The Impact of EU structural funds on regional disparities within member states

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Abstract. We examine the impact of the structural and cohesion funds on regional disparities within EU countries over the period 1995-2006. We find that the structural funds have reduced regional disparities over this period. Our empirical estimates also suggest that the effect of the structural funds on regional disparities is potentially reversed above some level of transfer intensity (approximately 1.6% of country GDP). This has implications for the desirable allocation of the funds across countries especially since, in the current programming period (2007-2013), all the new member states of the Union bar Cyprus and Malta have a transfer intensity which exceeds this threshold.

1. Introduction

According to Artícle 158 of the Treaty on European Union the EU "shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas." In tune with this objective, a large body of work has analyzed the impact of the structural funds on the growth of regional GDP as well as regional and national convergence across Europe (see, Gripaios and Bishop, 2008 and Mohl and Hagen 2010 for reviews of the literature). In general, one cannot speak of a solid consensus in the empirical contributions: Some studies report a positive impact on regional growth (Becker et al 2010a, Dall'erba 2005, Mohl and Hagen 2010, Ramajo et al 2008). Others find no effects in terms of regional convergence (Esposti and Bussoletti 2008, Dall'erba and Le Gallo 2008). Still others find that structural spending improves national economic convergence across the EU (Beugelsdijk and Eijffinger, 2005).

In this article we examine the extent to which the European Union's regional policy has affected regional disparities within countries. In particular, we analyze the impact of the structural and cohesion funds on regional disparities within EU countries over the period 1995-2006. We focus on within-country disparities for several reasons. First, overall inequality across the EU regions can be decomposed into inequality across countries and inequality across regions within each country (Puga, 2002). While up to the early 80s overall regional inequality could be divided more or less equally between cross country and within-country inequalities, since then the relative weight of the latter has increased so that "nowadays most regional income inequalities in Europe are within rather than across Member States." (Puga, 2002: 376). Thus, explaining within-country regional disparities goes some way towards evaluating the effectiveness of the EU's policy. Second, even if within-country regional income differences were not as

important in explaining regional inequality across Europe, it would still be useful from a policy perspective to examine how the pursuit of greater equality across Europe's regions may affect within-country regional inequalities. Third, because we measure regional disparities within countries by way of a country-wide indicator, we are able to control for factors like fiscal decentralization and government size which are likely to have an incidence on the effectiveness of structural funds and which are available at the national level. An additional advantage of such an indicator is that it is likely to capture many of the spillover effects generated by the funds since these effects are more likely between the regions of the same country[1].

We find that the structural funds have reduced within-country regional disparities over the period under examination. Moreover, our empirical results suggest that beyond some level of transfer intensity (approximately 1.5% of country GDP), the positive impact of structural funds is potentially reversed something which has implications for the desirable allocation of the funds across countries.

The structure of the paper is as follows. In section 2 we explain the varying intensities in structural funding across countries between 1995 and 2006. We also present our measure of regional disparities and describe its variation across countries and over time. We then discuss, in section 3, our empirical methodology with special attention paid to the control variables employed in the analysis. We follow with our main results (section 4) as well as several checks on their robustness (section 5) before concluding the paper with the main findings and implications (section 6).

[1] It is notable that several scholars emphasize the importance of spillover effects: because the funds go mostly towards financing transport infrastructures, their effect may spillover into neighbouring or economically interconnected regions (Arbia et al 2008, Becker et al 2010a, Dall'erba and Le Gallo 2008, Mohl and Hagen 2010). To the extent that these effects are significant, then the overall impact of structural funds may be underestimated if one measures their effect only on the receiving regions.

2. Structural funds and regional disparities in the EU

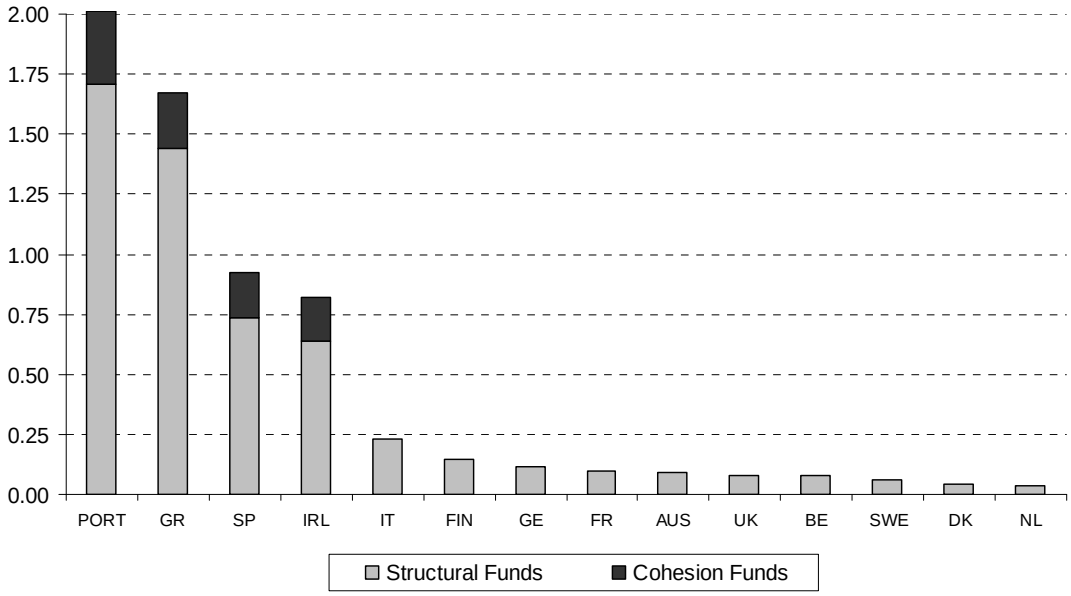
Our focus is on the period 1995-2006 which basically covers the two most recent EU budgetary periods (1994-99 and 2000-06) and during which the EU was composed of 15 countries. We consider the amount of transfers from the European Union budget to the member states under the concept of structural and cohesion funding. The structural funds benefited mainly all NUTS II regions whose GDP per person was less than 75% of the Community average (objective 1 regions). The Cohesion Fund, established by the Maastricht Treaty, aims to contribute towards economic and social cohesion in the EU and benefits the poorer member states (GNP per capita below 90% of the EU average) which during the period analysed were Portugal, Greece, Spain and Ireland (from here-on the cohesion countries). We restrict our analysis to the funds aiming to promote infrastructure investments. This means that we focus on the European Regional Development Fund (ERDF), the European Agricultural Guidance and Guarantee Fund (EAGGF) and the Financial Instrument for Fisheries Guidance (FIFG) plus the Cohesion Fund[2].

To present an overview of the distribution of the structural and cohesion funds by country, Figure 1 shows the payments expressed in terms of share of GDP and in annual means for the whole period (1995-2006). All the countries considered have benefited from structural funds and four states have, moreover, received cohesion funding. Clearly three groups of countries can be distinguished: the poorer cohesion countries (Portugal and Greece) receiving an amount of payments higher than 1.5% of their GDP,

[2] The Cohesion Fund finances environmental projects and trans-European transport infrastructure networks. The structural funds include all Community Initiatives that account for less than 5% of the funds during the period covered.

the other two cohesion countries with a percentage between 0.75 and 1%, and finally, the non cohesion countries with payments that represent less than 0.25% of their GDP.

Figure 1. Structural and cohesion funds received per country (in % of GDP and mean of the period 1995-2006).



In order to measure regional disparities within countries, we use the population-weighted coefficient of variation (PW-CV), which is a measure typically used in the literature focused on regional disparities that is independent of the scale, population size, number of regions considered and satisfies the Pigou-Dalton principle (Cowell, 1995)[3]. The PW-CV is the population-weighted standard deviation of GDP per capita level within a country, divided by the country's GDP per capital level:

$$\text{PW-CV} = \frac{1}{\bar{y}}\left[\sum_{i=1}^{n} p_i(\bar{y} - y_i)^2\right]^{1/2}$$

[3] See Ezcurra and Pascual (2008), Lessmann (2009), Rodríguez-Pose and Ezcurra (2010) and Williamson (1965).

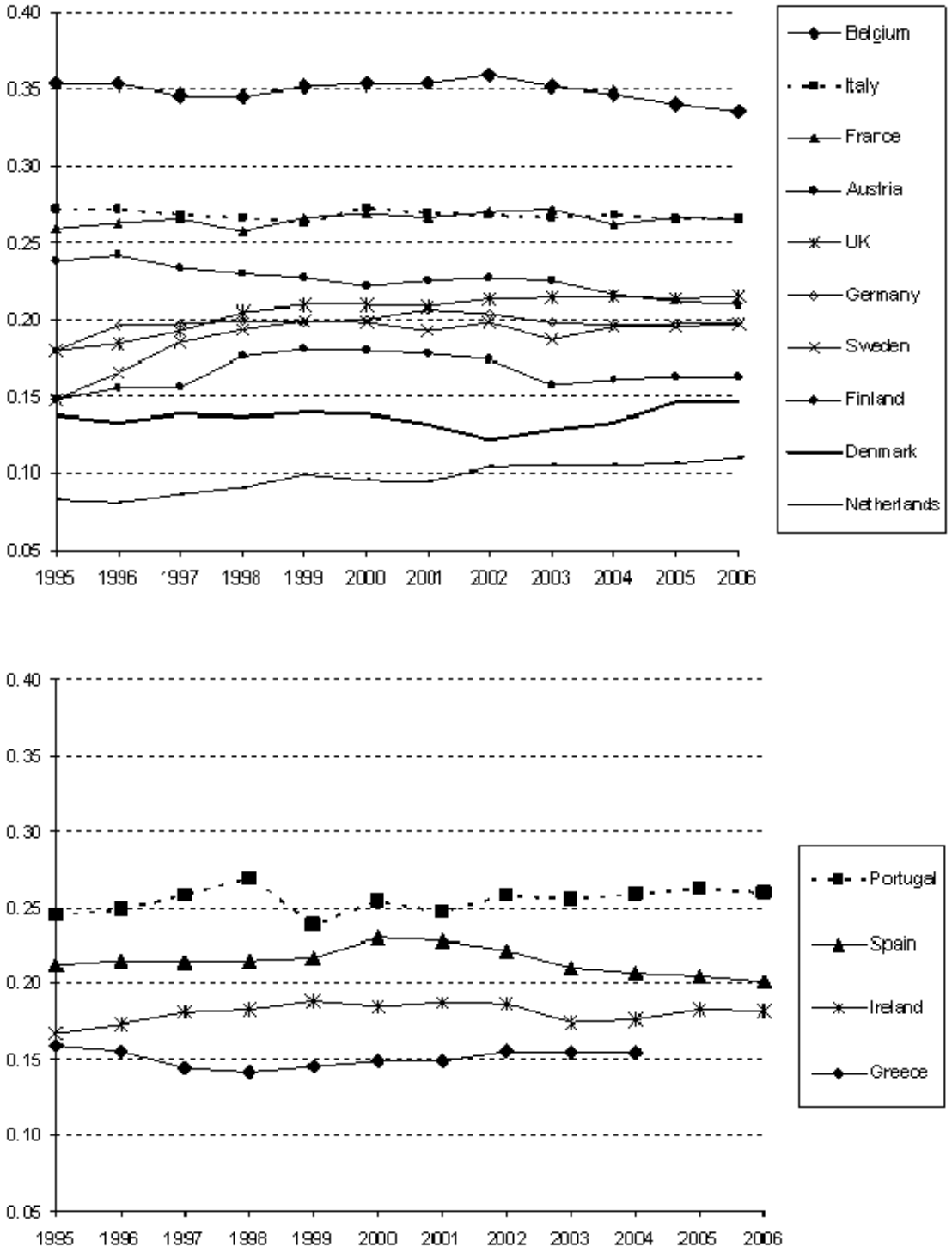
where $\bar{y}$ is the average country GDP per capita, y_i and p_i are the GDP per capita and population share of the region[4], and n is the number of regions. The PW-CV basically depicts disparities among the regions of a country, taking into consideration their relative population weights and takes values between 0 (equality) and 1 (maximum disparities).

Figure 2 shows the evolution of regional disparities through the population weighted coefficient of variation of regional GDP per capita in each of the EU non cohesion and cohesion countries respectively during the period 1995-2006. In both groupings, the degree of regional disparities varies markedly across countries while in most cases it is very stable through time and a clear time tendency cannot be deduced[5]. The highest disparities are found in Belgium and to a lesser extent in Italy, France and Portugal, while the lowest values appear in the Netherlands (although it is the country with a clearer increasing tendency), Denmark and Greece.

[4] All regions are defined at the NUTS 2 level, except for Belgium, Germany, Netherlands and the UK which are so at the NUTS 1 level.

[5] This is in line with previous studies which have found that regional disparities within the EU member states appear to persist over time, although there tends to be a degree of income convergence at the national level (see Geppert and Stephan (2008) for a review).

Figure 2. Regional disparities in EU countries over the period 1995-2006.



3. Empirical methodology

With the exception of Luxembourg, the sample includes all EU countries and represents an unbalanced panel of 14 EU countries over the period 1995 to 2006. Since the time series is short in our dataset, estimation of either fixed or random effects models does not seem reasonable. This is especially true for the former which relies exclusively on the time variation within each cross-section unit, something we have already identified as limited in our dependent variable. In the case of random effects, it would imply that our sample is a random one from a large population, something which obviously is not the case since our cross-section units are not exchangeable (Hsiao, 2003). Instead, we employ a Feasible General Least Squares (FGLS) estimator. This is asymptotically more efficient than the pooled OLS estimator when the series exhibit heteroskedasticity (Wooldridge 2006, p. 292). We use period SUR weights (Seemingly Unrelated Regression) that corrects for both period heteroskedasticity and serial correlation within a given cross-section (Parks, 1967).

We estimate the following model:

$$Regional\ Disparities_{it} = \alpha + \beta_1 SF_{it} + \beta_2 X_{it} + \varepsilon_{it} \qquad (1)$$

where i refers to countries, t to years, α is a constant, SF are structural or structural and cohesion funds as a percentage of GDP, X_{it} is a vector of control variables and ε_{it} is the error term.

We are also interested in identifying the functional form of the relationship between the structural funds and the evolution of regional disparities across countries and over time. Beugelsdijk and Eijffinger (2005) raise the prospect of moral hazard and substitution effects. In the case of the former, regions which apply the funds efficiently may, by virtue of higher growth rates, eventually become ineligible for funding. This provides an incentive for political elites in these regions to misallocate the funds so as to

continue being recipients. In the case of the latter, projects financed by structural funds may attract factors from more productive uses something which may be inimical to growth. Becker et al (2010b) argue that even assuming that structural funds are dedicated towards investment projects, they may be subject to diminishing returns and so beyond some threshold level of fund intensity, additional funds have no impact on growth. Since elite incentives, misallocation effects and diminishing returns are all likely to be greater at higher levels of fund intensity, we propose to explore a U-shaped quadratic form indicating that increasing the intensity of structural funds may reduce regional disparities but beyond some level of structural funds as a share of GDP, the positive effects on regional disparities might disappear or even be reversed. Thus, we also propose to estimate:

$$Regional\ Disparities_{it} = \alpha + \beta_1 SF_{it} + \beta_2 (SF_{it})^2 + \beta_3 X_{it} + \varepsilon_{it} \qquad (2)$$

again i refers to countries, t to years, α is a constant, X_{it} is the vector of control variables and ε_{it} is the error term.

In choosing our control variables we are basically concerned with accounting for factors which may affect both regional disparities and structural funds and, consequently, whose omission might bias the estimated impact of structural funding on regional disparities. Our first control variable is fiscal decentralization. Theoretically, fiscal decentralization can either increase or decrease regional disparities (see for example, Prud'homme, 1995 and Oates, 1999 for the former, and McKinnon, 1997 and Qian and Weingast, 1997 for the latter). Recent empirically work has found that fiscal decentralization tends to reduce regional disparities within countries (Ezcurra and Pascual, 2008; Lessmann, 2009; Rodríguez-Pose and Ezcurra, 2010). Fiscal decentralization may also affect the allocation of structural funds. The administrative capacity of regions is likely to be greater in more fiscally decentralized settings. Since

regional authorities play an active role in the setting up and execution of the projects to be financed, the extent of decentralization may affect the capacity of regions to absorb and execute structural funds (Bahr, 2008). Because it is available for the widest cross-country sample, fiscal decentralization has typically been measured as expenditure or revenue share of sub-central governments in total public expenditures (or as a percentage of GDP) based on the IMF's Government Finance Statistics (GFS). But these definitions do not control for inter-governmental transfers or grants to and from central government respectively (Kyriacou and Roca-Sagalés, 2011). We use indicators of fiscal decentralization (both on the expenditure and revenue sides) provided by Gemmell et al. (2009) which account for such grants and transfers based on the OECD General Government Accounts (see also Lessmann, 2009)[6].

We also control for GDP per capita. Obviously GDP per capita affects structural funds allocation since it is the main criterion employed for deciding on the eligibility of regions for funding. But GDP can also affect the evolution of regional disparities for reasons not necessarily related to structural fund allocation. Williamson (1965) has argued that disparities may increase at low levels of income and fall at higher ones (an inverted U shaped relationship). This is basically because at earlier stages of development resources may concentrate in some regions but at later stages capital moves to poorer regions due to higher factor costs or diseconomies of agglomeration in richer ones. Wealthier countries are also likely to have a greater scope for redistributive policies which may reduce regional disparities (Lessmann, 2009).

[6] In particular, subnational expenditure as a proportion of consolidated general government spending (which subtracts from state and local expenditure, transfers paid to central government), and subnational revenue as a proportion of consolidated general government revenue (which subtracts from state and local revenues, grants from other governments).

In a similar vein, we further control for the government share of real GDP since this determines the redistributive capacity of the state (Rodríguez-Pose and Ezcurra, 2010). This is especially important given that the additionality principle requires that projects financed through structural funds be, to a certain extent, co-financed by recipient countries. We, moreover, control for public investment since this has typically been aimed towards improving the productive capacity of less developed regions. In the absence of a country level indicator which reflects the regional dispersion of public investment we employ national public investment as a percentage of GDP.

Regional disparities are likely to be affected due to growing globalization. Rodríguez-Pose and Gill (2006) present a range of theoretical arguments from both the New Economic Geography and the Heckscher-Ohlin framework for why increasing trade or integration may either reduce or increase regional disparities. The empirical evidence is suggestive of a positive relationship between openness or economic integration and regional disparities (Giannetti, 2002; Petrakos et al, 2005). To the extent that openness contributes to falling regional incomes in less advantaged regions, then it may also be related to structural fund allocation.

Another factor which may influence the relationship between structural funds and regional disparities are human capital endowments. Human capital is a significant factor explaining economic growth at the national level (Mankiw et al, 1992) and it has been included in various empirical studies focusing on the impact of structural funds on growth either at the regional (Rodríguez-Pose and Fratesi, 2004; Rodríguez-Pose and Vilalta-Bufí, 2005) or country levels (Ederveen et al. 2006; Bähr, 2008). Typically, human capital has been measured by way of quantitative indicators of education. For our purposes here, to control for the impact of human capital on regional disparities, we ideally need a measure of the former which accounts for regional differences in human

capital endowments across countries. In the absence of such a measure, we turn to Barro and Lee (2001) who provide an indicator defined as the average years of schooling of the population aged 25 and over.

The relationship between structural funds and within-country regional inequalities may also be influenced by ethnic segregation. Alesina et al (1999) show that ethnic heterogeneity reduces agreement over public policies something which eventually, reduces public good provision. It could be that ethnically segregated societies have greater difficulties in agreeing on inter-territorial redistribution, something which is likely to increase regional disparities. Moreover, to the extent that the absorption of structural funding implies bargaining between regional and national authorities (Bachtler and McMaster, 2008; Bouvet and Dall'erba, 2010), ethnic segregation may affect the allocation process[7]. We measure ethnic segregation by way of Alesina and Zhuravskaya (2011): they propose a continuous variable which ranges from a value of 1, if a country's regions are inhabited by different ethnic groups (and therefore each region is fully homogeneous), and a value of 0 if each region has the same ethnic composition as the country as a whole. Their measure does not account for the "distance" or degree of difference between ethnic groups. Data is drawn from the Census closest to the year 2000, national statistical offices and regionally representative demographic and health surveys[8].

[7] See also Crescenzi (2009) for a discussion of the impact of political bargaining on the EU's regional policy.

[8] This indicator is, in fact, a squared coefficient of variation and it gives higher weight to the deviation of group composition from the national average in more populous regions than in less populous ones. A case could be made in favor of using this variable as a suitable proxy for the regional dispersion of human capital because of Borjas (1992) who has long argued that ethnicity, or ethnic capital, acts as an externality on the accumulation of human capital. The skills of future generations depend, among other things, on the average human capital of their

One final factor which may be related to regional disparities and structural funding is government quality. Institutional quality has been identified as an important factor explaining economic development at the country level (Acemoglu et al, 2005; Rodrik et al, 2004) and there is a growing appreciation that it also plays an important role in explaining regional development (Rodríguez-Pose, 2010). Similarly, several studies have dealt with the impact of institutional quality on the effectiveness of structural funds – measured in terms of their impact on GDP growth in a panel of countries, – the idea being that the effect of the funds depends to some extent on how effective governments are (Beugelsdijk and Eijffinger 2005; Ederveen et al 2006). Moreover, Katsaitis and Doulos (2009) consider how institution quality mediates in the relationship between structural funds and FDI flows. Finally, Bahr (2008) controls for institutional quality when estimating the impact of fiscal decentralization on the effectiveness of structural funds, again, in terms of their contribution to GDP growth in a panel of countries. Ideally, to calibrate the impact of government quality on regional disparities we require an indicator which captures the variance of government quality across regions. This in turn implies the need of indicators of government quality at the regional level which unfortunately are not available for our sample. In light of these limitations we follow previous work and use instead country-wide indicators of government quality from the World Governance Indicators (Kaufmann et al, 2006). We employ an aggregate indicator which captures four dimensions of government quality

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ethnic group. Assuming that there are significant differences in the productivity of ethnic capital across ethnic groups this may lead to appreciable differences in human capital accumulation. And one way that ethnic capital may be transmitted to human capital is through the territorial concentration of ethnic groups (Borjas, 1995). Ethnic segregation across regions could therefore capture inter-regional differences in human capital and we would expect more ethnic segregation to be associated with greater regional disparities.

namely, control of corruption, rule of law, regulatory quality and government effectiveness[9].

4. Results

We present our main regression results in table 1. The impact of our control variables on regional disparities is mostly in line with previous empirical work. We find that fiscal decentralization tends to be related with lower regional disparities within countries. Wealthier countries also tend to have lower regional disparities as we measure them in this paper. On the other hand, we found no evidence of an inverse U-shaped relationship between GDP per capita and disparities, probably because our sample only contains high-income countries. We also find that public investment reduces regional disparities in line with the expectation that governments may aim such investment towards the reduction of such disparities. The positive coefficient of ethnic segregation confirms the expectation that in societies with territorially separated ethnic groups it may be more difficult to adopt policies aimed at reducing regional disparities. The results also indicate that higher government quality tends to be associated with lower regional disparities. The empirical link between regional disparities and either government size or openness is more ambiguous. Openness is related to greater regional disparities, as found in previous work, but this relationship is not always statistically significant. Human capital also tends to increase regional disparities, possibly because an increase in the level of human resources in one region is largely due to the influx of educated people from neighbouring regions. Government size is sometimes associated with less regional disparities (as expected) but in some of our regressions it is also positively associated and, mostly, its impact is not statistically significant.

[9] For more information see *http://info.worldbank.org/governance/wgi/index.asp*.

Table 1. Regional disparities and structural funds.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Funds variable		SF	SFCF	SF	SFCF	SF	SFCF
Fiscal Decentralization	-0.172	-0.147	-0.184	-0.160	-0.138	-0.132	-0.138
	(0.040)***	(0.041)***	(0.043)***	(0.049)***	(0.050)***	(0.044)***	(0.042)***
GDP per capita	-0.031	-0.041	-0.026	-0.118	-0.095	-0.063	-0.064
	(0.029)	(0.028)	(0.030)	(0.050)**	(0.049)*	(0.033)*	(0.032)**
Size of Government	-0.163	0.016	-0.011	-0.020	-0.009	-0.161	-0.215
	(0.046)***	(0.056)	(0.052)	(0.076)	(0.074)	(0.060)***	(0.053)***
Public Investment	-0.544	-1.676	-1.618	-1.431	-1.407	-0.673	-0.606
	(0.268)**	(0.259)***	(0.245)***	(0.346)***	(0.333)***	(0.336)**	(0.324)*
Openness	0.038	0.028	0.031	0.043	0.040	0.017	0.026
	(0.013)***	(0.014)**	(0.014)**	(0.019)**	(0.019)**	(0.017)	(0.016)
Human Capital	0.013	0.005	0.002	0.001	0.001	0.012	0.013
	(0.004)***	(0.004)	(0.005)	(0.008)	(0.008)	(0.004)***	(0.005)**
Ethnic Segregation	0.493	0.390	0.384	0.388	0.379	0.481	0.485
	(0.102)***	(0.082)***	(0.077)***	(0.094)***	(0.096)***	(0.094)***	(0.113)***
Government Quality	-0.056	-0.045	-0.040	-0.047	-0.047	-0.043	-0.046
	(0.011)***	(0.011)***	(0.012)***	(0.016)***	(0.016)***	(0.013)***	(0.013)***
Dummy for cohesión countries	-0.084						
	(0.019)***						
Funds (-1)		-0.030	-0.026			-0.082	-0.076
		(0.004)***	(0.003)***			(0.015)***	(0.014)***
Funds (last 3 years mean)				-0.055	-0.040		
				(0.012)***	(0.008)***		
Funds (-1) ^{2}						0.029	0.024
						(0.005)***	(0.004)***
Adjusted R^2	0.45	0.51	0.57	0.47	0.45	0.40	0.48
Observations	138	138	138	110	110	138	138

Standard Errors in parentheses. *, **, *** measures statistical significance at the 10, 5 and 1% levels respectively. SF refers to structural funds and SFCF refers to structural funds plus cohesion funds. "Ethnic segregation" is a time constant variable. All regressions report FGLS using Period SUR weights and include constant (not shown).

We now turn to the impact of structural funds on regional disparities. In column 1 of the table we start by considering a dummy variable for the four cohesion countries identified in section 2. The reason for doing this is that cohesion countries have the highest transfer intensity, and so this dummy could be capturing the impact on regional disparities of

receiving relatively large transfers from the funds. We find that being a cohesion country is negatively and significantly related to regional disparities.

Since structural and cohesion funds are mostly destined towards infrastructures and consequently finance projects that may take more than a year to materialise in terms of their impact on economic growth, we have taken into account the potential importance of lagged effects.[10] In particular, we have considered our funds variables lagged one, two and three periods (one at a time and simultaneously) and, alternatively, including the mean of the last two and three year periods. Columns 2 to 5 show the results taking one year lags and the mean of the last three years of the funds variables considering structural funds (regressions 2 and 4) and structural and cohesion funds (regressions 3 and 5). They all show that the economic impact of the funds on regional disparities is negative and statistically significant[11].

In general, all the estimations in table 1 show a significant negative effect of our funds variables and confirm that they tend to reduce regional disparities within countries. We test for a quadratic relationship between funding and disparities in regressions 6 and 7 and find that this relationship is, as expected, a U-shaped one. In particular, our estimates suggest that structural funding towards a specific country up to 1.4% or 1.6% of GDP (SF and SFCF respectively), tend to reduce disparities but beyond this transfer intensity, structural funding tends to raise regional differences. This is line with previous work which has been concerned with the existence of elite incentives, misallocation effects and diminishing returns at higher levels of transfers. Following our discussion in section 2, this implies that Portugal and Greece may have received higher amounts of

[10] According to Becker et al (2010a) and Mohl and Hagen (2010) the effects of structural funds on growth may last up to 3 or 4 years while no immediate effects are detected.

[11] The results with longer lags and two year means are not presented and are available upon request.

transfers than would have been desirable from the perspective of reducing regional disparities within each of these countries.

5. Robustness analysis

In this section we examine the robustness of our findings. First, in order to fathom whether the results are being driven by one particular country in our sample, we repeat our regressions after removing each of the 14 countries one at a time for the whole sample. The results are stable, indicating that no single country is driving them, and confirm the role of structural and cohesion funds on regional disparities within countries.

Second, we examine the extent to which our results depend on the way we define regional disparities. Inequality indices entail different value judgements on income differences at the tails of the distribution (Lambert, 2001; Cowell, 1995), which lead to different inequality orderings. In this section we apply the same estimation approach to different measures of regional disparities. To this effect, we have considered, first, the population-weighted standard deviation of the logarithm of regional GDP per capita (PW-LOG), which is a measure widely used in the convergence literature to capture sigma convergence (Barro and Sala-i-Martin 1995):

$$\text{PW-LOG} = \left[\sum_{i=1}^{n} p_i (\ln \bar{y} - \ln y_i)^2 \right]^{1/2}$$

where $\bar{y}$ is the country GDP per capita average, y_i and p_i are the GDP per capita and population share of the region (at the NUTS 1 or 2 level as before), and *n* is the number of regions.

Secondly, we consider a measure proposed by Theil (1967) that is typically employed in the inequality literature and has also been used in order to analyse spatial disparities (Azzoni, 2001; Novotny, 2007):

$$\text{THEIL} = \left[\sum_{i=1}^{n} p_i \ln\left(\frac{\bar{y}}{y_i} \right) \right]$$

Third, the coefficient of variation of the regional GDP per capita (CV), indicator that does not take into account the distribution of the population across all regions. In this sense, this indicator would present higher disparities – compared to our main indicator which adjusts for population, – when the main region is significantly larger in terms of population than the others (that would be the case for instance for France and Greece where the population is concentrated in the region's capital, but also for UK and Germany because of the existence of large hubs concentrated in some regions).

$$\text{CV} = \frac{1}{\bar{y}} \left[\frac{1}{n} \sum_{i=1}^{n} (\bar{y} - y_i)^2 \right]^{1/2}$$

Both the Theil and CV indicators satisfy the technical requirements described in section 2. This is not the case for PW-LOG since it does not satisfy the Pigou-Dalton principle.

Finally, we also contrast the results using a population-weighted coefficient of variation index provided by the OECD (PW-CV OECD) which behaves slightly differently compared to that which we present in section 2[12].

[12] The simple correlations between our main indicator of regional disparities (as presented in section 2) and PW-LOG, THEIL, CV and PW-CV OECD are respectively, 0.94, 0.96, 0.76 and 0.60.

Table 2. Robustness Analysis: Different Ways to Measure Regional Disparities. Feasible GLS (FGLS).

Regional Disparities variable	*(1)* *THEIL*	*(2)* *PW-LOG*	*(3)* *PW-CV OECD*	*(4)* *CV*	*(5)* *THEIL*	*(6)* *PW-LOG*	*(7)* *PW-CV OECD*	*(8)* *CV*
SF (-1)	-0.005 (0.001)***	-0.024 (0.004)***	-0.042 (0.006)***	-0.038 (0.009)***				
SFCF (-1)					-0.005 (0.001)***	-0.024 (0.004)***	-0.029 (0.006)***	-0.031 (0.008)***
F-test	*14.59****	*12.46****	*23.01****	*20.637****	*19 461****	*18.75****	*18.92****	*24.07****
Adjusted R^2	*0.47*	*0.43*	*0.59*	*0.56*	*0.55*	*0.54*	*0.54*	*0.60*
Observations	138	138	139	138	138	138	139	138

Regional Disparities variable	*(9)* *THEIL*	*(10)* *PW-LOG*	*(11)* *PW-CV OECD*	*(12)* *CV*	*(13)* *THEIL*	*(14)* *PW-LOG*	*(15)* *PW-CV OECD*	*(16)* *CV*
SF (-1)	-0.016 (0.003)***	-0.060 (0.011)***	-0.125 (0.013)***	-0.147 (0.025)***				
SF (-1) ^{2}	0.005 (0.001)***	0.016 (0.004)***	0.039 (0.005)***	0.048 (0.009)***				
SFCF (-1)					-0.014 (0.003)***	-0.061 (0.011)***	-0.100 (0.013)***	-0.141 (0.023)***
SFCF (-1) ^{2}					0.004 (0.001)***	0.016 (0.003)***	0.027 (0.004)***	0.039 (0.007)***
F-test	*12.72****	*14.53****	*62.08****	*29.81****	*11.41****	*17.00****	*53.97****	*32.48****
Adjusted R^2	*0.46*	*0.50*	*0.82*	*0.68*	*0.43*	*0.54*	*0.79*	*0.70*
Observations	138	138	139	138	138	138	139	138

Standard Errors in parentheses. *, **, *** measures statistical significance at the 10, 5 and 1% levels respectively. SF refers to structural funds and SFCF refers to structural funds plus cohesion funds. All regressions report FGLS using Period SUR weights and include the following control variables: fiscal decentralisation, GDP per capita, size of government, public investment, trade openness, human capital, ethnic segregation (a time constant variable) and government quality.

In table 2 we present our regressions employing the regional disparities indicators just presented. Our results are fully consistent with our previous findings. Structural funds tend to reduce regional differences in GDP per capita within countries

(regressions 1 to 8). Moreover, the quadratic relationship with respect our funds variables is confirmed (regressions 9 to 16) as is the associated transfer level above which structural funds tend to increase regional disparities. Regardless of the indicator used, structural funds in excess of approximately 1.6% of GDP tend to increase regional disparities. In this respect, it is interesting to consider that Becker et al (2010b) employ data from the same programming periods and find that beyond a transfer intensity of 1.3% of a region's GDP, additional funds do not contribute towards income growth. These results are not markedly different to ours, despite the fact that they refer to transfer intensity at the regional rather than the national levels and, moreover, employ a different empirical methodology namely, general propensity score estimation.

Before closing here we must deal with an additional methodological issue namely, the problem of reverse causality. Structural funds may reduce regional disparities, but can regional disparities as we measure them in this paper affect structural fund allocation? We would argue that this is not necessarily the case. Typically, regions which have been eligible for the lion's share of the funds are ones whose GDP per capita is lower than 75% of the EU average (objective 1 regions). In the years under examination, most of these regions where located in the poorer member states. But the poorer member states are not necessarily the ones with the highest regional disparities. For example, all Greek regions are eligible for funding but Greece has one of the lowest regional disparities of any country in our sample (see section 2). Alternatively, although most of Belgium's regions where not classifiable as objective 1 regions, Belgium has the highest regional disparities during the period under examination. Thus, it is not the case that more within-country regional disparities imply more structural funds. Notwithstanding this argumentation and since we are aware that reverse causality can bias our estimates, we account for its potential impact by

instrumenting all potentially endogenous variables using 2 and 3 year lags as instruments and estimating via two stage least squares (see also Barro, 2000). In the case of ethnic segregation which is time invariant we use an instrument proposed and motivated by Alesina and Zhuruvskaya (2011) which relates the spatial distribution of ethnic groups in a country to the composition of major ethnic groups present in neighbouring countries. The assumption is that people belonging to a particular group "gravitate" towards the borders of countries that are populated by people from the same group. Our main findings are maintained[13].

6. Conclusion

The declared objective of the European Union's regional policy is to reduce regional disparities across the Union's regions. In this paper we have focused on the effect of structural spending on one important component of EU-wide regional income differences namely, within-country regional disparities. Our results show that the structural and cohesion funds helped to reduce regional disparities within EU members during the programming periods 1994-99 and 2000-06. They also point to the existence of a maximum desirable level of structural fund transfers (approximately 1.6% of national GDP) beyond which structural funds may increase regional differences within countries. Reasons for this may range from moral hazard and substitution effects to diminishing returns.

Since the year 2000 the European Union adheres to a transfer intensity ceiling such that no country's total transfers from the structural and cohesion funds can exceed

[13] Results available upon request. Conceptually, this reverse causality aspect is potentially a more serious problem when studying the impact of structural funds on GDP growth at either the regional or national levels.

4 percent of its GDP[14]. A look at the execution of the current 2007-2013 programming period indicates that while transfer intensity is below the 4% ceiling, it is well above the 1.5% threshold in all the new member states bar Cyprus and Malta. Interestingly, because funds have been redistributed away from previous cohesion countries towards the new members, none of the old members currently exceed the 1.5% threshold. Extrapolating our results to the new member states, suggests that the current fund intensity may make a negative contribution towards evolution of regional disparities within these countries.

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[14] The December 1999 Berlin Summit established the principle of 'absorption capacity' implying that no member country is allowed to get more than 4 per cent of its GDP in form of structural funds (European Council, 1999).

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Appendix. Data Sources

Variable	Source	Comments
Regional GDP per capita	Cambridge Econometrics and national statistics (courtesy of A. Rodríguez-Pose)	Time varying (annual)
Population	World Development Indicators (World Bank)	Time varying (annual)
Structural and cohesion funds	Annual Reports on the Structural Funds (European Commission)	Time varying (annual)
Fiscal decentralization	OECD General Government Accounts (courtesy of I. Sanz)	Time varying (annual)
GDP per capita	Penn Tables	Time varying (annual)
Government size	IMF Government Finance Statistics	Time varying (annual)
Public investment	European Economy Statistical Annex (European Commission)	Time varying (annual)
Trade openness	Penn Tables	Time varying (annual)
Human capital	Barro and Lee (2001)	Time varying (5 year periods)
Ethnic segregation	Alesina and Zhuravskaya (2011)	Time invariant
World Governance Indicators	World Bank	Time varying (annual)

Notes: See main text for the definitions of the variables.