EXTENDED ABSTRACT

Title: Regional Financial Support Policy: What We Have Learned from the Past and Where Are We Moving

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Abstract: One of the issues of the European Union (EU) – disparities between and within Member States (MS). The European Commission (EC) is addressing this issue in shaping regional Cohesion Policy (CP) and the allocation of Structural Funds (SF) and Cohesion Fund (CF) support. One of the ultimate goals of support is to strengthen economic and social cohesion by correcting imbalances between EU regions. Given the importance of this issue, great attention is being paid to responding to this objective in previous research. However, research most often investigates the linear impact of SF support on economic growth at countries, NUTS 1 and 2 level and leaves open the question of whether there is an impact on convergence between regions and whether non-linear effects occur, especially at NUTS 3 level. Non-linear effect of SF support on outcomes may occur due the diminishing returns, substitution effects and moral hazard phenomenon. We might expect non-liner relation in a form of inverted U-shaped letter between SF and CF transfers intensity and the outcomes suggested by the diminishing returns, substitution effects and moral hazard phenomenon. According to Becker et al. (2012), since regional support is mainly directed toward investment projects, SF and CF transfers may generate diminishing returns i.e. large and additional amount of transfers to investment projects expected to associate with lower marginal outcomes. Therefore, it is assumed that when EU regional support reached the threshold intensity level, additional SF and/or CF transfers do not generate additional regional productivity, GDP per capita growth and convergence. Moreover, marginal effects might become reverse.

Substitution effect occurs when beneficiary regions reduce their local and/or national resources and substitute them with EU regional support (Beugelsdijk and Eijffinger 2005, del Bo et al. 2011, Marzinotto 2012). Those public support schemes are inefficient and are accompanied by such undesirable results: i) if projects funded by SF or CF are close substitute for private capital, this may have the effect of crowding out private investment; ii) public entities would have to invest even more if SF and CF support will end; iii) SF and CF support loses its importance and without multiplicative impacts investments become unnecessary in lagging regions; iv) local authorities lose motivation to generate enough revenue from their own source; v) the usage of SF and CF transfers as a substitute of local or national funds may reduce the potential returns of EU regional support because enlist inputs from more productive areas.

Moral hazard phenomenon related to the considered parties' aspirations to obtain additional benefits taking higher risks and often violating established rules. According to Beugelsdijk and Eijffinger (2005), as regions receive SF and CF support only below a certain level of development, in order to achieve or preserve beneficiary status regional or national government may manipulate statistics. It can lead to funding cut-off from productive projects and result in lower or even negative outcomes of SF and CF transfers. The rate of convergence between regions may decrease or even increase regional divergence if SF transfers are directed to regions that have already reached a high level of development. Corruption in support allocation schemes also is related to a moral hazard phenomenon and can lead to the same results.

Diminishing returns, substitution effects and moral hazard phenomenon justify the importance to determine the desirable intensity level of SF and CF transfers. This would allow for a rational redistribution of EU regional support and make CP more effective. However, just a few previous studies (Mohl and Hagen, 2008; Wostner and Šlander, 2009; Becker et al., 2012; Kyriacou and Roca-Sagales, 2012; Pinho et al. 2015, Pellegrini and Ceruqua, 2016; Pontarollo, 2017) investigated effect of transfers' intensity on SF returns. They all (except Hagen and Mohl, 2008) reveal that after a certain SF and/or CF commitments intensity additional payments do not generate significant positive outcomes. According to Becker et al. (2012) findings, this boundary line is approximately 1.3 per cent of regional GDP. Hagen and Mohl (2008), reveal that SF transfers do not affect economic growth rate significantly, and taking this in to account, conclude that it does not matter which "dose" of SF transfers the regions have received. Some authors (Wostner and Šlander, 2009; Kyriacou and Roca-Sagales, 2012; Pinho et al. 2015) highlighted that it is matter not only maximum desirable level of SF and/or CF transfers intensity but also minimum i.e. if transfers intensity is too low it does not promote economic growth. According to Kyriacou and Roca-Sagales (2012) minimum desirable level of transfers intensity is approximately 1.75 per cent of countries GDP. It is in line with Wostner and Šlander (2009) finding that minimum desirable transfer's intensity is 1.6 per cent, both assessment covers country level. Pinho et al. (2015) find that minimum desirable level of transfer's intensity is 3 per cent of countries GDP i.e. higher comped with Wostner and Šlander (2009), and Kyriacou and Roca-Sagales (2012) findings. Bandonio and Pellegrini (2016), European Commission (2016), Pellegrini and Cerqua (2016) agree that SF and CF transfer intensity matters for returns, but do not provide a desirable level. Thus, the results of the previous study are not uniform and clear. Also, it should be noted, that previous investigations do not determine desirable level of SF and CF transfer intensity at NUTS3 level for positive impact on convergence. To address this gap, our research aims to evaluate non-linear effect of the EU regional financial support on convergence not only at NUTS 2, but also at NUTS 3 level over the 2000-2006 and 2007-2014 programming periods and to provide main guidelines for adjusting the EU's Cohesion Policy.

Our examination on how different levels of funding intensity over the two last programming periods is related to diminishing regional disparities at NUTS 2 and 3 level is based on regression model and modified difference-in-differences approach to account for possible non-linear effect. The detailed explanation of the methodology employed in the research and data on SF and CF funding is provided in the Appendix. Table 1 (see Appendix) reports information on two variables considered in the research as the dependent since we are interested here in estimating to what extent SF and CF contributed to diminishing disparities between regions in terms of development level and productivity. Data on productivity over 1995-1999 is missing for Greece, except for Attiki, The Netherlands, and for four UK regions. Data on Mayotte (France) is missing

for all years. For Poland the average was calculated including just two years, 1998 and 1999. Table 2 (see Appendix) reports information about control variables included in the model.
Table 3 (see Appendix) reports fixed effects estimates of Eq. (3) for two last programing periods. Estimations are made separately for a sample of NUTS 2 and 3 regions and for two dependent variables – per capita GDP and productivity. The estimated direction of control variables seems to be reasonable. Higher investment ratio, bigger share of employed in high-technology sectors, higher population density and thus agglomeration effect, bigger industry sector according to a share of created GVA have positive statistically significant effect on regional per capita GDP. Bigger proportion of working age population and share of it with tertiary education seems to have positive but insignificant effect on per capita GDP in a region. On contrary, bigger proportion of working age population with primary education and size of agriculture sector in a region is negatively and significantly related with its per capita GDP. Amount of investment per worker, workers' tertiary education, innovations, and higher share of employed in industry sector have positive significant correlation, whereas primary education and employment in agriculture have negative significant correlation with productivity. Infrastructure measured as the density of motorways has positive insignificant effect.
All estimations show that financial support contributed to diminishing disparities among regions in terms of their development level and productivity. Nevertheless, relationship between funding intensity and the effect on disparities is non-linear, suggesting that not in all regions and not all support had a positive effect. Last row in Table 3 reports calculated turning point of financial support intensity using Eq. (4). Marginal effect of funding intensity above this point on diminishing disparities is estimated to be negative. Table 4 (see Appendix) reports which regions were overfunded according to estimated turning points in Table 3. Calculations are made separately for both programming periods, taking into the account disaggregation level and dependent variable under consideration. Fig. 1-4 (see Appendix) present relationships between level of funding intensity and estimated effect on convergence, between level of funding intensity and estimated marginal effect on convergence, between level of funding intensity and standard error of estimated marginal effect on convergence, between level of funding intensity and t-ratio of estimated marginal effect on convergence respectively. They allow to analyse not just size, but as well significance of the estimated effect.
According to our estimation results, distribution of SF and CF funding across regions over the last two programming periods was far from being an optimal considering maximizing the effect of SF and CF expenditures on convergence. The same is true for both disaggregation levels and for both dependent variables under consideration. Despite the fact that in a wide range of relatively high funding intensity its marginal positive (or negative) effect on convergence is estimated as statistically insignificant, in some extreme cases of funding intensity not just marginal, but as well total effect on convergence was significant and negative.
Comparing two programming periods and two disaggregation levels, we see some differences. The overfunding was more typical for 2007-2013 programming period and for NUTS 2 level (over both periods under investigation). Among mostly overfunded dominate regions from Portugal and Greece (over 2000-2006 programming period) and from Poland, Hungary, Bulgaria, Portugal and Greece (over 2007-2013 programming period). It seems that vast amount of SF and CF funding for the least developed regions did not helped to increase their productivity and development level significantly enough for convergence to appear.

Our results are in line with previous research analysing earlier programming periods and effect on other than convergence outcomes. Despite the fact that our estimated turning points (the maximum desirable funding intensity) is higher compared to existing empirical evidence (probably due to different outcome variable, analysed period, and method), our conclusion is quite the same – there are too many too much funded regions, which are not spending SF and CF allocations efficiently to boost their productivity and growth to ensure regional convergence. Thus the re-allocation of ES funds, avoiding overfunding, is crucial over the following programming period to ensure more efficient use. This conclusion also brings us to the one more question – what cause inefficient use of SF and CF funding in very highly supported regions? Is it a matter of a simple diminishing returns to investment or more complicated issue related to corruption, misallocation of funds due to shortage of managerial knowledge or week institutional environment? Having a robust answer to this question would allow to firstly direct funding to solve problems in the areas which interfere efficient use of regional support.

Keywords: difference-in-differences (diff-in-diffs) estimator, Structural Funds, Cohesion Policy, regional disparities, convergence, NUTS 3.

JEL codes: O47, O52, R11, R12, R15, R58.

APPENDIX

Methodology and data

Aiming to estimate the maximum desirable support intensity level, which still has a positive effect, and minimal level that starts to have significant effect, we examine potentially non-linear relation between financial support intensity and imbalances among EU regions. We ground our model on difference-in-differences (DiD) approach. The initial specification of the linear regression equation, which allows to estimate just homogeneous DiD parameter, is:

$$Y_{it} = \delta_0 + \delta_1 \cdot t2_t + \delta_2 \cdot s_{it} + \delta_{DiD} \cdot t2_t \cdot s_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is the variable in the *i*-th region whose disparities between supported and unsupported regions is under examination. δ_0 is the estimate of the average Y_{it} in the group of not supported (control) regions over the reference period. $t2_t$ is a dummy variable equal to 1 for the financial intervention period and equal to 0 for the reference period. δ_1 shows how average Y_{it} in in the control group changed over the financial intervention period, compared with the reference period, i.e. how variable under consideration has changed without financial support. s_{it} is a dummy variable equal to 1 if the region received financial support and equal to 0 otherwise. δ_2 shows how average Y_{it} differed between financial support recipients and control group already before the financial intervention took place, i.e. shows the initial (over the reference period) difference between supported and not supported regions. We expect to estimate negative parameter on δ_2 since CP focuses on less developed regions. δ_{DiD} is the DiD parameter which shows the effect of support, i.e. whether the initial negative differences between support recipients and control group became smaller due to financial support. Positive parameter on δ_{DiD} would give an evidence that initial differences over reference period became smaller over financial intervention period, i.e. financial support contributed to regional convergence. ε_{it} is the error term.

We assume that regions will not respond to SF transfers in exactly the same way simply because the amount of support is not constant across regions. To put in other words, the effect of financial support hinges on the amount of financial support. Thus, there we expect some heterogeneity in the impact across regions as well. We can estimate DiD assuming heterogeneity of the support effect by interacting s_{it} dummy with financial support intensity, S_{it}. If a region does not receive financial support, s_{it} and S_{it} as well as their interaction equal to zero. If a region receives support, s_{it} is equal to unity and its interaction with S_{it} is equal to S_{it}. Thus, s_{it} substituting with S_{it} we will estimate the effect of financial support intensity on the convergence:

$$Y_{it} = \delta_0 + \delta_1 \cdot t2_t + \delta_2 \cdot S_{it} + \delta_{DiD} \cdot t2_t \cdot S_{it} + \varepsilon_{it}, \quad (2)$$

where δ_{DiD} now measures the effect of financial support intensity change by one unit on regional disparities.

To relax an assumption that the marginal effect of S_i on the convergence is constant, i.e. relationship is linear, we introduce quadratic specification. To account for other factors having effect on Y_{it} we add C_{jit} that correspond to a vector of a time-varying factors, and θ_i that correspond to a vector of a time-constant factors:

$$Y_{it} = \delta_0 + \delta_1 \cdot t2_t + \delta_{21} \cdot S_{it} + \delta_{22} \cdot S_{it}^2 + \delta_{DiD1} \cdot t2_t \cdot S_{it} + \delta_{DiD2} \cdot t2_t \cdot S_{it}^2 + \beta_j \cdot C_{jit} + \mu \cdot \theta_i + \varepsilon_{it}. \quad (3)$$

Statistically significant and positive δ_{DiD1}, and statistically significant and negative δ_{DiD2} would give an evidence of a quadratic form of relationship in the form of inverted U with a marginal effect of financial support intensity on Y_{it} calculated as:

$$\frac{\partial(Y_{it})}{\partial(S_{it})} = \delta_{DiD1} + 2 \cdot \delta_{DiD2} \cdot S_{it}. \tag{4}$$

In the case of interactive Eq. (1) and (2), after the first differencing or time-demeaned transformations[1], they collapse to simple additive models for the second (financial intervention) period and estimated standard errors on coefficients associated with DiD parameter are general ones. However, in the case of the Eq. (3) the multiplicative term is retained after the first differencing or time-demeaned transformations for the second period (*t2*=1):

$$\begin{aligned} \ddot{Y}_i &= \delta_0 + \delta_1 \cdot (1) + \delta_{DiD1} \cdot (1) \cdot \ddot{S}_i + \delta_{DiD2} \cdot (1) \cdot \ddot{S}_i^2 + \varepsilon_i, \\ \ddot{Y}_i &= (\delta_0 + \delta_1) + \left(\delta_{DiD1} + \delta_{DiD2} \cdot \ddot{S}_i\right) \cdot \ddot{S}_i + \varepsilon_i, \end{aligned} \tag{5}$$

where $\ddot{}$ stands for the time-demeaned variable[2]. Therefore, not just the marginal effect of S_i on Y_i, i.e. slope $(\delta_{DiD1} + \delta_{DiD2} \cdot S_i)$ is conditioned on the value of S_i itself, but following Friedrich (1982), we can argue that the standard error of the slope coefficient is also conditioned on S_i value and standard error of the sum $(\delta_{DiD1} + \delta_{DiD2} \cdot S_i)$ is:

$$SE_{(\delta_{DiD1}+\delta_{DiD2} \cdot S_i)} = \sqrt{var(\delta_{DiD1}) + S_i^2 \cdot var(\delta_{DiD2}) + 2 \cdot S_i \cdot cov(\delta_{DiD1}, \delta_{DiD2})}. \tag{6}$$

This implies that the estimated marginal effect of S_i on Y_i can potentially be not significant over all range of observed S_i values, i.e. it is not necessary to reach the tipping point of S_i for the marginal effect not to differ from zero. In line with the usual logic of constructing for a coefficient, a test of statistical significance against the possibility that the population parameter is zero, the *t* value for the marginal effect of S_i on Y_i can be calculated, when S_i^2 is added to the equation, as:

$$t = \frac{\delta_{DiD1} + \delta_{DiD2} \cdot S_i}{SE_{(\delta_{DiD1}+\delta_{DiD2} \cdot S_i)}}. \tag{7}$$

Having an empirical relationship between Y_i and S_i in the form of inverted U letter, Eq. (7) enables us to test what the minimum level of S_i is required for the marginal effect of S_i on y_i to become significant and whether the marginal effect of S_i is still significant when the turning point is reached and the marginal effect becomes negative.

Compared to the study carried out in relation to 2000-2006 programming period (SWECO, 2008), the report for 2007-2013 programming period (Ciffolilli, et al, 2015) collects data on expenditure and not only allocations to selected projects. Having just allocations data for 2000-2006 period, but aiming to compare effects of two last fully expired programming periods, and considering that expenditure but not allocations could make an effect, we are putting forward few assumption regarding policy intervention periods and financial support intensity calculation:

(i) Under the framework of the EU CP for 2000-2006 programming period, old MS could spend the last allocation available until the end of the year 2008 (the n+2 rule) and for the central and eastern European countries the rule was applied as n+3 that time. From this perspective, 2000-2009 is considered as a policy intervention period for 2000-2006, since over 2000-2009 allocations could be spend and could made an effect. Financial support intensity is calculated as the ratio between allocations over 2000-2006 and total GDP over 2000-2009.

(ii) Since report for 2007-2013 programming period collected actual expenditure data by the end of 2014, we consider 2007-2014 as policy intervention period. Financial support intensity is calculated as the ratio between expenditures by the end of 2014 and total GDP over 2007-2014. 2007, 2008 and 2009 overlap with the years over which we evaluate effect of previous programming. We assume here that expenditures over 2007-2009 from 2007-2013 programming period had not great effect since the absorption capacity is increasing progressively when the end of the programming period is approaching.

For both periods, we analyse ERDF and CF allocations/expenditure combined. For 2000-2006 SWECO (2008) database contains data at NUTS 2 and 3 levels for the Cohesion Fund, ERDF Objective 1, ERDF Objective 2, URBAN and INTERREG IIIA allocations. The total amount mapped in the database for NUTS 3 is 149.819 bill. EUR which is 93.5% and for NUTS 2 is 156.174 bill. EUR which is 97.5% of the total CF and ERDF budget for 2000-2006. All current EU MS except Bulgaria, Romania and Croatia could receive funding for 2000-2006, thus there were 1251 NUTS 3 and 260 NUTS 2 level regions (according to NUTS classification that existed) under policy consideration. 188 NUTS 2 regions received funding and 72 did not. According to descriptive statistics, minimum of funding intensity was 0.03%, maximum – 2.92% with the average and median of 0.39% and 0.20% respectively. Over the same period 871 NUTS 3 regions received funding and 380 did not. According to descriptive statistics, minimum of funding intensity was 0.01%, maximum – 8.44% with the average and median of 0.37% and 0.13% respectively.

[1]These two alternative transformations are used to control all region-specific time-constant effects, i.e. θ_i. For example, geographical position of the region, which determines its access to infrastructure, such as seaports, highways etc. or economic linkages between regions, which can be an important growth factor for peripheral regions situated near core regions. Having little possibility to control these effects by including all necessary variables at NUTS 2 & 3 level, an unexplained variation which now would account for a part of the error term could lead to a correlation between ε_{it} and Y_{it} as well as between ε_{it} and S_{it}. This correlation is very likely to occur since financial support is not randomly distributed among regions, but depends on region's characteristics, which are also related to its growth and thus impose endogeneity problem.

[2] Using the first differencing, we would yield quite the same equation, just δ_0 would not be retained.

For 2007-2013, Ciffolilli, et al (2015) database contains cumulative expenditures of both ERDF and CF programmes at the NUTS 2 (276) and 3 (1342) levels of EU regions for all 28 EU countries and covers the Convergence, Regional Competitiveness and Employment as well as the European Territorial Cooperation Objectives for the period 2007-2013. The total amount mapped in the database for NUTS 3 is 200.193 bill. EUR which is 97.3% and for NUTS 2 is 202.854 bill. EUR which is 98.6% of the total expenditures by the end of 2014. 191 NUTS 2 regions received funding and 85 did not. According to descriptive statistics, minimum of funding intensity was 0.03%, maximum – 4.66% with the average and median of 0.72% and 0.34% respectively. Over the same period 958 NUTS 3 regions received funding and 384 did not. According to descriptive statistics, minimum of funding intensity was 0.02%, maximum – 8.81% with the average and median of 0.63% and 0.15% respectively.

Table 1. Dependent variables of the research

Short name	Full name	Description and source of data
GDP	Regional per capita GDP at constant prices	The main source of the data is *Gross domestic product indicators (reg_eco10gdp)*, subsection for *Gross domestic product (GDP) at current market prices by NUTS3 regions (nama_10r_3gdp)*. To correct the changes at price levels over time, we used *Price index (implicit deflator), 2010=100, euro (PD10_EUR)*. To calculate per capita GDP we used *Average annual population to calculate regional GDP data (thousand persons) by NUTS 3 regions (nama_10r_3popgdp)*. Data for GDP and population in aforementioned Eurostat data sources is not available prior to 2000. Data for 1995–1999 on *Gross domestic product (GDP) at current market prices at NUTS level 3* and *Average annual population* was retrieved from *nama_r_e3gdp* and *demo_r_d3avg* datasets respectively that were available on Eurostat previously and merged with currently available dataset.
GVA	Regional GVA per employed at constant prices	The main source of the data is *Branch and household accounts (reg_eco10brch)*, subsection for *Gross value added (GVA) at basic prices by NUTS 3 regions (nama_10r_3gva)*. To correct the changes at price levels over time, we used *Price index (implicit deflator), 2010=100, euro (PD10_EUR)*. To calculate GVA per worker we used *Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers)*. Data for GVA and employment in aforementioned Eurostat data sources is not available prior to 2000. Data for 1995–1999 on *Gross value added at basic prices at NUTS level 3* and *Employment (in persons) at NUTS level 3* was retrieved from *nama_r_e3vabp95* and *nama_r_e3empl95* datasets respectively that were available on Eurostat previously and merged with currently available dataset.

Table 2. Control variables[3] of the research

Short name	Full name, description and source of data	Measure-ment unit	NUTS level at which data is available		Model for which variable is used	
			2	3	GDP	GVA
IGDP	*Investment* calculated as the ratio between *Gross fixed capital formation by NUTS 2 regions (nama_10r_2gfcf)* and *Gross domestic product (GDP) at current market prices by NUTS 2 regions (nama_10r_2gdp)*.	%	X		X	
IWRK	*Investment* calculated per worker, as the ratio between *Gross fixed capital formation by NUTS 2 regions (nama_10r_2gfcf)* and *Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers)*.	Eur.	X			X
PEDUC	*Primary educations*, i.e. proportion of 25-64 years-old population with less than primary, primary and lower secondary education (levels 0-2). Data retrieved from *Population aged 25-64 by educational attainment level, sex and NUTS 2 regions (%) (edat_lfse_04)*.	%	X		X	X
TEDUC	*Tertiary education*, i.e. proportion of 25-64 years-old population with tertiary education (levels 5-8). Data retrieved from *Population aged 25-64 by educational attainment level, sex and NUTS 2*	%	X		X	X

[3] If the data for 1995-1999 according to The European System of National and Regional Accounts (ESA 2010) was missing, it was collected according to ESA 1995 and merged with current dataset.

	regions (%) (edat_lfse_04).					
HTEC	*Employment in High-technology sectors (high-technology manufacturing and knowledge-intensive high-technology services). Data for 1995-2007 retrieved from Employment in technology and knowledge-intensive sectors by NUTS 2 regions and sex (1994-2008, NACE Rev. 1.1) (htec_emp_reg). For 2007-2017 from Employment in technology and knowledge-intensive sectors by NUTS 2 regions and sex (from 2008 onwards, NACE Rev. 2) (htec_emp_reg2).*	Percentage of total employment	X		X	
MINFR	*Motorways*. Retrieved from *Road, rail and navigable inland waterways networks by NUTS 2 regions (tran_r_net).*	Kilometres of motorways per thousand square kilometres	X			X
PDENS	*Population density by NUTS 3 region (demo_r_d3dens).*	Inhabitants per square kilometre	X	X	X	
PSTR	*Population structure* calculated as proportion of 15-64 years-old to total number of inhabitants in the region. Calculations are made using data from *Population on 1 January by broad age group, sex and NUTS 3 region (demo_r_pjanaggr3).*	%	X	X	X	
INOV	*Patents per million inhabitants*. Data retrieved from *Patent applications to the EPO by priority year by NUTS 3 regions (pat_ep_rtot).*	Number of patents per million inhabitants	X	X		X
AEMPL	*Employment in agriculture sector*. Calculated as the proportion of workers employed in agriculture, forestry and fishing (A in NACE activities). Data retrieved from *Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers).*	%	X	X		X
IEMPL	*Employment in industry sector*. Calculated as the proportion of workers employed in industry (except construction, B-E in NACE activities). Data retrieved from *Employment (thousand persons) by NUTS 3 regions (nama_10r_3empers).*	%	X	X		X
AGVA	*Agriculture gross value added*. Calculated as the proportion of GVA created in agriculture, forestry and fishing (A in NACE activities). Data retrieved from *Gross value added at basic prices by NUTS 3 regions (nama_10r_3gva).*	%	X	X	X	
IGVA	*Industry gross value added*. Calculated as the proportion of GVA created in industry (except construction, B-E in NACE activities). Data retrieved from *Gross value added at basic prices by NUTS 3 regions (nama_10r_3gva).*	%	X	X	X	

Table 3. Fixed effects estimates

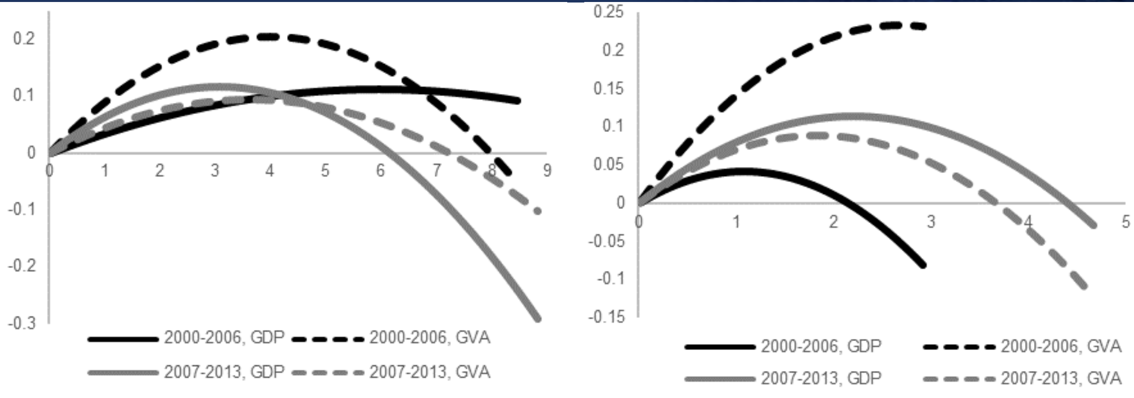
Variable	Parameter	Programming period of 2000-2006				Programming period of 2007-2013			
		NUTS 2		NUTS 3		NUTS 2		NUTS 3	
		ln GDP(1)	ln GVA(2)	ln GDP(1)	ln GVA(2)	ln GDP(1)	ln GVA(2)	ln GDP(1)	ln GVA(2)
Intercept	δ_0	9.81*** (0.00)	10.82*** (0.01)	9.82*** (0.00)	10.81*** (0.00)	9.92*** (0.00)	10.75*** (0.00)	9.88*** (0.00)	10.72*** (0.00)
$t2_t$	δ_1	0.19*** (0.01)	0.02 (0.01)	0.17*** (0.00)	0.01 (0.01)	0.03*** (0.00)	0.04*** (0.01)	0.04*** (0.00)	0.05** (0.00)
$t2_t \cdot S_{it}$	δ_{DiD1}	0.08** (0.03)	0.17*** (0.05)	0.04*** (0.01)	0.10*** (0.02)	0.10*** (0.02)	0.10*** (0.01)	0.08*** (0.01)	0.05*** (0.01)
$t2_t \cdot S_{it}^2$	δ_{DiD2}	-0.04** (0.02)	-0.03 (0.03)	-0.00 (0.00)	-0.01*** (0.00)	-0.02*** (0.01)	-0.03*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
IGDP	β_{IGDP}	0.01*** (0.00)				0.01*** (0.00)			
ln IWORK	β_{IWORK}		0.28*** (0.10)				0.23*** (0.07)		
PEDUC	β_{PEDUC}	-0.03** (0.01)	-0.03** (0.01)			-0.02*** (0.00)	-0.01*** (0.00)		
TEDUC	β_{TEDUC}	0.02 (0.02)	0.01* (0.02)			0.02* (0.01)	0.02* (0.01)		
HTEC	β_{HTEC}	0.00** (0.00)				0.00** (0.00)			
ln MINFR	β_{MINFR}		0.13 (0.10)				0.15 (0.12)		
ln INOV	β_{INOV}		0.20*** (0.08)		0.16*** (0.06)		0.19*** (0.06)		0.18*** (0.05)
ln PDENS	β_{PDENS}	0.15** (0.06)		0.13** (0.05)		0.16** (0.07)		0.15** (0.06)	
PSTR	β_{PSTR}	0.01 (0.10)		0.01 (0.07)		0.02 (0.08)		0.02 (0.05)	
AGVA	β_{AGAV}	-0.02** (0.00)		-0.03** (0.00)		-0.02** (0.00)		-0.03** (0.00)	
IGAV	β_{IGAV}	0.01** (0.00)		0.01** (0.00)		0.01** (0.00)		0.01** (0.00)	
AEMPL	β_{AEMPL}		-0.03** (0.00)		-0.03** (0.00)		-0.03** (0.00)		-0.03** (0.00)
IEMPL	β_{IEMPL}		0.01** (0.00)		0.01** (0.00)		0.01** (0.00)		0.01** (0.00)
N		520	466	2502	2326	552	550	2684	2682
Within R-squared		0.57	0.62	0.49	0.55	0.51	0.59	0.40	0.48
Estimated turning point, %		1.08	2.69	5.95	3.99	2.20	1.84	3.07	3.62

Notes: Robust (using HCCME) standard errors presented in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. (1) ln GDP refers to estimates where logged regional per capita GDP is used as a dependent variable. (2) ln GVA refers to estimates where logged regional GVA per worked is used as a dependent variable.

Table 4. Analysis of overfunding

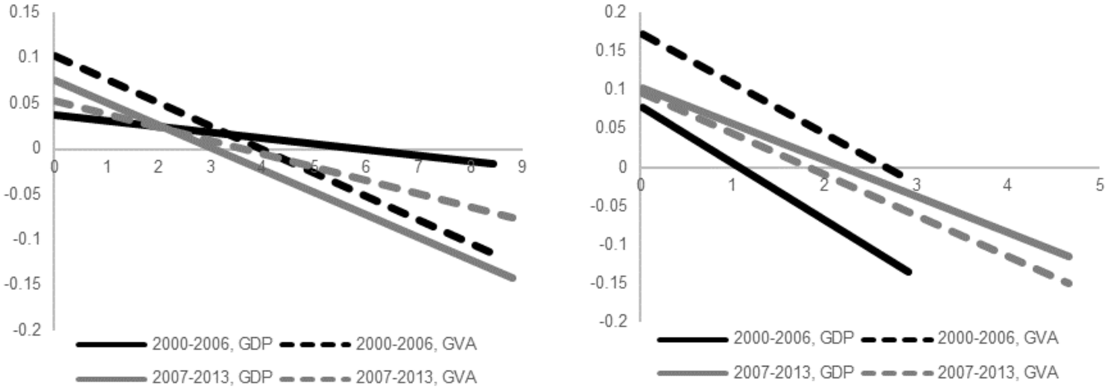
Disaggrega-tion level	Estimated turning point of positive marginal effect on convergence	Regions that were overfunded, their actual funding intensity and country	Amount of overfunding
		Programming period of 2000-2006	
NUTS 2	1.08% for convergence according to GDP	Notio Aigaio-1.17-(EL) Norte-1.25-(PT) Algarve-1.37-(PT) Anatoliki Makedonia, Thraki-1.41-(EL) Extremadura-1.42-(ES) Dytiki Ellada-1.42-(EL) Centro-1.43-(PT) Ionia Nisia-1.44-(EL) Sterea Ellada-1.55-(EL) Dytiki Makedonia-1.72-(EL) Alentejo-1.99-(PT) Voreio Aigaio-2.04-(EL) Região Autónoma da Madeira-2.26-(PT) Região Autónoma dos Açores-2.74-(PT) Ipeiros-2.92-(EL)	6.967 Bill. EUR
	2.69% for convergence according to GVA	Região Autónoma dos Açores-2.74-(PT) Ipeiros-2.92-(EL)	116 Mill EUR
NUTS 3	5.95% for convergence according to GDP	Alto Tâmega-8.27-(PT) La Palma-8.44-(ES)	507 Mill EUR
	3.99% for convergence according to GVA	Terras de Trás-os-Montes-4.32-(PT) Alto Tâmega-8.27-(PT) La Palma-8.44-(ES)	960 Mill EUR
		Programming period of 2007-2013	
NUTS 2	2.20% for convergence according to GDP	Lubelskie-2.26-(PL) Dytiki Ellada-2.29-(EL) Közép-Dunántúl-2.62-(HU) Nyugat-Dunántúl-2.68-(HU) Warminsko-Mazurskie-2.90-(PL) Podkarpackie-2.95-(PL) Dél-Dunántúl-3.10-(HU) Észak-Magyarország-3.40-(HU) Região Autónoma dos Açores (PT)-3.42-(PT) Dél-Alföld-4.46-(HU) Észak-Alföld-4.66-(HU)	7.337 Bill EUR
	1.84% for convergence according to GVA	Jihozápad-1.85-(CZ) Severozapaden-1.88-(BG) Strední Morava-1.92-(CZ) Eesti-1.93-(EE) Lietuva-1.97-(LT) Ipeiros-1.98-(EL) Latvija-2.01-(LV) Yuzhen tsentralen-2.01-(BG) Podlaskie-2.02-(PL) Alentejo-2.07-(PT) Swietokrzyskie-2.08-(PL) Yugoiztochen-2.10-(BG) Lubelskie-2.26-(PL) Dytiki Ellada-2.29-(EL) Közép-Dunántúl-2.62-(HU) Nyugat-Dunántúl-2.68-(HU) Warminsko-Mazurskie-2.90-(PL) Podkarpackie-2.95-(PL) Dél-Dunántúl-3.10-(HU) Észak-Magyarország-3.40-(HU) Região Autónoma dos Açores (PT)-3.42-(PT) Dél-Alföld-4.46-(HU) Észak-Alföld-4.66-(HU)	11.940 Bill EUR

NUTS 3	3.07% for convergence according to GDP	Gozo and Comino / Ghawdex u Kemmuna-3.11-(MT) Tarnowski-3.12-(PL) Inowroclawski-3.21-(PL) Zemgale-3.34-(LV) Bács-Kiskun-3.35-(HU) Kesk-Eesti-3.36-(EE) Slupski-3.41-(PL) Aitoloakarnania-3.42-(EL) Kyustendil-3.42-(BG) Região Autónoma dos Açores (PT)-3.42-(PT) Somogy-3.44-(HU) Pomurska-3.44-(SI) Baranya-3.48-(HU) Hajdú-Bihar-3.51-(HU) Elblaski-3.52-(PL) Borsod-Abaúj-Zemplén-3.55-(HU) Sliven-3.56-(BG) Baixo Alentejo-3.57-(PT) Vidzeme-3.58-(LV) Kurzeme-3.59-(LV) Veszprém-3.61-(HU) Nógrád-3.62-(HU) Tauragės apskritis-3.67-(LT) Sieradzki-3.80-(PL) Latgale-4.08-(LV) Terras de Trás-os-Montes-4.11-(PT) Yambol-4.29-(BG) Rzeszowski-4.30-(PL) Haskovo-4.40-(BG) Békés-4.42-(HU) Jász-Nagykun-Szolnok-4.97-(HU) Csongrád-5.79-(HU) Alto Alentejo-5.82-(PT) Szabolcs-Szatmár-Bereg-5.92-(HU) Ithaki, Kefallinia-7.30-(EL) Alto Tâmega-7.52-(PT) Thesprotia-8.81-(EL)	5.801 Bill EUR
	3.62% for convergence according to GVA	Tauragės apskritis-3.67-(LT) Sieradzki-3.80-(PL) Latgale-4.08-(LV) Terras de Trás-os-Montes-4.11-(PT) Yambol-4.29-(BG) Rzeszowski-4.30-(PL) Haskovo-4.40-(BG) Békés-4.42-(HU) Jász-Nagykun-Szolnok-4.97-(HU) Csongrád-5.79-(HU) Alto Alentejo-5.82-(PT) Szabolcs-Szatmár-Bereg-5.92-(HU) Ithaki, Kefallinia-7.30-(EL) Alto Tâmega-7.52-(PT) Thesprotia-8.81-(EL)	3.108 Bill EUR



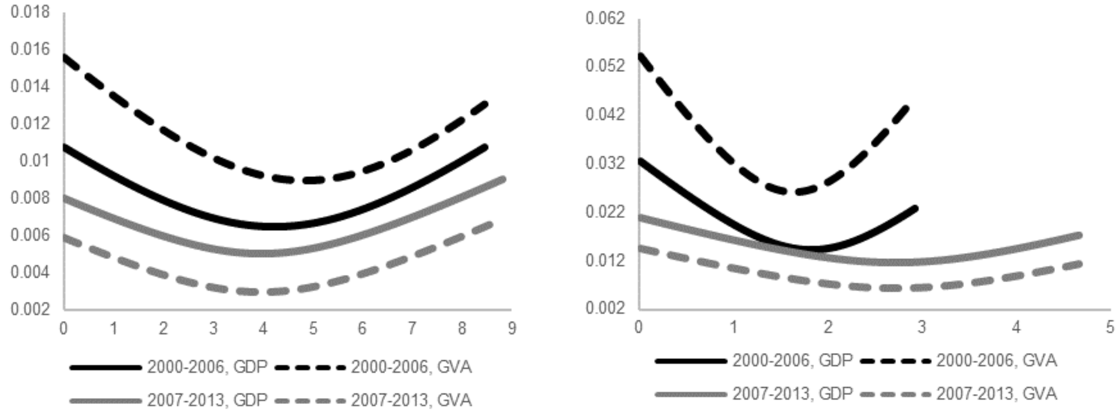
a) at NUTS 3 level b) at NUTS 2 level

Fig. 1. Estimated effect of financial support intensity (S_i, horizontal axis) on convergence ($\delta_{DiD1} \cdot S_i + \delta_{DiD2} \cdot S_i^2$, vertical axis).



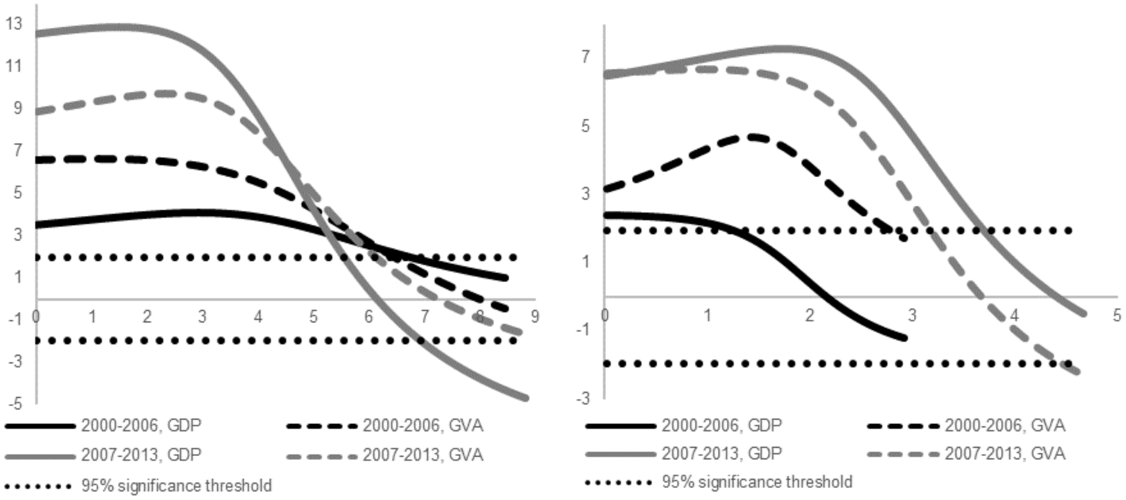
a) at NUTS 3 level b) at NUTS 2 level

Fig. 2. Estimated marginal convergence effect ($\delta_{DiD1} + \delta_{DiD2} \cdot S_i$, vertical axis) of financial support intensity (S_i, horizontal axis).



a) at NUTS 3 level b) at NUTS 2 level

Fig. 3. Relationship between financial support intensity (S_i, horizontal axis) and standard error (vertical axis) of estimated marginal effect on convergence ($\delta_{DiD1} + \delta_{DiD2} \cdot S_i$).



a) at NUTS 3 level b) at NUTS 2 level

Fig. 4. Relationship between financial support intensity (S_i, horizontal axis) and t-ratio (vertical axis) of estimated marginal effect on convergence ($\delta_{DiD1} + \delta_{DiD2} \cdot S_i$).

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