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Effects of EU Regional Policy: 1989-2013

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ABSTRACT

This paper analyzes the regional effects of EU Regional Policy during four programming periods: 1989-1993, 1994-1999, 2000-2006, 2007-2013. In particular, the focus is on the impact of transfers during the Financial and Economic Crisis and on the effects of gaining versus losing treatment status under the main Regional Policy subprogram – referred to as Objective 1 or Convergence Objective. We find that effects of Objective 1 status on growth are positive though not very long-lived: the effects of *losing Objective 1 status* on economic growth are negative, and the earlier positive effects on growth in the period(s) of Objective 1 treatment more or less undone. We show that the effects are weaker during the Crisis than before, in particular, on per-capita income in countries where the Crisis hit harder.

1. Introduction

The European Union (EU) runs a system of public transfers to subnational regions. The general idea of EU transfers – which are labeled *European Agricultural Guarantee Fund* (EAGF) and *European Agricultural Fund for Rural Development* (EAFRD) in the context of agriculture and *Structural Funds* and *Cohesion Fund* in the context of infrastructure, education, and labor markets – is to foster structural and economic homogeneity across countries and regions in order to make the EU's system of market integration viable. As early as 1973, the British Commissioner for Regional Policy, George Thomson, argued that regional policy is "necessary" to help the poorer regions of Europe.

We focus on *Structural and Cohesion Funds*, the second-largest budget line after the EU's agricultural expenses. Economic research in recent years focused on its effectiveness.[1] The insights from this work were three: expenses through the EU's *Structural and Cohesion Funds* (i) induced *positive average effects* on per-capita income growth in subnational regions that lagged behind the EU average; (ii) more expenses did *not generally* induce proportionately larger effects; (iii) regions responded *heterogeneously*, with smaller effects found in regions where the institutions are bad (corruption is high) and where human capital is scarce. Most of the work on the EU's regional transfer scheme identified positive effects on recipient-region economic growth.[2]

The present paper considers all programming periods 1989-93, 1994-99, 2000-06, and 2007-13. Including the latest completed programming period, 2007-13, goes beyond previous work and might speak to the effectiveness of EU Regional Policy at times of the Economic and Financial Crisis relative to "normal" times. In particular we explore heterogeneity across transfer recipients in terms of their exposure to the Financial and Economic Crisis. We concentrate on the effects of Objective 1 treatment (now called Convergence Objective) on a variety of outcomes such as growth of per-capita income and employment, and total as well as public investment intensity.

Going beyond cross-sectional identification, we seek to estimate the effects on economic growth and other outcomes when a region switches into, and eventually loses, Objective 1 status – an issue which requires

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[1] See, e.g., Becker et al. (2010), (2012), (2013); Pellegrini et al. (2013); Cerqua and Pellegrini (2015).

[2] See Ederveen et al. (2002); Cappelen et al. (2003); Dall'erba and Le Gallo (2008); Becker et al. (2010), (2012), (2013); Pellegrini et al. (2013); Cerqua and Pellegrini (2015); Rodríguez-Pose and Di Cataldo (2015) see Mohl and Hagen (2010), for an overview.

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data from the last two programming periods 2000-06 and 2007-13 and which, with the exception of Barone et al. (2016), has not been studied.[3] A region may lose Objective 1 status for two reasons: being just below the 75% threshold in the previous period, it might overtake other regions and end up above the 75% threshold. Alternatively, the expansion of the EU into Eastern Europe pulled down the 75% threshold in absolute terms: the same absolute level of GDP per capita which made a region eligible beforehand, no longer satisfies eligibility. The associated results may speak to the longevity – or, conversely, the short-livedness – of the growth effects from receiving funding. A priori, one could imagine three possible scenarios for regions which lose Structural and Cohesion Funds recipient status: (i) the earlier funding might have put them on a permanently higher growth trajectory; (ii) the loss of funding status might make them return more or less rapidly to a growth trajectory corresponding to their economic fundamentals without funding; or (iii) they might suffer from the "sudden stop" of losing large amounts of EU funding and face a growth of even less than the one corresponding to their economic fundamentals without funding. Transfers associated with *Objective 1* did, on average, over the quarter of a century, 1989-2013, generate additional growth in per-capita income among the funded regions in the EU, but less strongly so in 2000-13 than on average. Regions that lose Objective 1 status fall behind the average non-recipient region in terms of economic growth, and earlier positive growth effects from such funding are more than undone, at least in the short run. Focusing on regions that receive Objective 1 transfers for the first time we find immediate positive effects which are not significantly different from the effects observed for the average recipient region.

The remainder of the paper is organized as follows. Section 2 outlines the econometric setup. Section 3 describes the data, and Section 4 presents the empirical results. Finally, Section 5 provides a policy discussion and concludes.

2. Empirical approach

We consider an approach, where the treatment is a binary Objective 1/Convergence Objective indicator for NUTS2 region i and program period r. We will generally use Y_{ir} for economic outcomes and X_{ir} for the forcing variable. In particular, we need to distinguish between funding eligibility (according to the 75% cutoff rule regarding EU average per-capita income), E_{ir}, and actual treatment, D_{ir}, as there were some exceptions from the treatment rule, giving rise to a *fuzzy* regression-discontinuity design (RDD). Fig. 1 shows the corresponding discontinuity in the treatment probability for the pooled sample across all pre-budgetary-period years in the data. We estimate the fuzzy RDD in a two-stage least-squares approach where the first- and second-stage regression equations, respectively, are given by:

$$D_{ir} = h_0(X_{ir}) + E_{ir}[\gamma_1 + h_1(X_{ir}) - h_0(X_{ir})] + \zeta_{ir} + \nu_{ir}, \quad (1)$$

$$Y_{ir} = f_0(X_{ir}) + D_{ir}[\alpha_1 + f_1(X_{ir}) - f_0(X_{ir})] + \eta_{ir} + \varepsilon_{ir}, \quad (2)$$

with α_1 measuring the local average treatment effect (LATE) of binary Objective 1 transfer treatment. Akin to $h_1(X_{ir})$ and $h_0(X_{ir})$ in the first stage, $f_1(X_{ir})$ and $f_0(X_{ir})$ are flexible, smooth (differentiable) functions of pre-budgetary-period normalized log-per-capita income in purchasing power parity. The functions h_1 (f_1) and h_0 (f_0) are separately estimated for the eligible (treated) and non-eligible (non-treated) observations, respectively, and include linear and quadratic terms of normalized per-capita GDP.[4] The terms ζ_{ir} and η_{ir} reflect row vectors of effects, including fixed country and time effects and, in some of the analysis, the impact of country-level government-bond-yield spreads as measures of the Financial and Economic Crisis.

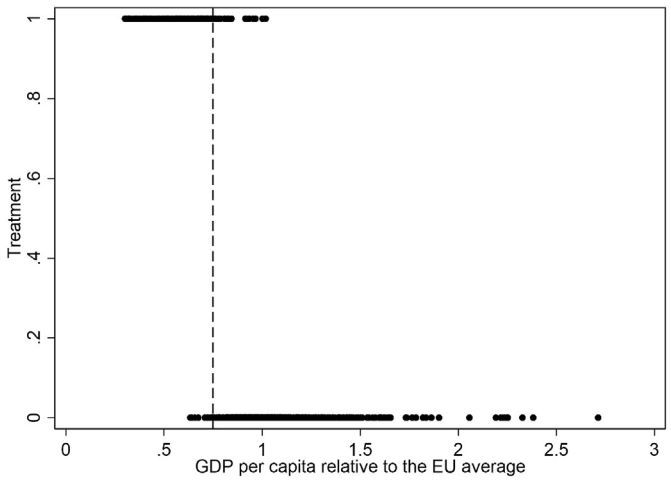

Fig. 1. Assignment of Objective 1 treatment. *Notes*: The graph corresponds to the pooled data for all four programming periods.

3. Data and descriptive statistics

We downloaded data on most variables from Eurostat Regional Statistics. We complement this by data from Cambridge Econometrics. The information about Objective 1 status and eligibility as well as information on expenditures stem from the European Commission. See Table A1 for details about the data sources.

Treatment variable The binary Objective 1 treatment indicator variable, D_{ir}, is determined on the basis of NUTS2 real per-capita levels in specific years prior to each programming period.[5] Given non-compliance, we need to distinguish between *eligible* and *recipient* NUTS2 regions. Two important reasons for non-compliance are: (i) regions that did not qualify for Objective 1 status based on the data available at the time when regional funds were assigned, turned out to be eligible ex post (or vice versa), when GDP figures were revised; (ii) specific exceptions were granted to regions with a low population density and in peripheral locations.[6]

Outcome variables We consider the following outcomes: average annual PPP-adjusted GDP-per-capita growth; average annual employment growth; average annual total investment intensity (gross fixed capital formation relative to GDP); and average annual public investment intensity (gross fixed capital formation of the public sector relative to GDP).

Control variables In some of the regressions we control for fixed

[3] Barone et al. (2016) study the case of one Italian region (Abruzzi) that lost its funding status de jure at the end of 1999 and de facto at the end of 2000. They use a synthetic control method (i.e., they generate an artificial Abruzzi region by weighting other Italian regions). In contrast, our approach focuses on the loss of Objective 1 status at large, considering all EU regions, and it is based on a regression discontinuity design, which identifies the treatment effect from a subsample of EU regions in the vicinity of the 75% of EU average per-capita income threshold.

[4] We do not consider non-parametric specifications of these functions for two reasons: first, we focus on switchers with respect to Objective 1 status and the mass of switchers is not large enough to support non-parametric estimation; second, there is no existing procedure to determine the optimal bandwidth for non-parametric RDD with panel data and fixed effects.

[5] These years were 1983-85, 1988-90, 1994-96 (1997-99 for new members), 2000-2002 for the four programming periods considered here. See the EU Council Regulations 2052/88, 2082/93, 502/1999, 595/2006, and 189/2007, for further details.

[6] Examples for such NUTS2 recipient regions are ones in northern Sweden and eastern Austria.

Table 1
Eligibility and actual treatment under Objective 1 according to 75% GDP per capita threshold.

1989-2013	Objective 1 treatment		
Eligible for Objective 1	0	1	Total
0	609	37	646
1	14	242	256
Total	623	279	902
1989-1993			
0	131	9	140
1	4	43	47
Total	135	52	187
1994-1999			
0	148	14	162
1	3	44	47
Total	151	58	209
2000-2006			
0	149	12	161
1	5	87	92
Total	154	99	253
2007-2013			
0	181	2	183
1	2	68	70
Total	183	70	253

Notes: For the first and second programming periods our samples base on the NUTS2 classification from 2003. This yields 187 EU12 NUTS2 regions in 1989-1993 and 209 EU15 NUTS2 regions in 1994-1999. In the last two programming periods our sample bases on the 2006 classification which yields 253 EU25 NUTS2 regions in 2000-2006 and 2007-2013. Phasing-out regions are treated as non-Objective 1 regions. Results are robust to defining phasing-out regions are treated as Objective 1 regions.

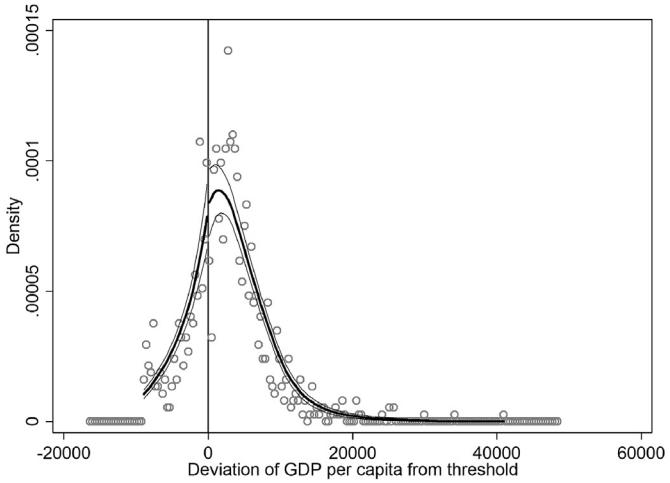

Fig. 2. Density check to detect potential manipulation of GDP per capita. *Notes*: The graph shows a density plot of GDP per capita in the years determining eligibility for Objective 1 status. Data are pooled over all four programming periods.

country and time effects and, in a smaller set of regressions, also for the effects of government-bond-yield spreads (GBYS) with ten years of maturity which vary across countries and years. The latter were collected from the European Central Bank (ECB) and the OECD.[7]

Sample composition We do not include Bulgaria, Romania, and Croatia in the analysis for reasons of data availability. In order to harmonize the data, we use Eurostat's correspondence tables and assign all observations in the periods 1989-93, 1994-99 according to the NUTS classification from 2003 and those in the periods 1994-99, and 2000-06 according to the NUTS classification from 2006.[8] The number of NUTS2 regions available after harmonizing data on economic outcomes from Cambridge Econometrics and the European Commission's Structural Funds is 187 in 1989-93, 209 in 1994-99, 253 in 2000-06, and 253 in 2007-13.

Descriptive statistics for variables at the NUTS2 level Table 1 shows eligibility for Objective 1 funding (dubbed E_{ir} in Section 2) and actual treatment (D_{ir}). While Panel A pools regions over all programming periods so that the numbers refer to region-period observations (one observation representing one NUTS2 region in a single programming period), Panels B-E present the programming-period-specific numbers. We briefly discuss the numbers in Panel A. Altogether, of 902 NUTS2-region-by-period observations covered, 343 were eligible for Objective 1 treatment, while 279 actually got funding. Cases where eligible regions did not get Objective 1 treatment are rare (14 out of 256 observations), but treatment in absence of a formal eligibility in terms of the initial-period per-capita-income rule are not as infrequent (37 out of 646 cases). Objective 1 treatment eligibility generally guaranteed actual treatment unless national governments did not provide data on per-capita incomes at the appropriate regional level. Objective 1 treatment for ineligible regions roots in a number of exceptions that were formulated in the respective budgets (see Section 3 for examples).

Table A2 shows summary statistics for key variables of interest, pooled over the four programming periods 1989-93, 1994-99, 2000-06, and 2007-13: *GDP per capita growth* is measured as the average annual difference of the logarithms of end-of-period and prior-to-period GDP per capita. The prior-to-period years are 1988 for 1989-93, 1993 for 1994-99, 1999 for 2000-06, and 2006 for 2007-13.[9] *Employment growth* is also defined in terms of logarithms and for the same years, while (total) *Investment per GDP* and *Public investment per GDP* are average ratios observed across all years *during* a programming period. Hence, with *GDP per capita growth*, an average of 0.03 indicates an average annual growth rate of about 3 percent during a programming period. With, e.g., *Investment per GDP*, an average of 0.23 indicates an average annual investment rate of 23 percent of GDP during a programming period. The means of 0.31 for actual treatment (D_{ir}) and of 0.28 for treatment eligibility (E_{ir}) are consistent with the numbers in Table 1. The final row displays per-capita GDP in purchasing-power parity terms as a deviation from the respective EU average: negative numbers indicate normalized values of by-rule eligible NUTS2 regions, while positive numbers indicate normalized values of by-rule ineligible NUTS2 regions.

Validity of the RDD setup Fig. 2 shows the density distribution of GDP per capita relative to the 75% threshold when pooling observations across all four programming periods. This figure following McCrary (2008) does not indicate any manipulation of GDP per capita in order to gain eligibility for Objective 1 funds, as would be suggested by a spike in the number of regions just below the 75% threshold. In particular, we obtain an estimate of 0.02 for the discontinuity of the density function at the threshold and a relatively large standard error of 0.11.

A further test for the validity of the RDD setup is to check whether not only the treatment (as illustrated in Fig. 1) but also covariates displayed a discontinuity at the threshold. We graphically document a lack of

[7] We calculate the GBYS as follows. For most countries, we take the difference between the harmonized long-term interest rates on government bonds and the short-term rates of the ECB (fixed-rate tenders within the main refinancing operations) which are provided on-line by the ECB (www.ecb.europa.eu/stats/html/index.en.html). Where these data are not available, we take the difference between the long-term interest rates on government bonds and the short-term interest rates of that country provided by the OECD (using the Monetary and Financial Statistics Database).

[8] See data appendix for details.

[9] The prior-to-period years in the table should not be confused with the set of years prior to each programming period which served to determine Objective 1-treatment eligibility based on average real per-capita-income levels.

Table 2
Effects of objective 1 treatment–1989–2013.

	Linear		2nd. order polynomial	
	(1)	(2)	(3)	(4)
GDP per capita growth				
Objective 1	0.013***	0.019***	0.012***	0.019***
	(0.002)	(0.006)	(0.003)	(0.006)
Fixed effects	no	yes	no	yes
Observations	901	901	901	901
No. regions	259	259	259	259
F first-stage	689.104	140.088	477.942	133.942
AIC	−5182.407	−5463.379	−5194.106	−5464.468
Employment growth				
Objective 1	−0.005**	0.005	−0.008***	0.003
	(0.002)	(0.006)	(0.003)	(0.006)
Fixed effects	no	yes	no	yes
Observations	901	901	901	901
No. regions	259	259	259	259
F first-stage	689.104	140.088	477.942	133.942
AIC	−5208.505	−5566.503	−5202.542	−5607.387
Investment per GDP				
Objective 1	0.043***	−0.002	0.033***	−0.002
	(0.009)	(0.017)	(0.011)	(0.017)
Fixed effects	no	yes	no	yes
Observations	901	901	901	901
No. regions	259	259	259	259
F first-stage	689.104	140.088	477.942	133.942
AIC	−2736.250	−3615.999	−2740.356	−3614.497
Public investment per GDP				
Objective 1	0.036***	0.030	0.038***	0.039*
	(0.006)	(0.021)	(0.007)	(0.022)
Fixed effects	no	yes	no	yes
Observations	807	802	807	802
No. regions	254	254	254	254
F first-stage	508.083	50.947	328.900	45.460
AIC	−3547.812	−3870.893	−3544.216	−3856.188

Notes: ***, **, * denote significance at the 1-, 5-, and 10-percent level, respectively. All estimates base on a two-stage least square approach using eligibility as the instrument, controlling for the forcing variable and its interactions, and time fixed effects. Specifications without NUTS2 fixed effects include country fixed effects. Growth rates refer to log differences divided by the number of years. Investment rates refer to the sum of investments divided by the sum of GDP over the respective programming period. Lower AIC indicates better model-fit. For details about the data sources see Table A1.

discontinuity for a number of candidate covariates (employment share in services; employment share in manufacturing; population per square kilometer; employment measured at the employment location over active population measured at the residence location) for the sample at hand in Fig. A1 in the Appendix. All of these variables could be thought of as determinants of economic growth.[10]

These tests together suggest that (a) there is no manipulation of GDP per capita to obtain eligibility and (b) there is no jump in any of the covariates at the 75% threshold, so the only jump of interest is the one in treatment status and subsequently in the outcomes of interest.

4. Local average effects of binary Objective 1 treatment

Period 1989-2013 Table 2 summarizes results based on the approach in Section 2 and the pooled data for 1989-2013 in Section 3. Column (1) pertains to a linear specification in terms of the forcing variable, X_{ir}. Column (2) is the same as Column (1) except that NUTS2 fixed effects across programming periods are included. With dense-enough data – i.e., with sufficiently many observations in the neighborhood of $X_{ir} = 0$ – including such fixed effects (or any other control variable) would not be necessary as observations on both sides of the thresholds are quasi identical. However, given the limited number of NUTS2 regions at hand, it may be that unobserved factors still vary across eligible and non-eligible regions and thus controlling for fixed NUTS2 effects might be desirable. Columns (3) and (4) correspond to Columns (1) and (2), respectively, except that they use linear as well as quadratic terms of X_{ir}.

The parameters in Panel A of Table 2 are relatively stable across the four columns of interest, and they vary between 0.012 in Column (3) and 0.019 in Columns (2) and (4). These findings support an increase in period-specific per-capita-income growth by somewhat less than 2 percentage points due to Objective 1 treatment. These results are quantitatively close to the findings in Becker et al. (2010) for only three programming periods. The fact that including versus excluding the region-specific fixed effects is of little bearing for the statistical (and economic) significance of the results suggests that omitted variables are of minor importance, and the RDD is quite successful in isolating the causal effect of Objective 1 treatment on per-capita income growth.

This is much less the case for *Employment growth* and (total) *Investment per GDP* (i.e., investment intensity) in Panels B and C, respectively. There, we find statistically significant effects on employment growth (negative) and investment intensity (positive) only when not controlling for region-specific fixed effects, whereas the impact of Objective 1 treatment is statistically insignificant when accounting for those effects. This suggests that Objective 1 treatment and/or the forcing variable is correlated with time-invariant determinants of employment growth and investment intensity (this is different from the determinants of and results for per-capita income growth). With regard to *Public investment per GDP* we find a significant and robust effect of about 2.2 percentage points. Hence, we should be more cautious in interpreting the effects on employment and private investment relative to the ones on per-capita-income growth or on public investment intensity. Moreover, the results suggest that the increased accumulation of public capital stock crowds out some private investments.

Period 2000-13 and the Financial and Economic Crisis Table 3 repeats the analysis of Table 2 for only the last two programming periods. This serves two purposes: first, it allows us to understand whether effects of Objective 1 transfers are stable over time; second, it provides estimates for the role of Objective 1 transfers for regions in more versus less crisis-stricken countries. The table is organized in six columns. The results in Columns (1)-(3) are based on linear functions of the forcing variable, X_{ir}, while Columns (4)–(6) are based on quadratic functions of it. Columns (2) and (5) include NUTS2-region and time fixed effects, whereas the other columns only include country and time fixed effects. Columns (3) and (6) account for the average treatment effect as a parameter on the Objective 1 indicator, on the main effect of the Financial and Economic Crisis through the government-bond-yield spreads (GBYS) variable, and an interaction term of the former with the demeaned GBYS. The coefficient on the latter may inform us about the heterogeneity of the LATE of Objective 1 treatment in terms of the country-level GBYS.[11]

The findings for the main effect of Objective 1 transfers in the periods 2000-06 and 2007–13 in Columns (1)–(2) and (4)–(5) are somewhat different from the ones for the pooled period in 1989–2013: (a) GDP growth effects are smaller than for 1989–2013; (b) interestingly, there is a positive effect on employment growth in that subperiod; (c) there is no

[10] Similar evidence for continuity of covariates in the first three periods 1989–2006 is documented in Fig. 4 of Becker et al. (2010).

[11] When running the same regressions as in Table 3 for the NUTS2 regions of EU15 countries only in the programming periods spanning 2000-13 in Table A3, we find very similar effects as in Table 3. Hence, the difference in the results between the last two programming periods and the earlier ones in 1989-99 (or the pooled sample for 1989–2013) should not be attributed to the difference in the sample composition.

Table 3
Effects of objective 1 treatment during the Crisis – 2000–2013 .

	Linear			2nd. Order polynomial		
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita growth						
Objective 1	0.006***	0.012*	0.015**	0.005*	0.012**	0.014**
	(0.002)	(0.006)	(0.007)	(0.003)	(0.006)	(0.007)
Objective 1×GBYS			−0.004***			−0.003**
			(0.001)			(0.002)
GBYS			−0.004***			−0.004***
			(0.001)			(0.001)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	506	506	428	506	506	428
No. regions	253	253	253	253	253	253
AIC	−3022.157	−3271.642	−2970.299	−3028.902	−3344.430	−2984.258
Employment growth						
Objective 1	0.006**	0.019***	0.015*	0.003	0.017***	0.012
	(0.002)	(0.006)	(0.008)	(0.003)	(0.006)	(0.008)
Objective 1×GBYS			0.001			−0.000
			(0.002)			(0.002)
GBYS			−0.005***			−0.004***
			(0.001)			(0.001)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	506	506	428	506	506	428
No. regions	253	253	253	253	253	253
AIC	−3047.726	−3323.749	−2885.460	−3055.183	−3351.848	−2917.826
Investment per GDP						
Objective 1	0.007	0.010	0.010	0.004	0.008	0.008
	(0.008)	(0.009)	(0.014)	(0.010)	(0.009)	(0.015)
Objective 1×GBYS			0.001			−0.001
			(0.003)			(0.003)
GBYS			−0.001			−0.001
			(0.003)			(0.003)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	506	506	428	506	506	428
No. regions	253	253	253	253	253	253
AIC	−1758.079	−2846.211	−2349.714	−1757.593	−2846.036	−2351.288
Public investment per GDP						
Objective 1	0.016***	−0.002	0.006*	0.016***	−0.002	0.006**
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)
Objective 1×GBYS			0.002**			0.004***
			(0.001)			(0.001)
GBYS			−0.001			−0.000
			(0.001)			(0.001)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	274	250	174	274	250	174
No. regions	149	149	149	149	149	149
AIC	−1694.864	−2028.886	−1511.265	−1694.588	−2029.357	−1526.619

Notes: ***, **, * denote significance at the 1-, 5-, and 10-percent level, respectively. All estimates base on a two-stage least square approach using eligibility as the instrument, controlling for the forcing variable and its interactions, and time fixed effects. Specifications without NUTS2 fixed effects include country fixed effects. The exposure to the Financial and Economic Crisis, is measured by government-bond-yields spreads (GBYS). Government-bond-yields spreads are denoted in percent. We use data for 2005, 2006 in the first period and 2009–2012 in the second period. Lower AIC indicates better model-fit. For details about the data sources see Table A1.

Table 4
NUTS2 Regions no longer in objective 1 status.

No longer Obj.1 in 2000–2006 but in 1994-1999		No longer Obj.1 in 2007-2013 but in 2000–2006	
NUTS2 code	Name	NUTS2 code	Name
BE32	Prov. Hainaut	AT11	Burgenland (AT)
DE30	Berlin	DE42	Brandenburg - Südwest
ES13	Cantabria	DED3	Leipzig
FR83	Corse	ES12	Principado de Asturias
IE02	Southern and Eastern	ES41	Castilla y León
ITF1	Abruzzo	ES52	Comunidad Valenciana
ITF2	Molise	ES62	Región de Murcia
NL23	Flevoland	ES63	Ciudad Autónoma de Ceuta
PT17	Lisboa	ES64	Ciudad Autónoma de Melilla
UKM6	Highlands and Islands	ES70	Canarias
UKN0	Northern Ireland	FI13	Itä-Suomi
		FI19	Länsi-Suomi
		FI1A	Pohjois-Suomi
		GR12	Kentriki Makedonia
		GR13	Dytiki Makedonia
		GR24	Sterea Ellada
		GR30	Attiki
		GR42	Notio Aigaio
		HU10	Közép-Magyarország
		IE01	Border, Midland and Western
		ITF5	Basilicata
		ITG2	Sardegna
		PT15	Algarve
		PT30	Região Autónoma da Madeira
		SE31	Norra Mellansverige
		SE32	Mellersta Norrland
		SE33	Övre Norrland
		UKD5	Merseyside
		UKE3	South Yorkshire

Notes: The majority of these regions received phasing-out support in the programming period after loosing Objective 1 support. All regions that received Objective 1 support in the period 1989-1993 received Objective 1 support in the period 1994-1999, too.

Table 5
Effects of entering and losing Objective 1 treatment – 1989–2013 .

	Entering Objective 1		Losing Objective 1	
	(1)	(2)	(3)	(4)
GDP per capita growth				
Change status	0.026***	0.021***	−0.017**	−0.017*
	(0.005)	(0.005)	(0.008)	(0.009)
Observations	515	515	167	167
No. regions	193	193	68	68
AIC	−3038.959	−3168.091	−821.291	−824.415
Employment growth				
Change status	0.007**	0.006*	−0.006	−0.005
	(0.003)	(0.003)	(0.004)	(0.005)
Observations	515	515	167	167
No. regions	193	193	68	68
AIC	−3529.970	−3564.679	−1018.382	−1018.788
Investment per GDP				
Change status	−0.005	−0.000	0.033***	0.018
	(0.007)	(0.008)	(0.011)	(0.012)
Observations	515	515	167	167
No. regions	193	193	68	68
AIC	−2621.725	−2626.276	−699.220	−712.098
Public investment per GDP				
Change status	–0.005	–0.001	0.005	0.000
	(0.007)	(0.008)	(0.005)	(0.006)
Observations	456	456	136	136
No. regions	190	190	62	62
AIC	−2402.075	−2404.599	−834.805	−844.144

Notes: ***, **, * denote significance at the 1-, 5-, and 10-percent level, respectively. All estimates base on a fixed effect specification controlling for the forcing variable and its interactions. We use only regions that comply with the eligibility rule and accordingly estimate a sharp RDD. Growth rates refer to log differences divided by the number of years. *Change status* is a dummy either indicating observations that received Objective 1 transfers for the first time (columns (1) and (2)) or observations that received Objective 1 transfers in the previous period and lost this status (columns (3) and (4)). In total 95 observations switched Objective 1 status (55 gained and 40 lost Objective status) in the programming periods considered. All *Entering Objective 1* specifications are restricted to observations that never received Objective 1 transfers or received them for the first time. Specifications for *Losing Objective 1* are restricted to observations that always received Objective 1 transfers or lost them in the previous period. Columns (1) and (3) include linear terms of the forcing variable; columns (2) and (3) include quadratic terms of the forcing variable. Since we identify from changes in status, all specifications are restricted to three out of four periods because we have no data prior to 1989-1993. Lower AIC indicates better model-fit.

effect on the total investment intensity as with pooling over all programming periods; and (d) there is no longer an effect on the public investment intensity. A lower level of GBYS reflects a greater degree of sustainability of public finances in a country. Accordingly, countries that were hit harder by the European Crisis are characterized by a relatively sharp increase in GBYS after 2008. The results in Columns (3) and (6) of Table 2 suggest that the Crisis induced negative effects on per-capita-income and employment growth of similar magnitude. However, a greater exposure to the Crisis (reflected in a bigger increase in GBYS) resulted in a lower Objective 1-treatment effect on per-capita-income growth and a higher Objective 1-treatment effect on employment growth than on average. Hence, Objective 1 treatment was less successful to shield regions of adverse effects in terms of per-capita-income growth than of ones in terms of employment. The results suggest that an increase in GBYS by about one-and-a-half standard deviations fully cancels the positive average treatment effect of Objective 1 transfers (the standard deviation of GBYS in the data is 1.89). Such an increase was experienced in Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, and in the Slovak Republic during 2007-13. One explanation for this result is the requirement for local co-financing to receive transfers. The EU recognized this issue and reduced co-financing rates during the crisis (see EU Council Regulation 18512/11), but this adjustment apparently came late and was not sufficient to accommodate the needs to cushion the detrimental effects of the Crisis on the effects of Objective 1 transfers on real income growth.[12]

Entering and Losing Objective 1 status: 1989-2013 With the four programming periods at hand, we may for the first time study how regions developed after having lost their Objective 1 status in the EU as a whole.[13] Table 4 lists the regions that dropped out of the Objective 1 program in the periods 2000-06 and 2007-13 (note that all regions that had received Objective 1 support in 1989-93 did remain in the program also during 1994–1999). Different from the fuzzy RDD in Eqs. (1)–(2), this model excludes observations which continually receive Objective 1 treatment when exploring the effects of *Entering Objective 1* and it excludes observations which never received Objective 1 treatment when exploring the effects of *Losing Objective 1*. Again we control for

[12] Using data on allocations to NUTS2 regions and effective expenditure paid out to NUTS2 regions, we can compute an absorption rate for aggregate EU transfers and correlate this ratio with GBYS. It turns out that regions with a higher crisis exposure also had a lower absorption rate during 2007-13, as is indicated by a correlation coefficient of −0.504 between the two measures.

[13] As mentioned in the introduction, Barone et al. (2016) study the case of one specific Italian region, Abruzzi, after losing its transfer status.

Table 6
Income inequality across EU15 NUTS2 regions: 1989-2013.

	1989	1994	2000	2007
Coefficient of variation (CV)	2232.558	2724.720	3510.096	4682.964
Range/mean	5.277	5.270	4.930	5.471

Notes: We use per-capita GDP (PPP) in EU NUTS2 regions to compute the coefficient of variation (CV) and the ratio of the distribution's range and mean. These measures are compared for the first years of the four budgetary periods under consideration.

Table A1
Data sources.

Variable	Source
Objective 1 status	Official Journal of the European Communities
1989-93	Number L 374, Volume 31, 31.12.1988
1994-99	Number L 193, Volume 36, 31.7.1993
2000-06	Number L 194, Volume 53, 27.7.1999
2007-13	Number L 243, Volume 44, 6.9.2006
GDP per capita	Eurostat&Cambridge Econometrics 2015
Employment (by sectors)	Cambridge Econometrics 2015
Gross value added (by sectors)	Cambridge Econometrics 2015
Population	Eurostat
Active population	Cambridge Econometrics 2015
Total investment	Eurostat
Public investment	Eurostat
Government-bond-yield spreads (*GBYS*)	European Central Bank&OECD

asymmetric functions of the forcing variable and report the linear and quadratic models with GDP per capita growth, employment growth, investment per GDP, and public investment per GDP as alternative outcomes. We generally include NUTS2 fixed effects in these specifications such that the effects are identified from units that changed Objective 1 status. Table 5 reports the corresponding results where Columns (1) and (2) show the effects of *Entering Objective 1* and Columns (3) and (4) the ones of *Losing Objective 1*. The former is to be interpreted as the gains of a newly treated region compared to those that never receive Objective 1 transfers. Analogously, the effect of *Losing Objective 1* reflects the reduction in economic activity when losing transfers compared to a counterfactual where transfers continue to be received. Note that there are several types of regions: non-Objective 1 regions which mostly receive a low but positive treatment intensity (via Objective 2 and 3), regions that were assigned phasing-out Objective 1 status and regions that were assigned Objective 1 status in spite of not being eligible according to the 75% threshold rule, and regions that were assigned Objective 1 status according to the rule. Notably the latter category receives about 2-3 times higher transfers (in the budgeting periods 2000–06 and 2007–13) than the regions that were assigned Objective 1

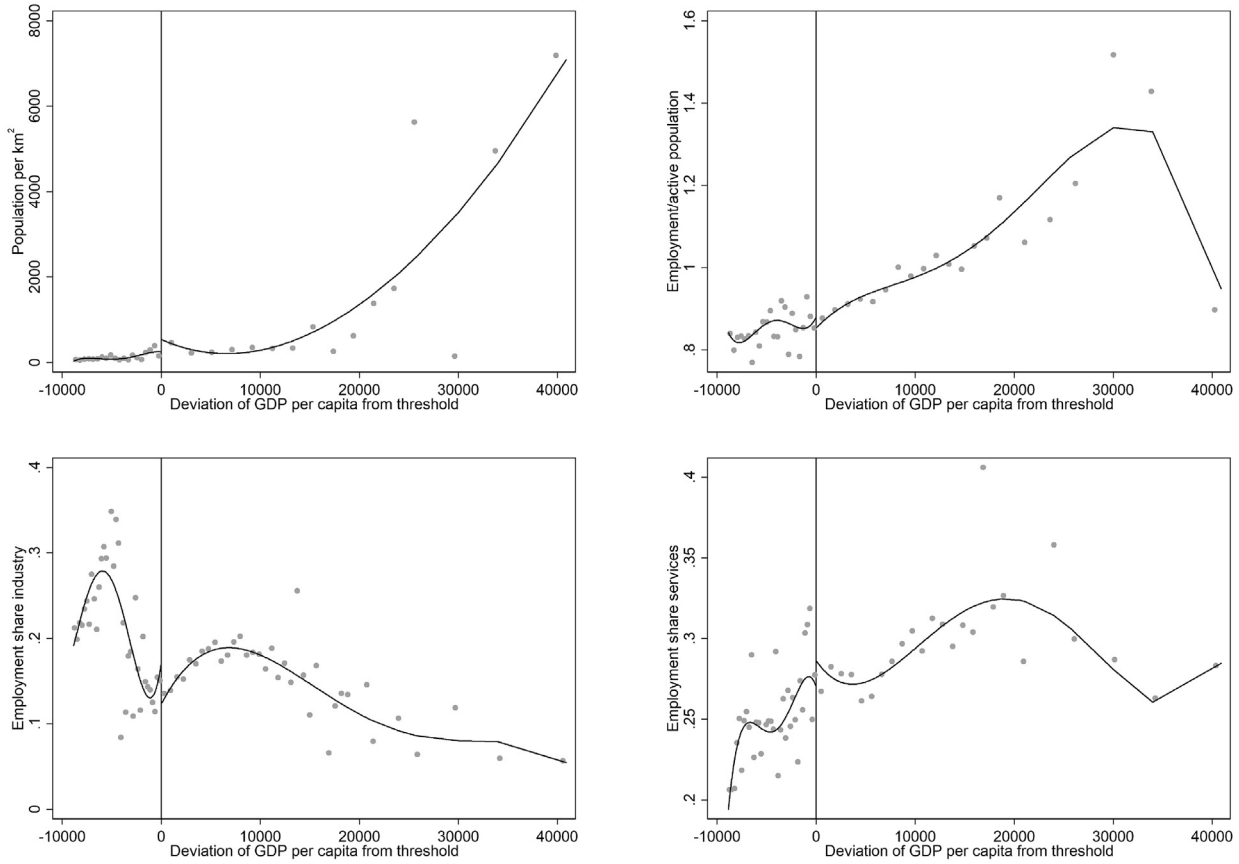

Fig. A1. Continuity of covariates. *Notes*: The graph shows depicts local averages as well as a local polynomial fits for the covariates against the forcing variable.

Table A2
Descriptive statistics NUTS2 – 1989–2013.

	Mean	StdDev	Min	Max
	(1)	(2)	(3)	(4)
GDP per capita growth	.03	.02	−.06	.13
Employment growth	.006	.02	−.08	.07
Total investment per GDP	.23	.06	.11	.62
Public investment per GDP	.05	.04	0.01	.46
Objective 1	.31	.46	.00	1.00
Eligible for Objective 1	.28	.45	.00	1.00
GDP per capita minus 75% of EU average	2790.60	5479.27	−8851.53	40895.61

due to some exceptions. As we aim to study the effects of switching from strict Objective 1 status to the non-eligible status and vice versa, we restrict the sample in the following to the units which complied with the treatment rule.

Compared to regions that neither received Objective 1 transfers in t nor in $t-1$, those that entered into the program in period t but did not receive transfers in $t-1$ grew 2.1 to 2.6 percentage points *more* than never-treated comparison regions. In contrast, regions that dropped out of Objective 1 status in t and accordingly lost substantial transfers compared to $t-1$ grew 1.7 percentage points *less* than the always-treated comparison regions. These estimates are very stable across specifications and highly significant. With regard to employment growth we observe a

Table A3
Effects of objective 1 treatment in EU15 regions during the Crisis – 2000-2013.

	Linear			2nd. Order polynomial		
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita growth						
Objective 1	0.004	0.015***	0.016***	0.003	0.012**	0.015***
	(0.002)	(0.005)	(0.006)	(0.003)	(0.005)	(0.006)
Objective 1× GBYS			−0.003***			−0.004***
			(0.001)			(0.001)
GBYS			−0.004***			−0.004***
			(0.001)			(0.001)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	422	422	348	422	422	348
No. regions	211	211	211	211	211	211
AIC	−2604.847	−2809.102	−2563.986	−2607.398	−2867.684	−2576.552
Employment growth						
Objective 1	0.002	0.020***	0.014*	−0.000	0.016***	0.010
	(0.002)	(0.006)	(0.007)	(0.003)	(0.006)	(0.007)
Objective 1 × GBYS			0.001			0.001
			(0.001)			(0.002)
GBYS			−0.005***			−0.005***
			(0.001)			(0.001)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	422	422	348	422	422	348
No. regions	211	211	211	211	211	211
AIC	−2582.447	−2779.992	−2364.746	−2586.054	−2826.028	−2402.833
Investment per GDP						
Objective 1	0.006	0.003	0.004	0.000	0.002	0.002
	(0.009)	(0.008)	(0.013)	(0.011)	(0.008)	(0.013)
Objective 1×GBYS			−0.001			−0.000
			(0.003)			(0.003)
GBYS			−0.001			−0.001
			(0.002)			(0.002)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	422	422	348	422	422	348
No. regions	211	211	211	211	211	211
AIC	−1467.031	−2470.157	−1985.164	−1464.496	−2470.182	−1985.679
Public investment per GDP						
Objective 1	0.021***	−0.009**	0.375	0.020***	−0.013***	0.108
	(0.004)	(0.004)	(1.034)	(0.005)	(0.004)	(0.184)
Objective 1 Crisis			0.631			0.190
			(1.748)			(0.320)
GBYS			0.003			−0.000
			(0.012)			(0.003)
NUTS2 fixed effects	no	yes	yes	no	yes	yes
Observations	194	170	96	194	170	96
No. regions	109	109	109	109	109	109
AIC	−1166.472	−1384.826	−759.391	−1171.652	−1389.450	−894.495

Notes: ***, **, * denote significance at the 1-, 5-, and 10-percent level, respectively. All estimates base on a two-stage least square approach using eligibility as the instrument, controlling for the forcing variable and its interactions, and time fixed effects. Specifications without NUTS2 fixed effects include country fixed effects. The exposure to the Financial and Economic Crisis, is measured by government-bond-yields spreads (GBYS). Government-bond-yields spreads are denoted in percent. We use data for 2005, 2006 in the first period and 2009-2012 in the second period. Lower AIC indicates better model-fit. For details about the data sources see Table A1.

significant effect of entering into treatment whereas losing Objective 1 status is not related to significant immediate reductions in employment growth. Considering the immediate drop in income and the slow response of labor markets this seems plausible. For investments, we do not find any significant effects.

These findings suggest that the positive contemporaneous responses to transfers are not permanent and seem to vanish when transfers are stopped. While there is a significant and sizable contemporaneous effect of Objective 1 transfers this may be largely due to consumption effects and it remains questionable, whether self-sustaining growth is triggered by the transfers, at least by their recipience over less than two decades. The evidence suggests that the contemporaneous benefits of transfers are undone after losing Objective 1 status. This finding is very much in line with Barone et al. (2016) who find the same result in their study of the Italian Abruzzi region. Our result that Objective 1 treatment effects are not long-lasting is in line with the overall pattern of GDP per capita (PPP) disparities across EU15 NUTS2 regions measured in terms of the coefficient of variation (CV) and the ratio of the distribution's range and the mean (Range/mean) as summarized in Table 6. While it is impossible to isolate the causal role of transfers regarding this descriptive evidence, it nevertheless indicates that overall economic disparities among the EU15 NUTS2 regions did not decline such that transfers were at least not capable of compensating any other trends that contributed to increasing disparities among the respective regions over a relatively large time window.

5. Discussion and conclusions

After agricultural assistance, the European Union's Regional Policy is the second-biggest line in the Union's budget. At times of tighter budgets due to stagnation if not economic downturn, voters and politicians in net-contributing (to the EU budget) countries and regions ask about the justification of such budgets, even more so than at times of economic prosperity.

This paper sheds light on the effects of the Structural Funds in recipient regions. It illustrates that the programme induced positive effects not only over all periods for which data exist in the past but also in the two most recent completed budgetary periods (2000–06 and 2007-13) which were affected adversely by cyclical phenomena. The effects of transfers in the Crisis period were weaker than before, in particular, on per-capita income in countries where the Crisis hit harder. Adjustments with regard to co-financing were successful in strengthening the treatment effect of *Objective 1* or *Convergence Objective* transfers on employment growth but not on income growth in particularly Crisis-prone regions. Another insight is that transfers tend to display immediate effects, but they do not show much longevity beyond a programming period when it comes to stimulating real per-capita-income growth in recipient regions. Hence, previous growth gains seem to be largely undone once Objective 1 status is lost. This finding is consistent with the idea that Objective 1 status – when awarded at all – should probably be kept for longer periods and should be geared towards investments that support long-term growth prospects. Otherwise, some regions might just see a one-off bonanza without any long-term benefits.

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Appendix

NUTS regions

Eurostat, the statistical agency of the European Union, operates a regional classification scheme of five levels for all regional units within the EU, the Nomenclature des Unités Territoriales Statistiques (NUTS). The highest level of regional aggregation (NUTS1) corresponds to Germany's Bundesländer, France's Zones d'Études et d'Aménagement du Territoire, the United Kingdom's Regions of England/Scotland/Wales, Spain's Grupos de Comunidades Autónomas, Italy's Gruppi di Regioni Nord-Est/Nord-Ovest/Centro/Sud/Isole, or Austria's clusters of Bundesländer, namely, Westösterreich/Südösterreich/Ostösterreich. At the other end of the NUTS classification scheme, NUTS5 regions correspond to municipalities. From an institutional point of view, two subnational aggregates are particularly important for EU Regional Policy, namely NUTS2 and NUTS3. The following types of regions correspond to NUTS2: Regierungsbezirke (Germany), Régions (France), Groups of Metropolitan Counties or Shire Counties (United Kingdom), Comunidades y Ciudades Autónomas (Spain), Regioni (Italy), or Bundesländer (Austria). The following types of regions correspond to NUTS3: Landkreise (Germany), Départements (France), Unitary Authorities (United Kingdom), Provincias y Islas y Ceuta y Melilla (Spain), Provincie (Italy), and Gruppen von Politischen Bezirken (Austria). The NUTS2 and NUTS3 aggregates are important, since the allocation of funding is determined at those levels (e.g., eligibility under the Objective 1 line is determined at the NUTS2 level, and actual funding at other levels and reporting thereof to the EU is determined at the NUTS3 level).

Note that the regional aggregation – NUTS – was adjusted on a regular basis (i.e. in the years 1995, 1999, 2003, 2006, 2010, and 2013) and data is not available for all outcomes and all years according to a homogeneous classification. We use the 2003 classification for the first two periods as many units cannot be uniquely assigned the classification from 2006.

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