscedasticity Diagnostics

STATA plot of robust residuals against the dependent variable for B4 (robust model A4).
Replication of model A with robust standard errors.

Table 6: Model B - Regression Coefficients for the Change in the Unemployment Rate for Males and Females over 15. Robust Standard Errors.

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<th>(5)</th>
<th>(6) Prais-Winsten of (4)</th>
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<td></td>
<td>(3.309)</td>
<td>(3.141)</td>
<td>(3.235)</td>
<td>(2.769)</td>
<td>(2.804)</td>
<td>(2.505)</td>
</tr>
<tr>
<td></td>
<td>(0.297)</td>
<td>(-0.407)</td>
<td>(-0.709)</td>
<td>(-0.559)</td>
<td>(-0.577)</td>
<td>(-0.908)</td>
</tr>
<tr>
<td>Participation Rate</td>
<td>0.00508</td>
<td>0.000798</td>
<td>0.00179</td>
<td>0.00262</td>
<td>0.00228</td>
<td>0.00458</td>
</tr>
<tr>
<td></td>
<td>(0.982)</td>
<td>(0.148)</td>
<td>(0.332)</td>
<td>(0.487)</td>
<td>(0.423)</td>
<td>(0.721)</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>0.132***</td>
<td>0.132***</td>
<td>0.133***</td>
<td>0.134***</td>
<td>0.135***</td>
<td>0.148***</td>
</tr>
<tr>
<td>Funding</td>
<td>-0.201**</td>
<td>-0.189**</td>
<td>-0.157*</td>
<td>-1.463***</td>
<td>-1.568***</td>
<td>-1.639***</td>
</tr>
<tr>
<td></td>
<td>(-2.239)</td>
<td>(-2.137)</td>
<td>(-1.761)</td>
<td>(-3.792)</td>
<td>(-3.930)</td>
<td>(-3.568)</td>
</tr>
<tr>
<td>Years of Funding, pre-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU Member</td>
<td>-0.485**</td>
<td>-0.375*</td>
<td>-0.347</td>
<td>0.329</td>
<td>0.368</td>
<td>0.376</td>
</tr>
<tr>
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<td>(-2.440)</td>
<td>(-1.782)</td>
<td>(-1.616)</td>
<td>(1.032)</td>
<td>(1.150)</td>
<td>(0.990)</td>
</tr>
<tr>
<td>Years in EU</td>
<td>-0.0234***</td>
<td>-0.162**</td>
<td>-0.314***</td>
<td>-0.312***</td>
<td>-0.351***</td>
<td>-0.396***</td>
</tr>
<tr>
<td></td>
<td>(-3.004)</td>
<td>(-2.301)</td>
<td>(-3.257)</td>
<td>(-3.231)</td>
<td>(-3.296)</td>
<td>(-2.996)</td>
</tr>
<tr>
<td>Years in EU Squared</td>
<td>0.00442***</td>
<td>0.00786***</td>
<td>0.00786***</td>
<td>0.00786***</td>
<td>0.00887***</td>
<td>0.00987***</td>
</tr>
<tr>
<td></td>
<td>(2.077)</td>
<td>(2.946)</td>
<td>(2.946)</td>
<td>(2.946)</td>
<td>(2.731)</td>
<td>(2.731)</td>
</tr>
<tr>
<td>Funding x Years in EU</td>
<td>0.06444***</td>
<td>0.0728***</td>
<td>0.0728***</td>
<td>0.0728***</td>
<td>0.0712***</td>
<td>0.0712***</td>
</tr>
<tr>
<td></td>
<td>(3.311)</td>
<td>(3.427)</td>
<td>(3.427)</td>
<td>(3.061)</td>
<td>(3.061)</td>
<td>(3.061)</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.463***</td>
<td>-2.055***</td>
<td>-1.344***</td>
<td>-0.438</td>
<td>-0.438</td>
<td>-0.450</td>
</tr>
<tr>
<td></td>
<td>(-6.251)</td>
<td>(-5.226)</td>
<td>(-3.028)</td>
<td>(-0.756)</td>
<td>(-0.755)</td>
<td>(-0.657)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,784</td>
<td>1,776</td>
<td>1,776</td>
<td>1,776</td>
<td>1,776</td>
<td>1,776</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.384</td>
<td>0.387</td>
<td>0.389</td>
<td>0.394</td>
<td>0.394</td>
<td>0.377</td>
</tr>
<tr>
<td>F-Stat</td>
<td>50.40</td>
<td>47.14</td>
<td>45.86</td>
<td>43.41</td>
<td>41.42</td>
<td>39.20</td>
</tr>
</tbody>
</table>

Notes: Robust t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.
APPENDIX C – DIAGNOSTICS FOR MODEL C

**Multicollinearity Diagnostics**

STATA output for diagnostic tests of multicollinearity in model C6.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>gvagrowth</td>
<td>1.30</td>
<td>0.77</td>
</tr>
<tr>
<td>Popdensity</td>
<td>1.71</td>
<td>0.58</td>
</tr>
<tr>
<td>Gdpcapita</td>
<td>3.00</td>
<td>0.33</td>
</tr>
<tr>
<td>Educ_terr</td>
<td>2.86</td>
<td>0.64</td>
</tr>
<tr>
<td>Educ_second</td>
<td>4.34</td>
<td>0.76</td>
</tr>
<tr>
<td>Act_agri</td>
<td>1.58</td>
<td>0.37</td>
</tr>
<tr>
<td>Funding</td>
<td>3.01</td>
<td>0.67</td>
</tr>
<tr>
<td>Fundingyrs_pre2000</td>
<td>2.53</td>
<td>0.61</td>
</tr>
<tr>
<td>Eumember</td>
<td>2.17</td>
<td>0.54</td>
</tr>
<tr>
<td>Eumemberyrs</td>
<td>125.43</td>
<td>0.99</td>
</tr>
<tr>
<td>eumemberyrssq</td>
<td>115.20</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Pairwise correlation matrix to identify collinearity in model C6.

\[
\begin{array}{cccccccccc}
\text{d_long-p} & 1.0000 \\
\text{popden-y} & 0.4047 & 1.0000 \\
\text{hhincome} & 0.0479 & 0.2224 & 1.0000 \\
\text{gdp_capita} & 0.0618 & 0.3431 & 0.7357 & 1.0000 \\
\text{educ_second} & -0.0268 & 0.0681 & 0.0350 & 0.1090 & 1.0000 \\
\text{particip-of} & 0.1450 & 0.0947 & 0.2935 & 0.3657 & 0.2640 & 1.0000 \\
\text{longterm_a-g} & -0.2734 & 0.6121 & -0.4810 & -0.4132 & 0.2256 & -0.4309 & 1.0000 \\
\text{act_indus} & -0.0031 & -0.0121 & 0.1840 & 0.1418 & 0.7977 & 0.0571 & -0.0004 & 1.0000 \\
\text{funding} & -0.1555 & -0.1083 & -0.4851 & -0.4454 & -0.1296 & -0.2656 & 0.3951 & -0.1255 & 1.0000 \\
\text{eumember} & -0.1387 & -0.0588 & 0.7587 & 0.3642 & -0.3214 & -0.0464 & -0.2145 & -0.0039 & 0.1099 & 1.0000 \\
\text{eumemberyrs} & 0.0017 & 0.0986 & 0.7362 & 0.4256 & -0.1868 & -0.0169 & -0.2790 & 0.0006 & -0.1824 & 0.5074 & 1.0000 \\
\end{array}
\]

**Heteroscedasticity Diagnostics**

STATA RVF-plot for model C6.
STATA output for an IM-test and Het-test of Model C6.

Cameron & Trivedi's decomposition of IM-test

<table>
<thead>
<tr>
<th>Source</th>
<th>chi2</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity</td>
<td>765.80</td>
<td>153</td>
<td>0.0000</td>
</tr>
<tr>
<td>Skewness</td>
<td>55.13</td>
<td>18</td>
<td>0.0000</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.16</td>
<td>1</td>
<td>0.0756</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>823.88</strong></td>
<td><strong>172</strong></td>
<td><strong>0.0000</strong></td>
</tr>
</tbody>
</table>

. Hettest
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
H0: Constant variance
Variables: fitted values of d.longterm.unemp

\[
\chi^2(1) = 159.99 \\
\text{Prob} > \chi^2 = 0.0000 \]
APPENDIX D – MODEL D AND DIAGNOSTICS

Model Specification Diagnostics

Diagnostic tests for model misspecification in model D (robust model C).

```
. linktest // not good

Source          SS    df    MS                  Number of obs =  1716
Model            294.09882   2  147.04941    F( 2, 1713) = 248.04
Residual        1849.38045  1713  .62685296   Prob > F =  0.0000
                R-squared =  0.2189
Adj R-squared   =  0.2138
Total           1343.48753  1715  .78337665   Root MSE =  .78269

```

```
. estat hettest

```

Heteroscedasticity Diagnostics

STATA plot of robust residuals against the dependent variable for model D6 (robust model C6).
Replication of model C with robust standard errors.

<table>
<thead>
<tr>
<th>Table 7: Model D - Estimated Regression Coefficients for the Change in the Long-Term Unemployment Rate. Robust standard errors.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Explanatory Variables</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Household Income</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GDP per Capita</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Secondary Education</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Funding</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Lagged Long-Term</td>
</tr>
<tr>
<td>Unemployment</td>
</tr>
<tr>
<td>Funding</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Years of Funding, pre-2000</td>
</tr>
<tr>
<td>EU Member</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Years in EU</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Years in EU Squared</td>
</tr>
<tr>
<td>Funding x Years in EU</td>
</tr>
<tr>
<td>Industrial Activity Share</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
<tr>
<td>F-Stat</td>
</tr>
</tbody>
</table>

Notes: Robust t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.
Appendix E – Diagnostics for Model E

Multicollinearity Diagnostics

STATA output for diagnostic tests of multicollinearity in model E4.

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>SQRTVIF</th>
<th>Tolerance</th>
<th>R-Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>gvagrowth</td>
<td>1.30</td>
<td>1.14</td>
<td>0.7706</td>
<td>0.2294</td>
</tr>
<tr>
<td>popdensity</td>
<td>1.71</td>
<td>1.31</td>
<td>0.5848</td>
<td>0.4152</td>
</tr>
<tr>
<td>gdpcapita</td>
<td>3.00</td>
<td>1.73</td>
<td>0.3333</td>
<td>0.6667</td>
</tr>
<tr>
<td>educ_tert</td>
<td>2.86</td>
<td>1.69</td>
<td>0.3501</td>
<td>0.6499</td>
</tr>
<tr>
<td>educ_second</td>
<td>4.34</td>
<td>2.08</td>
<td>0.2304</td>
<td>0.7696</td>
</tr>
<tr>
<td>act_indus</td>
<td>3.48</td>
<td>1.87</td>
<td>0.2872</td>
<td>0.7128</td>
</tr>
<tr>
<td>act_agri</td>
<td>1.58</td>
<td>1.26</td>
<td>0.6319</td>
<td>0.3681</td>
</tr>
<tr>
<td>funding</td>
<td>3.01</td>
<td>1.73</td>
<td>0.3323</td>
<td>0.6677</td>
</tr>
<tr>
<td>fundingyrs_pre2000_static</td>
<td>2.53</td>
<td>1.59</td>
<td>0.3948</td>
<td>0.6052</td>
</tr>
<tr>
<td>eumember</td>
<td>2.17</td>
<td>1.47</td>
<td>0.4613</td>
<td>0.5387</td>
</tr>
<tr>
<td>eumemberyrs</td>
<td>125.43</td>
<td>11.20</td>
<td>0.0080</td>
<td>0.9920</td>
</tr>
<tr>
<td>eumemberyrssq</td>
<td>115.20</td>
<td>10.73</td>
<td>0.0087</td>
<td>0.9913</td>
</tr>
</tbody>
</table>

Mean VIF 14.84

Pairwise correlation matrix to identify collinearity in model E4

(obs=1745)
Heteroscedasticity Diagnostics

STATA RVF-plot for model E4.

![Residual Plot](image)

STATA output for an IM-test and Het-test of Model E4.

Cameron & Trivedi’s decomposition of IM-test

<table>
<thead>
<tr>
<th>Source</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity</td>
<td>373.94</td>
<td>152</td>
<td>0.0000</td>
</tr>
<tr>
<td>Skewness</td>
<td>26.05</td>
<td>18</td>
<td>0.0006</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>7.83</td>
<td>1</td>
<td>0.0080</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>407.82</td>
<td>171</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of gvwgrow

$\chi^2(1) = 64.61$
Prob $> \chi^2 = 0.0000$
APPENDIX F – MODEL F AND DIAGNOSTICS

Model Specification Diagnostics

Diagnostic tests for model misspecification in model F4 (robust E4).

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 1745</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>2227.56084</td>
<td>2</td>
<td>1113.78042</td>
<td>FC (2, 1742) = 237.71</td>
</tr>
<tr>
<td>Residual</td>
<td>7528.67632</td>
<td>1742</td>
<td>4.32185782</td>
<td>R-squared = 0.2283</td>
</tr>
<tr>
<td>Total</td>
<td>9756.23716</td>
<td>1744</td>
<td>5.59412768</td>
<td>Adj R-squared = 0.2274</td>
</tr>
</tbody>
</table>

| gvgrowth | Coef. Std. Err. t Pr(>|t|) [95% Conf. Interval] |
|----------|-----------------------------------------------|
| _c       | 1.140417 0.1795284 6.35 0.000 0.78303 1.492531 |
| _h 세이 | -0.0239652 0.0839559 -0.28 0.779 -0.08183 0.033473 |
| _c + h   | -1.77693 0.2556407 -7.08 0.482 -2.670414 0.126455 |

- otest // not good

Ramsey RESET test using powers of the fitted values of gvgrowth
Ho: model has no omitted variables
F(3, 1723) = 1.25
Prob > F = 0.2897

Heteroscedasticity Diagnostics

STATA plot of robust residuals against the dependent variable for model F4 (robust E4).
Replication of model E with robust standard errors.

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7) Prais-Winsten of (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density</td>
<td>-0.000155***</td>
<td>-0.000167***</td>
<td>-0.000242***</td>
<td>-0.000260***</td>
<td>-0.000242***</td>
<td>-0.000249***</td>
<td>-0.000270***</td>
</tr>
<tr>
<td></td>
<td>(-2.610)</td>
<td>(-2.813)</td>
<td>(-3.997)</td>
<td>(-4.185)</td>
<td>(-4.020)</td>
<td>(-3.981)</td>
<td>(-4.086)</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>4.39e-05***</td>
<td>5.01e-05***</td>
<td>6.54e-05***</td>
<td>6.87e-05***</td>
<td>6.38e-05***</td>
<td>6.51e-05***</td>
<td>7.24e-05***</td>
</tr>
<tr>
<td>Tertiary Education</td>
<td>0.000581**</td>
<td>0.00134***</td>
<td>0.00138***</td>
<td>0.00133***</td>
<td>0.00136***</td>
<td>0.00133***</td>
<td>0.00129***</td>
</tr>
<tr>
<td></td>
<td>(2.247)</td>
<td>(5.032)</td>
<td>(5.170)</td>
<td>(4.964)</td>
<td>(5.100)</td>
<td>(5.023)</td>
<td>(4.637)</td>
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<tr>
<td>Secondary Education</td>
<td>9.29e-05</td>
<td>-0.000740***</td>
<td>-0.000788***</td>
<td>-0.000736***</td>
<td>-0.000757***</td>
<td>-0.000739***</td>
<td>-0.000715***</td>
</tr>
<tr>
<td></td>
<td>(0.468)</td>
<td>(-4.093)</td>
<td>(-4.415)</td>
<td>(-4.065)</td>
<td>(-4.221)</td>
<td>(-4.071)</td>
<td>(-3.741)</td>
</tr>
<tr>
<td>Industrial Activity Share</td>
<td>-0.00149***</td>
<td>-0.000525</td>
<td>-0.000579</td>
<td>-0.000569</td>
<td>-0.000575</td>
<td>-0.000594</td>
<td>-0.000561</td>
</tr>
<tr>
<td></td>
<td>(-3.741)</td>
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<td>(-1.559)</td>
<td>(-1.539)</td>
<td>(-1.551)</td>
<td>(-1.607)</td>
<td>(-1.452)</td>
</tr>
<tr>
<td>Agricultural Activity Share</td>
<td>0.00528***</td>
<td>0.00433***</td>
<td>0.00406***</td>
<td>0.00355***</td>
<td>0.00389***</td>
<td>0.00383***</td>
<td>0.00358**</td>
</tr>
<tr>
<td></td>
<td>(3.179)</td>
<td>(2.809)</td>
<td>(2.646)</td>
<td>(2.303)</td>
<td>(2.556)</td>
<td>(2.529)</td>
<td>(2.232)</td>
</tr>
<tr>
<td>Funding</td>
<td>1.050***</td>
<td>0.638***</td>
<td>0.663***</td>
<td>0.361*</td>
<td>-0.488</td>
<td>0.369*</td>
<td>0.369*</td>
</tr>
<tr>
<td></td>
<td>(5.896)</td>
<td>(3.640)</td>
<td>(3.847)</td>
<td>(1.804)</td>
<td>(-0.596)</td>
<td>(1.750)</td>
<td>(1.750)</td>
</tr>
<tr>
<td>Years of Funding, pre-2000</td>
<td>0.0469**</td>
<td>0.0481**</td>
<td>0.0469**</td>
<td>0.0481**</td>
<td>0.0469**</td>
<td>0.0481**</td>
<td>0.0469**</td>
</tr>
<tr>
<td></td>
<td>(2.314)</td>
<td>(2.232)</td>
<td>(2.314)</td>
<td>(2.232)</td>
<td>(2.314)</td>
<td>(2.232)</td>
<td>(2.232)</td>
</tr>
<tr>
<td>EU Member</td>
<td>-2.203***</td>
<td>-0.265</td>
<td>0.0205</td>
<td>0.269</td>
<td>0.602</td>
<td>0.498</td>
<td>0.258</td>
</tr>
<tr>
<td></td>
<td>(-6.947)</td>
<td>(-0.681)</td>
<td>(0.0507)</td>
<td>(0.645)</td>
<td>(1.035)</td>
<td>(1.260)</td>
<td>(0.600)</td>
</tr>
<tr>
<td>Years in EU</td>
<td>-0.160***</td>
<td>-0.682***</td>
<td>-0.714***</td>
<td>-0.800***</td>
<td>-0.748***</td>
<td>-0.724***</td>
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<tr>
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<td>(-9.084)</td>
<td>(-6.246)</td>
<td>(-6.446)</td>
<td>(-5.561)</td>
<td>(-6.727)</td>
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<td>(-6.150)</td>
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<tr>
<td>Years in EU Squared</td>
<td>0.0171***</td>
<td>0.0173***</td>
<td>0.0196***</td>
<td>0.0181***</td>
<td>0.0176***</td>
<td>0.0176***</td>
<td>0.0176***</td>
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<tr>
<td>Funding x Years in EU</td>
<td>0.0567</td>
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<td></td>
<td>(1.430)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Total Years of Funding</td>
<td>0.0492***</td>
<td></td>
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<tr>
<td></td>
<td>(4.054)</td>
<td></td>
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<tr>
<td></td>
<td>(12.50)</td>
<td>(15.33)</td>
<td>(12.50)</td>
<td>(12.64)</td>
<td>(10.45)</td>
<td>(13.02)</td>
<td>(11.87)</td>
</tr>
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<td>Observations</td>
<td>1.753</td>
<td>1.745</td>
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<td>R-squared</td>
<td>0.153</td>
<td>0.214</td>
<td>0.225</td>
<td>0.228</td>
<td>0.227</td>
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<td>0.225</td>
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<td>F-Stat</td>
<td>21.17</td>
<td>25.85</td>
<td>25.66</td>
<td>24.44</td>
<td>24.27</td>
<td>25.15</td>
<td>166.5</td>
</tr>
</tbody>
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Notes: Robust t-statistics in parentheses. Year dummies not included in table. *** p<0.01, ** p<0.05, * p<0.1.
Bibliography


