Impact of European Cohesion Policy on regional growth:

When time isn't money

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Abstract

This paper contributes to the literature discussing the effects of the EU Funds on GDP growth by revealing the causal impact of regional absorption's speed. The analysis is conducted using a regression discontinuity design approach with heterogeneous treatment on NUTS-2 regions during the period 2000-2016. We show that a faster absorption, especially in the Mediterranean regions, is associated with worse economic outcomes of the Objective 1 treatment. These estimation results are robust to changes in specifications, sample compositions and outcome variables. Our results imply that the incentives provided by the European Commission to fasten absorption have a counter-productive impact.

Keywords: Regional economic growth; European Cohesion Policy; absorption capacity; regression discontinuity design.

JEL classification: E62, H50, R58

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1 Introduction

Cohesion Policy is designed to foster economic homogeneity across countries and regions of the EU to make their market integration be successful. In 1989, Jacques Delors, president of the European Commission between 1985 and 1995, argued that the Cohesion Policy is meant " to give every region an opportunity to benefit from the enormous advantages the single market will bring".[1] For the current programming period 2014-20, they constitute the second-largest budget line after the EU's Common Agricultural Policy as they stand for almost a third of the European budget.

A special scheme has been designed for NUTS-2 regions characterised by GDP per capita lower than 75% of the per capita European GDP average making them eligible for the Objective 1 treatment. Since the programming period 1989-94, this status allows some regions to benefit from markedly increased EU transfers to fasten their convergence process.

To make an efficient use of this European rent, recipient regions must use these transfers in investment projects generating additional economic growth. A high regional absorption capacity is therefore necessary to reach these policy goals. The European Commission defines absorption capacity as "the ability to use the financial resources made available [...] on the agreed actions and according to the agreed timetable.[2] Therefore, the absorption speed of the EU funds constitutes a policy target for the European Commission.

To accelerate absorption, a portion of the budgetary commitment is even automatically decommitted by the Commission if it has not been used or if no payment application has been received by the end of the second year following that of the budgetary commitment (*n+2 rule*). This rule has been introduced in 1999 due to a growing concern at the EU level about the poor financial performance of some EU regional development programmes. The programming period 2014-20 has been characterised by a softer rule since the decommitment procedure has been postponed 3 years after the end of the programming period (*n+3 rule*). Observing a slowdown in the absorption speed, the Commission has proposed to return to the *n+2 rule* for the programming period 2021-27 (Bachtler et al. (2019)).

Figure 1 below indicates the share of the European payments implemented after the end of their corresponding programming period, i.e. the late payments, for each NUTS-2 region for the programming period 2000-06. It appears that regions having the fastest absorption are mostly located in the South of Spain and in the entire Greece for the period 2000-06. Resulting from a fast absorption, these countries are identified as those with the lowest decommitment cumulative level, i.e. the amount of lost EU funds, while substantial amounts were decommitted in the Netherlands (11.1%), Luxembourg (10.8%) and Denmark (6.1%) for the period 2000-06 (Bachtler & Ferry (2015)). However, the strategy of spending faster may not lead to spending better. "Some Member States are critical of n+2 and argue that it will lead to a recurrence of problems with preparing and managing large, high-value projects, encourage a less strategic approach to project selection" (Bachtler et al. (2019), p.39).

[Figure 1 over here]

The main goal of this paper is therefore to assess whether fast absorption of the EU funds constitutes a desirable policy outcome of the Cohesion Policy. To study this question, in line with the increasing focus on the conditions under which heterogeneity in the effect of the policy emerges, this paper contributes to existing research by exploiting an additional source of the conditional impact of the Cohesion Policy: the absorption speed of the EU funds in recipient NUTS-2 regions. Real EU payments from the database of Lo Piano et al. (2017) are considered instead of commitments, usually employed in the literature on the Cohesion Policy (Becker et al. (2010); Becker et al. (2013); Pellegrini et al. (2013); Rodriguez-Pose & Garcilazo (2015); Gagliardi & Percoco (2017); Percoco (2017); Becker et al. (2018)). The analysis is conducted on the basis of a fuzzy regression discontinuity design (RDD) where the Objective 1 treatment is interacted with the share of late EU payments to determine whether those delays may generate heterogeneity in the treatment's effect. This paper adopt a fuzzy RDD formulation that exploits the discrete jump in the probability of EU transfer receipt at the 75% threshold for identification of causal effects of Objective 1 treatment on economic growth of EU regions.

Our paper shows that the Cohesion Policy has a purely conditional positive effect on regional growth, this effect being stronger in Objective 1 regions characterised by a slower absorption. In other words, faster the EU funds are absorbed in Objective 1 regions, lower is the marginal impact on economic growth. This result can be interpreted as the outcome of *easy-to-spend solutions* in these regions often characterised by low absorption capacity. A quantile regression analysis suggests that this result especially holds in regions having the lowest economic growth patterns, i.e the Mediterranean regions. These results are robust to different specifications, sample compositions and outcome variables. The interpretation pertaining to policy implications is that the return to the *n+2 rule* for the programming period 2021-27 might have a detrimental effect on the performance of the Cohesion Policy as Objective 1 regions stand for the main beneficiaries.

The remainder of this paper is organised as follows: Section 2 provides a related literature review. Section 3 deals with the methodology and data used to conduct our analysis. Section 4 provides the estimation results, the robustness tests alongside with the discussion. We conclude in Section 5.

2 Related literature

Among the large literature dealing with the Cohesion Policy, absorption capacity has unanimously been investigated as a promoting factor of the conditional impact of the EU funds on regional economic growth (see e.g., Ederveen et al. (2006); Becker et al. (2013); Rodriguez-Pose & Garcilazo (2015)).

Some recent studies highlight that fast absorption is a signal for high absorption capacity resulting from a sound institutional environment as Tosun (2014). This study explores the determinants of the absorption pace with regard to the European Regional Development Fund's (ERDF) 2000–06 programming period and finds that Member States' government effectiveness is positively associated with the speed of absorption of the ERDF. As well, Surubaru (2017) associates faster absorption to better institutions and stronger administrative capacity. This comparative study mentions that in the case of Bulgaria, the result of the favourable political and institutional environments has been a higher progression of the absorption speed than the Romanian one for the period 2007-13. A similar study conducted by Incaltarau et al.

(2020) states the promoting role of government effectiveness on national absorption rate. However, the view that fast absorption results from high absorption capacity is not unanimously acknowledged. Notably, Huliaras & Petropoulos (2016) provides a case study on Greece for the programming period 2007-13. The authors highlight the weaknesses of the administrative capacity and the bad institutional environment of authorities in charge of the implementation of the Cohesion Policy. As a result, the observed fast absorption has been more the result of *easy-to-spend solutions* than a good use of the EU funds resulting from a high absorption capacity. Indeed, "In 2010, one of the top priorities of the newly elected government was not to lose 'a single euro' of the National Strategic Reference Framework 2007–2013 money" (p.8, Huliaras & Petropoulos (2016)). Regarding the *n+2 rule* specifically, it led the authorities in charge of the implementation of the Cohesion Policy to focus on the pace of spending rather than the quality of interventions (CSIL (2010)). Therefore, our study provide insights whether fast absorption has a fostering or detrimental impact on the ability of Objective 1 treatment to stimulate growth at the regional level.

Regarding the estimation approach, we follow Becker et al. (2010) who is the first to adopt a RDD design to exploit the existence of a threshold in the attribution of the treatment status (set as 75% of the EU per capita GDP in purchasing power parity). An extended use of the RDD is then proposed in Becker et al. (2013) where heterogeneous local effects are estimated. The analysis based on heterogeneous local average treatment effect (HLATE) showed that the degree of absorptive capacity is important in explaining differences in outcomes. This approach has then been followed by numerous studies to reveal different sources of heterogeneity in the impact of the EU funds on regional growth: Gagliardi & Percoco (2017) provides evidence that the initial distribution of land matters since rural areas closed to city centres are those where the impact of EU funds is the strongest. For example, Percoco (2017) finds that that the size of the regional service sector is detrimental to the impact of the EU funds on regional growth. Becker et al. (2018) explores heterogeneity across transfer recipients in terms of their exposure to the last European financial and economic crisis and reveal that in spite of a positive impact, the effects of the European transfers are weaker in countries that have been hit harder by the crisis.

Next section presents the methodology and data employed in our analysis.

3 Methodology and Data

3.1 Regression Discontinuity Design Estimation

In this study, we focus on the potential heterogeneity of treatment effect according to the share of late payments $a_{i,\rho}$ which is defined as:

$$a_{i,\rho} = \frac{{eu_{i,\rho-1}}^{late}}{eu_{i,\rho-1}} \tag{1}$$

where ${eu_{i,\rho-1}}^{late}$ denotes the payments of the last programming period $\rho - 1$ made for a region i after the end of this corresponding programming period. We consider *late* payments as payments made during the two years after the end of programming periods 1994-99, 2000-06 and 2007-13 following the *n+2 rule*. $eu_{i,\rho-1}$ denotes the total allocation provided to region i for the associated programming period $\rho - 1$.

Finally, $a_{i,\rho-1}$ is bounded to [0;1].

We recall that the main contribution of this study is to analyse whether $a_{i,\rho}$ has a fostering or detrimental impact on the ability of Objective 1 treatment to impact regional economic growth. To answer this question, we make the hypothesis that $a_{i,\rho}$ is associated with the programming period $\rho + 1$. More precisely, the share of late payments of period 1994-99 is associated with 2000-06, the one of 2000-06 is associated with 2007-13, and the one of 2007-13 is associated with 2014-20. The reason why we make this hypothesis is that we test whether the share of late payments reflects absorption capacity, and we consider that the latter is inherited from one programming period to another. In other words, the way how the EU funds are managed in year 2007 are crucially determined by the absorption capacity of the programming period 2000-06 rather than the one of 2007-13. The second option would lead to consider that absorption capacity of year 2013 determines the one of year 2007, which does not seem very reasonable.

To conduct the analysis, we adopt a Heterogeneous Local Average Treatment (HLATE) estimation where the absorption rate may amplify or reduce the treatment effect. We rely on a Regression Discontinuity Design (RDD) in line with recent studies (see e.g., Becker et al. (2013); Gagliardi & Percoco (2017); Percoco (2017); Becker et al. (2018); Cerqua & Pellegrini (2018)). RDD is based on the principle that there is an exogenous eligibility rule built on an observable variable, called the forcing variable. In this study, this is the relative GDP per capita of one NUTS-2 region expressed in purchase power parity (PPS) regarding the European average. For the programming period 2000-06, the eligibility status is determined on the basis of years 1994-96 (1997-99 for countries that have joined the EU in 2004), years 2000-02 for the programming period 2007-13 and years 2007-09 for the programming period 2014-20.[3]

The treatment is a binary Objective 1 indicator for a NUTS-2 region i. We recall that Objective 1 status leads to increased transfers aiming at reducing the gap in per capita GDP between non-treated and treated regions. One key feature is that the treatment rule is not perfectly respected. Indeed, in reality, there are some exceptions from the treatment rule due to several reasons. We could mention that the sparsely populated regions in Austria, Finland and Sweden are eligible for funds despite being above the relevant threshold of 75%. Another group comprises the outermost regions of France, Portugal and Spain, where the Canary Islands are above the 75% threshold. Finally, the last exception is the phasing-out status, e.g. NUTS-2 regions that were granted Objective 1 transfers in 1994-99 with a GDP higher than the 75% threshold for the period 2000-06. In a nutshell, due to the imperfect compliance of the eligibility rule, we must implement a *fuzzy* RDD design. As indicated by Imbens & Lemieux (2008), applying ordinary least squares (OLS) would lead to biased estimates because of the fuzziness of the treatment. Therefore, a two-stage least squares (2SLS) where the actual treatment is instrumented by the eligibility rule should be implemented to provide reliable estimates. We follow Percoco (2017) for the entire econometric strategy.

The second stage of the 2SLS under *fuzzy* with a HLATE identification where the interaction variable is the share of late EU payments is given by:

$$y_{i,\rho} = \alpha_2 + \tau \hat{t_{i,\rho}} + \zeta_{0n}(1-\hat{t}_{i,\rho})H_n(\tilde{x}_{i,\rho}) + \eta_{0q}(1-\hat{t}_{i,\rho})I_q(a_{i,\rho}) + \zeta_{1n}\hat{t}_{i,\rho}H_n(\tilde{x}_{i,\rho}) + \eta_{1q}\hat{t}_{i,\rho}I_q(a_{i,\rho}) + \theta_k \sum_{k}^{K} k_{i,\rho} + \mu_{i,\rho} \tag{2}$$

where $y_{i,\rho}$ represents the GDP per capita growth of region i averaged for the programming period ρ, α_2 is a constant and $\mu_{i,\rho}$ is the error term. $\tilde{x}_{i,\rho}$ is the deviation from the 75% threshold while $a_{i,\rho}$ and $\sum_k^K k_{i,\rho}$, a set of K control variables, are expressed as the deviation from their sample mean. τ denotes the coefficient directly associated with the fitted value of the treatment $\hat{t_{i,\rho}}$. We take into account of the potential non-linearity of the relationship between the outcome and both the forcing and interaction variables. Therefore, $\tilde{x_{i,\rho}}$ ranges from the 3^{rd} to the 5^{th} order polynomials of the forcing variable that are represented by function H_n where n stands for polynomials' order. Similarly $z_{i,\rho}$ ranges from the 1^{st} to the 2^{rd} order polynomials of the interaction variable represented by function I_q with respectively associated coefficients $\zeta_{1,n}$ and $\eta_{1,q}$ when the treatment is switched-on ($t_{i,\rho} = 1$). $\zeta_{0,n}$ and $\mu_{0,q}$ are the same coefficients when the treatment is switched-off. Finally, $\mu_{i,\rho}$ denotes the error term.

Regarding the first stage regression, we use the eligibility rule that is represented *via* a binary variable taking the value of 1 if the NUTS-2 region has a GDP per capita below 75% of the EU average, and 0 otherwise. A linear probability model is implemented, the first stage regression is given by:

$$t_{ß,rho} = \alpha_1 + \sigma r_{i,\rho} + \beta_{0n}(1 - r_{i,\rho})F_n(\tilde{x}_{i,\rho}) + \gamma_{0q}(1 - r_{i,\rho})G_q(a_{i,\rho}) + \delta r_i + \beta_{1n} r_{i,\rho} F_n(\tilde{x}_{i,\rho}) + \gamma_{1q} r_{i,\rho} G_q(a_{i,\rho}) + \epsilon_{i,\rho} \quad (3)$$

where $t_{i,\rho}$ represents the instrumented variable that is the treatment status of region i for the programming period ρ, α_1 is a constant and $\epsilon_{i,\rho}$ is the error term of the first-stage estimation. Eligibility rule for treatment in programming period ρ, $r_{i,\rho}$, is determined according to the 75% threshold for region i that is eligible for treatment: $r_{i,\rho} = 1$ when the forcing variable is lower or equal to 75%, $r_{i,\rho} = 0$ in the other case. $\tilde{x}_{i,\rho,T}$ is the forcing variable normalised around the 75% threshold and $a_{i,\rho,T}$ is the interaction variable normalised around its mean value. Following Percoco (2017), $\tilde{x_{i,\rho}}$ polynomials range from the 1^{st} to the 3^{rd} order represented by function F_n where n stands for the polynomial's degree. Similarly, with q, $z_{i,\rho}$ polynomials range from the 1^{st} to the 2^{nd} order represented by function G_q with respectively associated coefficients $\zeta_{1,n}$ and $\eta_{1,q}$ when there is eligibility for the treatment ($r_{i,\rho} = 1$). $\zeta_{0,n}$ and $\mu_{0,q}$ are the same coefficients when $r_{i,\rho} = 0$, or when a region is not eligible for Objective 1 treatment. Finally, $\epsilon_{i,\rho}$ denotes the error term. The following section describes the data used in the analysis and their descriptive statistics.

3.2 Data and descriptive statistics

We collected most of the data from Eurostat Regional Statistics. They have been completed with data from Cambridge Econometrics. The information about Objective 1 status and eligibility and about expenditures come from the European Commission. We provide all data sources in Table A1 . Our sample covers a panel data set of the the EU's NUTS-2 regions for the period 2000-16. We do not include Bulgaria, Romania, and Croatia for reasons of data availability. The resulting number of NUTS-2 regions is 256. We used the NUTS2-2013 classification employed by EC (2019) which provides the input data used to build the following index. Regarding the time dimension of the dataset, data employed in the analysis are averaged for each programming period: 2000-06 and 2007-13. Regarding the programming period

2014-20, the latest available year is 2016, so the data correspond to averages of period 2014-16.[4] Such a transformation is implemented because the treatment variable is determined for each programming period ρ.

It should be mentioned that only actual received payments have been considered, and not commitments as most of studies of this literature (see e.g., Becker et al. (2010); Becker et al. (2013); Pellegrini et al. (2013); Tosun (2014); Rodriguez-Pose & Garcilazo (2015); Gagliardi & Percoco (2017); Surubaru (2017); Becker et al. (2018); Cerqua & Pellegrini (2018); Incaltarau et al. (2020)). As the European Commission declares: "Data collected on annual real expenditure from the EU funds follows the cycle of the EC member states' reimbursement and not exactly the date, on which payments took place". Hence, we consider this modelled annual expenditure as our actual EU funds expenditure variable. Information regarding the robustness and sensitivity of assumptions are available in Lo Piano et al. (2017).

As control variables, we include *population density* as the European authorities consider that a low population density is a structural handicap to achieve economic growth. We also use both the *share of the manufacturing sector and the share of financial and business services in regional gross added value (GVA)*. Moreover, we consider the *share of the active population* and the *unemployment rate* to have a proxy for the size of the labour force, and the share of the active population having achieved tertiary education as a proxy for *human capital*. Finally, to control for the effects of the asymmetric shocks from the Great Recession and the following Euro Crisis, we consider the difference between the national 10 years government-bond yield spreads ($GBYS$) of a region with the national German one.

Table 1 displays summary statistics for key variables of interest averaged and pooled over the programming periods 2000-06, 2007-13 and 2014-16. The outcome variable, *GDP per capita growth* is calculated as the difference between the logged-GDP per capita and its lagged value. The forcing variable, *relative GDP per capita*, is then displayed as a deviation from the 75% threshold of the EU average by the time of decision of the European Commission. The interaction variable is expressed in terms of deviation regarding the pooled sample mean value, and so are the above mentioned control variables. Table **??** presents summary statistics of the variables used in the analysis. Regarding the interaction variable, it appears that the mean is relatively similar between regions below and above the 75% threshold, although one subsample is more than twice bigger.

[Table 1 over here]

3.3 Validity of RDD setup and estimates of HLATE

This section will verify and document graphically the most important assumptions related to the RDD setup. Following Becker et al. (2018), variables are grouped and averaged in equally sized bins of 2 percentage points in width to the left and the right of the threshold level.

Identification of a causal effect of Objective 1 treatment on growth by means of RDD requires that there is a discontinuity at the threshold, which is obvious in Figure 2. The jump of the outcome variable at the threshold amounts to about 0.4 percentage point.[5] This result strengthens the usefulness of the RDD in apprehending the question of the impact of the EU funds on regional GDP growth.

Secondly, Figure 3 displays the density distribution of GDP per capita expressed using pooled averaged observations of programming periods 2000-06, 2007-13 and years 2014-16. The RDD setup would not be valid if a spike before the 75% threshold would have been observed as it would invalidate the exogeneity of the Objective 1 treatment. This is not suggested by Figure 3 since the density peak can be observed around a level of 90%.

Then, Figure A1 plots the interaction variable against the forcing variable. There is no indication of a jump at the 75% threshold, which ensures the validity of the RDD estimates. A similar pattern is observed for the control variables used in the analysis in Figure A3 .

Finally, Figure A2 illustrates graphically how the probability of Objective 1 treatment relates to region-specific per capita GDP relative to the European average prior to each programming period (forcing variable). While a probability jump is visible at the 75% threshold, the fuzziness of the RDD design is revealed as some regions having a relative GDP per capita higher than 75% of the European at the time of the European Commission's decision are treated, and *vice versa*.

[Figure 2 over here]

[Figure 3 over here]

4 Results and discussion

4.1 Estimation results

In this section, we present main results from performed analysis regarding regional GDP per capita growth and the share of late EU payments. In general, our results support the view that the later the payments are made i.e. slower the absorption of the EU funds is, the higher is the effectiveness of the Cohesion Policy in Objective 1 regions.

Table 2 reports estimates of the local average treatment effect (LATE) of Objective 1 status on regional economic growth. These simple RDD regressions stand for the average effect of the Objective 1 treatment on regional growth. The LATE is estimated in two different samples: averaged observations of regions having a share of late payments below (column (1)) and above (column (2)) the sample average. Following Percoco (2017), different polynomial specifications of the forcing variable centred around the 75% threshold are employed (i.e degree 3, 4 and 5). As it can be seen, the Objective 1 treatment has a positive and significant effect for regions characterised by a share of late EU payments below and higher than the average for all the specifications of the forcing variable. However, the size of coefficients remains higher for NUTS-2 regions exhibiting more payments delays than the sample average. Consequently, the estimates displayed in Table 2 might reveal an heterogeneous impact of the Objective 1 treatment according to the absorption pace. Therefore, we will allow heterogeneity of the Objective 1 treatment effects to vary with the share of the EU payments through estimates of heterogeneous local average treatment effect (HLATE).

[Table 2 over here]

The estimation results for the heterogeneous effects (HLATE) are displayed in Table 3. Heterogeneity is apprehended following the introduction of the interaction variable, the regional share of late EU payments centred around the sample mean. The following set of control variables is employed: regional population density, both activity and unemployment rates, active population having achieved tertiary education, both shares of manufacturing sector and financial and business services sector in the regional gross added value, and national government bond spreads with Germany. As well, country-fixed effects are introduced to capture all unobservable country characteristics and to absorb most of the spatial autocorrelation of regressions' residuals (Percoco (2017)). We use different degrees of the polynomial in the forcing variable (columns (1)-(3)). Furthermore, to capture all the unobserved factors related to each region, we introduce regional fixed effects.

The sample size is restricted to increase the reliability of the RDD estimates: we propose a subsample including regions with a relative GDP per capita 25% higher and lower than the European average at the time of decision by the European Commission, i.e. between 50% and 100%. The RDD approach is based on observations that are close to this threshold since they are likely to be very similar to each others with respect to observed and unobserved characteristics, except for the outcome variable. Therefore, the mean difference in the outcomes can be attributed to the treatment effect. This average treatment effect (ATE) sacrifices external validity by focusing only on observations close to the cut-off point, that is the 75% level of the average European regional GDP per capita. The analysis shows that weak instruments and endogeneity tests are generally verified. For sake of brevity, we report only second-stage estimates and coefficients of the forcing variable and control variables are not displayed.

The first striking result is that a faster absorption of the EU funds reduces the Cohesion Policy in Objective 1 regions. Indeed, in all specifications, the coefficient on the term of interaction between the share of late payments and the treatment exhibits a positive sign. The introduction of a quadratic interaction term even reinforces this result. In all specifications, we obtain $\frac{\partial y_{i,\rho}}{\partial a_{i,\rho}} > 0$ for Objective 1 regions which indicates that the net effect of an increase in the share of late payments is beneficial to regional growth. This result validates the findings of Huliaras & Petropoulos (2016), but is against those of Tosun (2014), Surubaru (2017) and Incaltarau et al. (2020).

A second result is the treatment does not have any robust direct impact on regional economic growth, making its impact purely conditional. This finding is in line with a large majority of the literature studying the effects of the Cohesion Policy (see e.g., Cappelen et al. (2003); Becker et al. (2013) ; Rodriguez-Pose & Garcilazo (2015); Percoco (2017); Becker et al. (2018)). We should mention as well that the coefficients associated with the effects of the Objective 1 term and its interactions remain remarkably stable across specifications characterised by different polynomial degrees of the forcing variable. In other words, a higher order of relative initial GDP per capita does not explain the impact associated with the share of late payments on regional economic growth.

[Table 3 over here]

To give strength to these results, we conduct additional regressions using different subsamples, a different outcome variable that is the growth of per capita regional investment and a different econometric approach with quantile regressions to investigate whether the treatment effects are homogeneous across per capita GDP growth levels.

4.2 Robustness tests

First, we restrict our sample to 12.5% around the eligibility threshold. Therefore, Table A2 provides estimates with NUTS-2 regions having a GDP per capita from 62.5% to 87.5% of the European average. This procedure increases the reliability of the estimates but leads to a sharp reduction of sample size since the number of observations falls from 373 to 206. In all regressions, the purely conditional impact of the Objective 1 treatment is confirmed, with a promoting role of the share of late payments on per capita GDP growth.

Then, we implement estimates for regional per capita investment growth as a second outcome variable. The graphical discontinuity of this variable around the eligibility threshold is displayed in Figure A3 . The estimates displayed in Table A3 and Table A4 are qualitatively similar to the those related to per capita GDP growth.

An interesting additional result provided by Table A5 is that the absorption speed appears to be relevant only in regions exhibiting the lowest economic growth patterns, which are mostly located in Southern Europe. Considering that most of the Objective 1 regions are located in the Mediterranean and the Central Eastern European (CEE) countries, 47% of the regions in the lowest 25% quantile, in terms of economic growth, belongs to the Mediterranean Europe and 5% to the CEE countries. On the contrary, if we consider the upper 25% quantile, where the absorption speed appears to be irrelevant, the CEE countries stand for 31% of the sample and this share falls to 30% for the Mediterranean ones.

4.3 General discussion

Firstly, our results indicate that fast absorption in the Objective 1 regions is not a desirable policy outcome. These results corroborate the findings of Huliaras & Petropoulos (2016). In details, the latter focuses on Greece, especially during the 2007-13 period, and reveals that every time a programming period end was approaching, the political authorities targeted *easy to spend* solutions, such as unconditional direct subsidies to small and medium-sized enterprises or the construction of parking facilities to keep authorities satisfied and exhibit the fact that all the European money has been spent on time. Moreover, the conclusions of Huliaras & Petropoulos (2016) particularly corroborate our estimation results as we have shown that fast absorption is the most detrimental in Objective 1 regions with poor growth performances (see Table A5), where the Greek regions stand for 18% of our observations. Regarding the *n+2* rule in particular, our results are in line with the literature pointing out that this rule resulted in an increased focus on the pace of spending rather than the quality of the investment projects (CSIL (2010)), especially in regions with limited administrative resources (ECA (2004)), as the Objective 1 regions.

In order to provide insights on the reasons why fast absorption is detrimental to growth in Objective

1 regions, we could refer to the political economy of the European funds that explains the potential primacy of the absorption goal of the EU funds. The initial point is the existence of a trade-off. The latter is built on two objectives that are a full and fast absorption of the European funds on one side, and the overall goal of achieving regional cohesion by aiding lagging regions on the other side. During the implementation of the Cohesion Policy, the European Commission and the Member States can be considered as Principals, and recipient regions as Agents (Dellmuth (2011); Charron (2016)). The policy goal of the European Commission is to maximise the absorption rates of recipient regions to send a signal that the EU funds are fully used, so as to provide incentives to the Member States to increase their financial contribution for the next programming period, it tends therefore to favour regions with high absorption rate past tracks when it comes to the allocation decision (Dellmuth (2011)). Charron (2016) shows that even Member States do not have full interest to go against the full absorption policy goal of the European Commission to send a good signal of the use of the EU funds to the European Commission. As a result, Member States push to foster absorption rate of EU funds in recipient regions, even the poorest ones. Having in mind that lagging regions are often characterised by low absorption capacity (Ederveen et al. (2006); Becker et al. (2013); Rodriguez-Pose & Garcilazo (2015)), it seems therefore likely that faster absorption could be associated with worse economic outcomes, reflecting the *easy-to-spend solutions* mentioned by Huliaras & Petropoulos (2016).

5 Conclusions

This study investigates the effect of EU funds on regional growth in Objective 1 NUTS-2 regions with a panel dataset of 256 regions for the period 2000-16 by using a RDD with heterogeneous treatment. It focuses on the speed of the EU funds' absorption. The latter has been approached as the share of real payments allocated for a given programming period implemented after the end of this corresponding programming period.

The study demonstrates the detrimental impact of fast absorption on economic performance of the treatment. In other words, faster the regional absorption of the EU funds is, worse are the economic outcomes in Objective 1 regions. This can be interpreted as the result of *easy-to-spend solutions* following the fact that fast absorption is a policy goal pursued by both the European Commission and the Member States. A more detailed analysis suggests that this result is especially valid in regions with the lowest economic growth performances, the latter being mostly located in the Mediterranean Europe.

Our results suggest to limit incentives intending to fasten EU funds' absorption in Objective 1 regions. The return to the *n+2 rule* for the programming period 2021-27 would therefore be detrimental to the overall economic performance of the Cohesion Policy. This would be especially relevant for the period 2021-27 as the budget allocated to the Cohesion Policy would globally be reduced but increasingly focused on the lagging regions.

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7 Disclosure statement

No potential conflict of interest was reported by the author.

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8 Data availability

Data of this manuscript are available with the following private link: https://figshare.com/s/86248080da4c6581f694

Notes

[1]From the *Programme of the Commission for 1989*. Address by Jacques Delors, President of the European Commission, to the European Parliament and his reply to the debate. Strasbourg, 16 February 1989.

[2]Final report - ERDF and CF expenditure. Contract No 2007.CE.16.0.AT.036.

[3] See the EU Council Regulations 595/2006 and 189/2007 for instance.

[4]This is not problematic for the interaction variable as the $n+2$ rule is implemented for the programming period 2007-13. Therefore, the late payments will be those of years 2014 and 2015.

[5]Another potential jump visible at around 60% of the European average per capita GDP could be pointed. Such a jump is observed in other related studies (see, e.g. Becker et al. (2010); Gagliardi & Percoco (2017); Percoco (2017)). However, this is out of the scope of studying the impact of the Objective 1 treatment on regional growth as we are focused on the 75% threshold.

9 Tables

Table 1: Descriptive statistics

Variable	Obs.	Mean	S.D.	Minimum	Maximum
GDP per capita growth	750	0.029	0.024	-0.122	0.185
Investment per capita growth	739	0.011	0.047	-0.168	0.318
Objective 1	748	0.314	0.462	0	1
Eligibility for Objective 1	748	0.267	0.442	0	1
Relative GDP per capita	750	0.935	0.328	0.291	2.603
Centered relative GDP per capita	750	0.185	0.328	-0.459	1.852
GBYS	727	0.013	0.017	-0.004	0.084
Activity rate	743	0.697	0.077	0.425	0.864
Unemployment rate	739	0.090	0.053	0.025	0.318
Population density	748	356.4	784.7	3.3	7394.0
Human capital	743	0.256	0.090	0.066	0.527
Share of manufacturing in GVA	750	0.218	0.087	0.039	0.558
Share of financial and business services in GVA	750	0.226	0.059	0.106	0.462
Share of late payments	727	0.601	.034	0	1
Below GDP 75% threshold	199	0.538	0.428	0	1
Above GDP 75% threshold	528	0.624	0.302	0	1
Below sample mean	374	0.318	0.343	0	0.600
Above sample mean	353	0.901	0.146	0.601	1

Detailed descriptive statistics are provided for the share of late payments.
Source: Own calculations based on data from European Commission, Eurostat and Cambridge Econometrics.

Table 2: Local average treatment effect (LATE) estimates of heterogeneity

	(1)	(2)
Sample	Late payments below the average	Late payments above the average
Third-order polynomial	0.013***	0.016***
	(0.003)	(0.003)
Fourth-order polynomial	0.014***	0.016***
	(0.003)	(0.003)
Fifth-order polynomial	0.014***	0.016***
	(0.003)	(0.003)
Observations	366	343

Robust standard errors in parentheses.
Results are qualitatively similar for the all sample. * denotes $p < 0.10$; ** $p < 0.05$; ***$p < 0.01$.

Table 3: Objective 1, late payments and regional economic growth– heterogeneous local average treatment effect (HLATE) (IV second stage estimates). Relative GDP per capita between 50% and 100%.

	(1) Third-order	(2) Fourth-order	(3) Fifth-order	(4) Fifth-order panel
Linear interaction				
Objective 1	-0.009	-0.009	-0.009	-0.011
	(0.008)	(0.008)	(0.007)	(0.011)
Objective 1* Late payments	0.027***	0.027***	0.027***	0.030***
	(0.019)	(0.007)	(0.007)	(0.008)
Late payments	-0.018***	-0.018***	-0.018***	-0.019***
	(0.005)	(0.005)	(0.005)	(0.024)
Constant	0.043***	0.042***	0.042***	0.070***
	(0.007)	(0.007)	(0.006)	(0.010)
R^2	0.410	0.410	0.410	0.572
Weak instruments	35.145***	35.268***	35.414***	14.827***
Durbin Endogeneity	4.581	4.568	4.561	1.581
Wu-Hausman Endogeneity	2.121	2.118	2.116	0.400
Quadratic interaction				
Objective 1	-0.013	-0.013	-0.013	-0.018
	(0.008)	(0.008)	(0.008)	(0.013)
Objective 1* Late payments	0.031***	0.031***	0.031***	0.039***
	(0.008)	(0.008)	(0.008)	(0.009)
Late payments	-0.019***	-0.018***	-0.018***	-0.019**
	(0.005)	(0.005)	(0.005)	(0.006)
Objective 1* Late $payments^2$	0.049*	0.049*	0.049**	0.085***
	(0.025)	(0.025)	(0.025)	(0.031)
Late $payments^2$	-0.029*	-0.029*	-0.029*	-0.040**
	(0.015)	(0.015)	(0.015)	(0.016)
Constant	0.043***	0.043***	0.043***	0.074***
	(0.007)	(0.007)	(0.007)	(0.012)
R^2	0.409	0.409	0.409	0.564
Weak instruments	23.540***	23.601***	23.700***	9.754***
Durbin Endogeneity	5.190	5.192	5.186	9.265**
Wu-Hausman Endogeneity	1.624	1.625	1.624	1.624
Country fixed effects	YES	YES	YES	NO
Regional fixed effects	NO	NO	NO	YES
Observations	372	372	372	372

Note: This table reports results from the two stage least square estimation with different polynomial orders of the forcing variable (columns (1)-(3)). The two stage least square (panel IV) estimation using regional fixed-effects uses the fifth-order of the forcing variable(column(4)). The sample is restricted to 25% around the 75% threshold of the forcing variable, where dependent variable presents GDP per capita growth and the interaction variable denotes the share of late payments from the EU.
The forcing variable is the relative GDP per capita of 1996-98 (97-99) for years 2000-06, 2000-02 for years 2007-13 and 2007-09 for years 2014-16. Robust standard errors are reported in parentheses. *p $<$ 0.1, **p$<$ 0.05, ***p$<$ 0.01.
Source: Own calculations based on data from European Commission, Cambridge Econometrics and Eurostat.

10 Figures

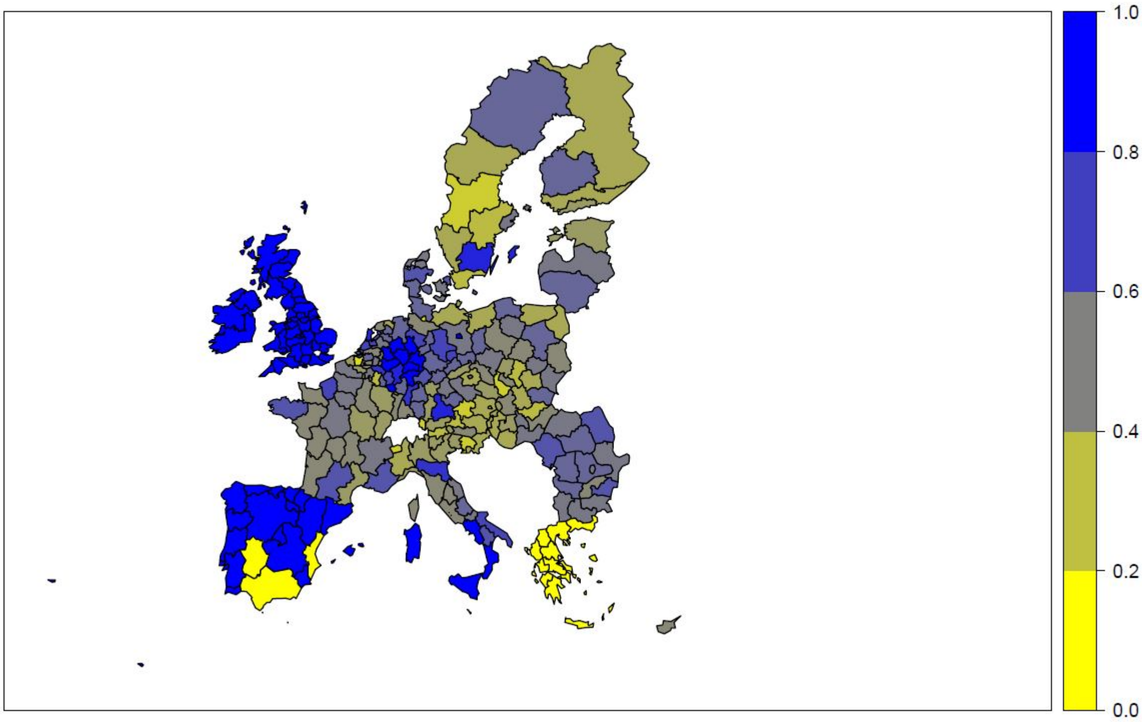

Figure 1: Share of late EU payments related to the period 2000-06.
Source: Own elaboration based on data from European Commission. © EuroGeographic EuroGeographics for the administrative boundaries.

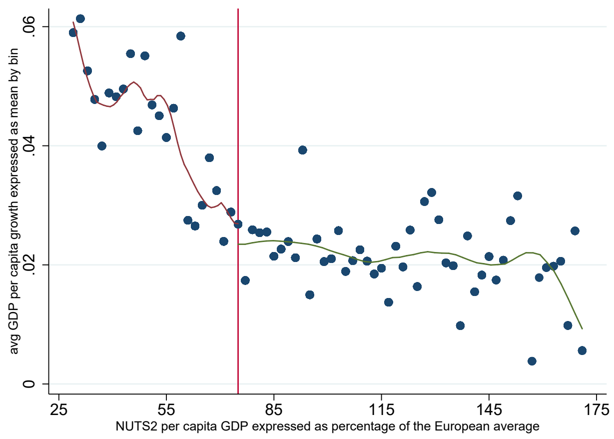

Figure 2: Discontinuity of outcome at the threshold
Note: The graph shows the GDP per capita growth plotted on the forcing variable with annual pooled data of programming periods 2000-16.
Source: Own elaboration based on data from Eurostat and Cambridge Econometrics.

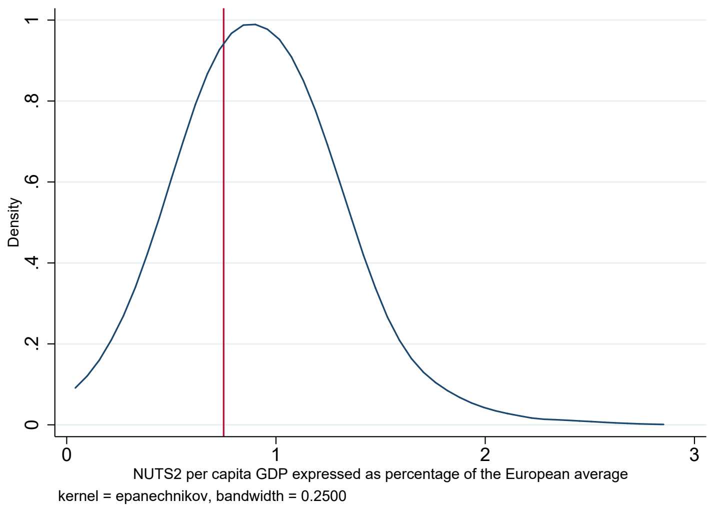

Figure 3: Density check to detect potential manipulation of GDP per capita
Note: The graph shows a density plot of relative GDP per capita based on the years determining the treatment status of a NUTS-2 region with pooled data of the period 2000-16.
Source: Own elaboration based on data from Eurostat.

11 Appendices

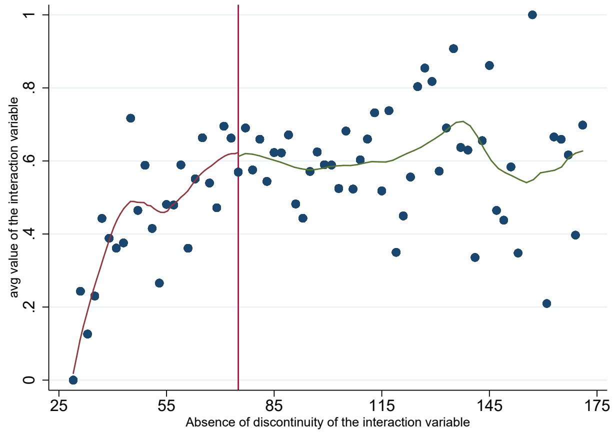

Figure A1 : Absence of discontinuity of the interaction variable
Note: The graph shows the share of late payments plotted on the forcing variable with annual pooled data of programming periods 2000-16.
Source: Own elaboration based on data from European Commission.

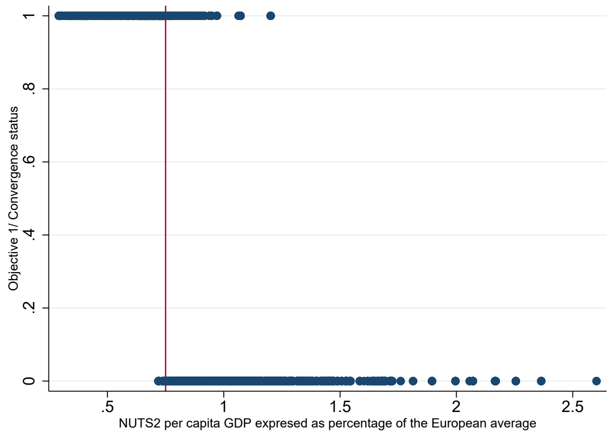

Figure A2 : Assignment of Objective 1 treatment status
Note: The graph shows the assignment of the actual treatment status (1 if a NUTS-2 region is treated, 0 in the other case) with annual pooled data of programming periods 2000-16.
Source: Own elaboration based on Eurostat and from EU regulations displayed in Table A1 .

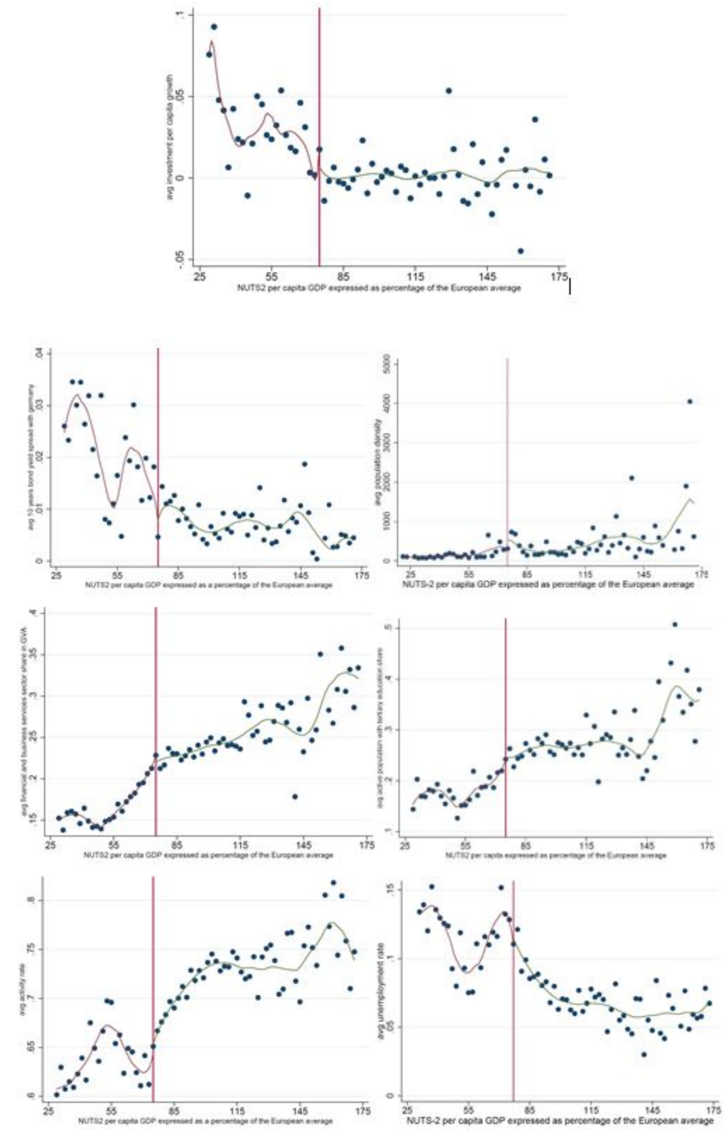

Figure A3 : Discontinuity of per capita investment growth and absence of discontinuity of the covariates at the threshold level

Note: The graph shows the covariates used in the analysis plotted on the forcing variable with averaged pooled data of programming periods 2000-06, 2007-13 and the period 2014-16.

Source: Own elaboration based on data from Cambridge Econometrics and Eurostat.

Table A1 : Variables definition and data sources

Variable	**Variable definition**	**Source**
GDP per capita growth	An averaged percentage variation of GDP per capita in PPS calculated as the difference of log GDP per capita in PPS and its lagged value.	Authors' calculations based on Eurostat and Cambridge Econometrics if missing data from Eurostat.
Investment per capita growth	An averaged percentage variation of regional investment calculated as the difference of log Investment and its lagged value.	Authors' calculations based on Cambridge Econometrics.
Objective 1 status	An averaged dummy variable being equal to 1 if a region is actually Objective 1	Official Journal of the European Communities L, 194, Volume 53, 27.7.1999 (2000-06) and L, 243, Volume 44, 6.9.2006 (2007-13)
Late EU real payments	An averaged share of the allocated budget of the previous programming period that has actually been spent in the current programming period	Authors' calculations based on European Commission
Relative GDP per capita	A share of regional GDP per capita in PPS relatively to the European average. (i) Years 1994-96 for programming period 2000-06 (97-99 for new countries), (ii) years 2000-02 for programming period 2007-13 and (iii) years 2007-09 for programming period 2014-16.	Authors' calculations based on European Commission
Government bond spread	An averaged difference in percentage between a region's national 10 year bond and the German one	Authors' calculations based on Eurostat
Activity rate	An averaged regional share of the population employed and unemployed	Cambridge Econometrics
Unemployment rate	An averaged regional share of the population unemployed	Cambridge Econometrics
Population density	Inhabitants per squared km for a region in a given year	Cambridge Econometrics
Tertiary education	An averaged regional share of the active population with tertiary education	Cambridge Econometrics
Manufacturing sector	An averaged regional share of the manufacturing sector in the gross added value	Cambridge Econometrics
Financial and business services sector	An averaged regional share of the financial and business services sector in the gross added value	Cambridge Econometrics

Source: Own elaboration.

Table A2 : Objective 1, late EU payments and regional economic growth – heterogeneous local average treatment effect (HLATE) (IV second stage estimates). Relative GDP per capita between 62.5% and 87.5%.

	(1) Third-order	(2) Fourth-order	(3) Fifth-order	(4) Fifth-order panel
Linear interaction				
Objective 1	0.005	0.005	0.005	0.005
	(0.018)	(0.018)	(0.018)	(0.023)
Objective 1* Late payments	0.033***	0.033***	0.033***	0.038***
	(0.011)	(0.011)	(0.011)	(0.013)
Late payments	-0.019**	-0.019**	-0.019**	-0.027***
	(0.008)	(0.008)	(0.008)	(0.069)
Constant	0.033**	0.033**	0.033**	0.072***
	(0.016)	(0.016)	(0.016)	(0.021)
R^2	0.398	0.398	0.398	0.588
Weak instruments	7.680***	7.682***	7.685***	4.025***
Durbin Endogeneity	1.672	1.668	1.668	1.158
Wu-Hausman Endogeneity	0.707	0.705	0.705	0.259
Quadratic interaction				
Objective 1	0.009	0.009	0.009	0.005
	(0.019)	(0.019)	(0.019)	(0.023)
Objective 1* Late payments	0.031**	0.031**	0.031**	0.036**
	(0.014)	(0.014)	(0.014)	(0.016)
Late payments	-0.018**	-0.018**	-0.018**	-0.025**
	(0.008)	(0.008)	(0.008)	(0.011)
Objective 1* Late $payments^2$	0.032	0.032	0.031	0.021
	(0.049)	(0.049)	(0.049)	(0.061)
Late $payments^2$	-0.038	-0.038	-0.038	-0.020
	(0.033)	(0.033)	(0.033)	(0.046)
Constant	0.031*	0.030*	0.030*	0.072***
	(0.018)	(0.018)	(0.018)	(0.020)
R^2	0.351	0.351	0.351	0.580
Weak instruments	4.739***	4.740***	4.741***	2.921**
Durbin Endogeneity	2.122	2.118	2.119	2.070
Wu-Hausman Endogeneity	0.608	0.607	0.061	0.031
Country fixed effects	YES	YES	YES	NO
Regional fixed effects	NO	NO	NO	YES
Observations	206	206	206	206

Note: This table reports results from the two stage least square estimation with different polynomial orders of the forcing variable (columns (1)-(3)). The two stage least square (panel IV) estimation using regional fixed-effects uses the fifth-order of the forcing variable(column(4)). The sample is restricted to 12.5% around the 75% threshold of the forcing variable, where dependent variable presents GDP per capita growth and the interaction variable denotes the share of late payments from the EU.

The forcing variable is the relative GDP per capita of 1996-98 (97-99) for years 2000-06, 2000-02 for years 2007-13 and 2007-09 for years 2014-16. Robust standard errors are reported in parentheses. *p $<$ 0.1, **p$<$ 0.05, ***p$<$ 0.01.

Source: Own calculations based on data from European Commission, Cambridge Econometrics and Eurostat.

Table A3 : Objective 1, late payments and regional investment growth– heterogeneous local average treatment effect (HLATE) (IV second stage estimates). Relative GDP per capita between 50% and 100%.

	(1) Third-order	(2) Fourth-order	(3) Fifth-order	(4) Fifth-order panel
Linear interaction				
Objective 1	-0.015	-0.015	-0.015	0.003
	(0.018)	(0.018)	(0.018)	(0.03)
Objective 1* Late payments	0.060***	0.060***	0.060***	0.070***
	(0.011)	(0.011)	(0.011)	(0.022)
Late payments	-0.019*	-0.019*	–0.019*	-0.030**
	(0.008)	(0.011)	(0.011)	(0.056)
Constant	0.035**	0.035**	0.035**	0.073**
	(0.015)	(0.015)	(0.015)	(0.029)
R^2	0.343	0.343	0.342	0.458
Weak instruments	35.146***	46.861***	47.050***	14.826***
Durbin Endogeneity	2.253	2.238	2.234	2.115
Wu-Hausman Endogeneity	0.964	0.958	0.957	0.590
Quadratic interaction				
Objective 1	-0.022	-0.022		-0.003
	(0.018)	(0.018)	(0.018)	(0.033)
Objective 1* Late payments	0.066***	0.066***	0.066***	0.080***
	(0.018)	(0.018)	(0.018)	(0.022)
Late payments	-0.020*	-0.020*	-0.020*	-0.031**
	(0.010)	(0.010)	(0.010)	(0.014)
Objective 1* Late *payments*^{2}	0.107 **	0.107**	0.107*	0.116*
	(0.054)	(0.054)	(0.054)	(0.067)
Late *payments*^{2}	-0.078**	-0.078**	-0.078**	-0.074*
	(0.032)	(0.032)	(0.032)	(0.041)
Constant	0.036**	0.036**	0.036**	0.074**
	(0.015)	(0.015)	(0.015)	(0.032)
R^2	0.348	0.348	0.348	0.448
Weak instruments	30.904***	31.151***	31.276***	9.754***
Durbin Endogeneity	1.738	1.743	1.744	3.696
Wu-Hausman Endogeneity	0.532	0.534	0.534	0.676
Country fixed effects	YES	YES	YES	NO
Regional fixed effects	NO	NO	NO	YES
Observations	372	372	372	372

Note: This table reports results from the two stage least square estimation with different polynomial orders of the forcing variable (columns (1)-(3)). The two stage least square (panel IV) estimation using regional fixed-effects uses the fifth-order of the forcing variable(column(4)). The sample is restricted to 12.5% around the 75% threshold of the forcing variable, where dependent variable presents GDP per capita growth and the interaction variable denotes the share of late payments from the EU.
The forcing variable is the relative GDP per capita of 1996-98 (97-99) for years 2000-06, 2000-02 for years 2007-13 and 2007-09 for years 2014-16. Robust standard errors are reported in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
Source: Own calculations based on data from European Commission, Cambridge Econometrics and Eurostat.

Table A4 : Objective 1, late payments and regional investment growth– heterogeneous local average treatment effect (HLATE) (IV second stage estimates). Relative GDP per capita between 62.5% and 87.5%.

	(1) Third-order	(2) Fourth-order	(3) Fifth-order	(4) Fifth-order panel
Linear interaction				
Objective 1	-0.034	-0.034	-0.034	-0.010
	(0.048)	(0.048)	(0.048)	(0.056)
Objective 1* Late payments	0.077***	0.077***	0.077***	0.108***
	(0.028)	(0.028)	(0.028)	(0.0329)
Late payments	-0.041**	-0.041**	-0.041**	-0.071***
	(0.016)	(0.016)	(0.016)	(0.020)
Constant	0.068*	0.068*	0.068*	0.110**
	(0.040)	(0.040)	(0.040)	(0.052)
R^2	0.375	0.375	0.375	0.564
Weak instruments	7.680***	7.075**	7.078**	4.025**
Durbin Endogeneity	2.965	2.966	2.966	1.913
Wu-Hausman Endogeneity	1.205	1.206	1.206	0.426
Quadratic interaction				
Objective 1	-0.024	-0.024	-0.024	-0.139
	(0.047)	(0.047)	(0.047)	(0.057)
Objective 1* Late payments	0.079***	0.079***	0.079***	0.113***
	(0.309)	(0.309)	(0.309)	(0.036)
Late payments	-0.038**	-0.038**	-0.038**	-0.068***
	(0.016)	(0.016)	(0.016)	(0.021)
Objective 1* Late $payments^2$	0.150	0.150	0.150	0.076
	(0.103)	(0.103)	(0.103)	(0.119)
Late $payments^2$	-0.134**	-0.134**	-0.134**	-0.038
	(0.063)	(0.063)	(0.063)	(0.085)
Constant	0.059	0.059	0.059	0.113**
	(0.039)	(0.039)	(0.039)	(0.053)
R^2	0.370	0.370	0.370	0.558
Weak instruments	4.700***	4.701***	4.703***	2.921**
Durbin Endogeneity	2.256	2.256	2.256	2.298
Wu-Hausman Endogeneity	0.694	0.694	0.694	0.311
Country fixed effects	YES	YES	YES	NO
Regional fixed effects	NO	NO	NO	YES
Observations	206	206	206	206

Note: This table reports results from the two stage least square estimation with different polynomial orders of the forcing variable (columns (1)-(3)). The two stage least square (panel IV) estimation using regional fixed-effects uses the fifth-order of the forcing variable(column(4)). The sample is restricted to 12.5% around the 75% threshold of the forcing variable, where dependent variable presents GDP per capita growth and the interaction variable denotes the punctuality of payments from the EU.

The forcing variable is the relative GDP per capita of 1996-98 (97-99) for years 2000-06, 2000-02 for years 2007-13 and 2007-09 for years 2014-16. Robust standard errors are reported in parentheses. Weak instruments test corresponds to F-test of the first-stage regression. *p < 0.1, **p< 0.05, ***p< 0.01.

Source: Own calculations based on data from European Commission, Cambridge Econometrics and Eurostat.

Table A5 : Objective 1, late payments and outcome variables– Simultaneous-quantile regressions.

	(1) Fifth-order 25%	(2) Fifth-order 75%	(3) Fifth-order 25%	(4) Fifth-order 75%
Objective 1	-0.019	0.002	-0.019	-0.009
	(0.016)	(0.008)	(0.013)	(0.019)
Objective 1* Late payments	0.072***	0.008	0.085***	0.023
	(0.018)	(0.028)	(0.027)	(0.025)
Late payments	-0.044***	-0.004	-0.037**	0.000
	(0.011)	(0.004)	(0.015)	(0.013)
Objective 1* Late $payments^2$	0.129***	0.028	0.211**	0.068
	(0.041)	(0.028)	(0.093)	(0.072)
Late $payments^2$	-0.038	0.002*	-0.059	-0.009
	(0.027)	(0.013)	(0.045)	(0.019)
Constant	0.027***	0.040***	-0.010	0.039***
	(0.009)	(0.005)	(0.010)	(0.010)
R^2	0.244	0.211	0.237	0.133
Observations	373	373	373	373

Note: The two stage least square (panel IV) estimation using regional fixed-effects uses the fifth polynomial order of the forcing variable. The forcing variable is the relative GDP per capita of 1996-98 (97-99) for years 2000-06, 2000-02 for years 2007-13 and 2007-09 for years 2014-16. Robust standard errors are reported in parentheses. It contains an estimate of the VCE via bootstrapping, and the VCE includes between-quantile blocks.
Estimations results of regional per capita GDP growth (columns (1)-(2)) and investment per capita growth (columns (3)-(4)) as outcome variables are reported. Regions having a GDP per capita 12.5% around the eligibility threshold have been selected.
*p $<$ 0.1, **p$<$ 0.05, ***p$<$ 0.01.
Source: Own calculations based on data from European Commission, Cambridge Econometrics and Eurostat.