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EU Cohesion Policies between Effectiveness and Equity: An Analysis of Italian Municipalities*

Anna Laura Baraldi† *Claudia Cantabene*‡ *Alessandro De Iudicibus*§ *Giovanni Fosco***

Abstract

The allocation of funds to finance cohesion policies has been a significant European and national level activity. We focus on the 2007-2013 and 2014-2020 programming periods within a 23-year (2000 to 2022) time frame to assess whether and how cohesion funds have affected per-capita income growth rates in the municipalities in the Objective 1 Italian regions of Calabria, Campania, Apulia, and Sicily. We use static and dynamic difference-in-differences methodologies. Municipal level examination allows us to filter out the distorting effects generated by characteristics typical of those countries whose regions have benefited from the allocation of structural funding. The literature shows that structural funding causes contrasting effects on various economic variables. We found significant increases in municipal per-capita income growth rates in the treated compared to the control group of municipalities, with increased effects starting from the 10th year after the first payment. We interpret our results in terms of income inequality; we show that funding causes a rise in both the Gini and Atkinson inequality indexes. This suggests that while EU cohesion funds have been effective for promoting income growth, they have not improved equity.

JEL Classification: C21, C22, R11, R15

Keywords: Cohesion Policies, Diff-in-Diff, Objective 1 Regions, Income growth, Inequalities

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1 Introduction

The geographic scope and financial scale of European regional policy aimed at reducing disparities among territories makes it an important international experience. Italy has received substantial financial resources which have been complemented by national interventions to pursue the strategic objectives of the European Union (EU). In Italy, EU regional policies, financed via European structural funds, have been implemented through various programs starting in the 1980s. The programming for the 2007-2013 and 2014-2020 periods which are the focus of this analysis, allocated around €250 billion to Italy (including the national co-financing).[1] Around €205 billion (82% of this combined funding) were allocated to the southern Italian regions. These regions are known collectively as Objective 1 regions and are characterized by economic, social, and infrastructural gaps with the northern Italian regions.[2] Policy making debate over the effectiveness of cohesion policies for reducing regional disparities has increased in recent years. However, governments worldwide continue to invest significant amounts of public funds in the implementation of these policies. The results of research on the effectiveness of cohesion policies for reducing regional disparities and promoting regional economic and social development are also not consistent (Berkowitz et al., 2020, Boldrin and Canova, 2001, Midelfart-Knarvik and Overman, 2002). Some studies find a positive although heterogeneous impact of cohesion policies (Cerqua and Pellegrini, 2018, Crescenzi and Giua, 2016), depending on the conditions in the specific countries and regions examined (Brandsma et al., 2015). Most existing studies focus on particular regions (Becker et al., 2018, Cerqua and Pellegrini, 2023) and specific programming periods (Bourdin, 2019, Le Gallo et al., 2011). However, a more in-depth assessment of the effects of cohesion policies requires consideration of national and regional differences (Bachtrögler et al., 2020, Crescenzi et al., 2020).

The present paper contributes to the debate on the effectiveness of cohesion funds and seeks to shed more light on whether and how cohesion policies have increased one of the most important measures of individual welfare, namely citizens' income. In contrast to previous studies, we consider two programming periods, 2007-2013 and 2014-2020, and utilize the staggered receipt of various tranches of project funding to implement a difference-in-differences (diff-in-diff) approach to evaluate the effect of this funding on the rate of growth of per capita income in these regions. We focus on the municipal funding related to the two programming periods disbursed to the four Objective 1 regions of Calabria, Campania, Apulia, and Sicily which received the majority of this funding.

In the first step of the empirical analysis, we use two-way fixed effects (TWFE) to estimate the average treatment effect (ATE) of the yearly payments on the growth rate of citizens' income. The staggered nature of the payments is used to identify the treatment and

[1] Source: OpenCoesione. OpenCoesione is the national open government initiative on cohesion policies, coordinated by the Department for Cohesion Policies and for the South of the Presidency of the Council of Ministers. It provides data and information on projects published on the portal funded with national and European resources

[2] Starting in 2007, the less developed regions previously designated Objective 1 are described as Convergence Objective. However, in this paper we use the designation Objective 1.

control groups, respectively those municipalities that received funding starting from the first payment and those municipalities that either did not receive funding or had received funding in the years before the first payment. In contrast to the regression discontinuity method, the above methodology allows us to consider all the municipalities in the Objective 1 regions and allows for a longer sample period (i.e. 23 years) which in turn enables observation of the dynamic of the policy measure over time (the second step in the empirical analysis). Our event study is based on estimation of a dynamic diff-in-diff model to confirm the validity of the parallel trend assumption (required for the diff-in-diff estimation) and also to examine the dynamic over time effect of the EU cohesion policy on the per capita income growth rate in the treatment and control municipalities.

We find that on average, the per-capita income growth rate increased by 0.33 percentage points in municipalities in the treatment group (those receiving the payment) with respect to the control group of (essentially) municipalities not yet treated. This represents a substantial amount; it corresponds to a quarter of the mean per-capita income growth rate in the Objective 1 region municipalities. To obtain a finer grained analysis we use the yearly (real) payments (in natural log) received by each municipality as our treatment variable to proxy for the intensity of the treatment. The continuous treatment estimates show that a 10% increase in the payment results in around 0.03 percentage point increase in the per-capita income growth rate in the treatment compared to the control group. We further refined the analysis by using the ratio of each municipality's yearly payments to its total funding in the period 2007 to 2022 as dependent variable to proxy for municipality capacity to absorb the funds. In this case, a 10 percentage points increase in the payment received leads to a 2.49 percentage points increase in the municipal per-capita income growth rate in the treatment compared to the control group.

Estimation of the event study model allows for an interesting interpretation of the results which complements the findings from estimation of the ATE. Having confirmed the parallel trend assumption, the dynamic that emerges is of a sharp increase in the per-capita income growth rate in the year of the first payment, no change in the following four years after the first payment, and then a continuous increase up to the 15th year after the first payment. The sharp initial increase in the income growth rate might reflect the short-term nature of some projects (e.g. purchase of goods and services, provision of training). The long-term upward trend might be due to the effect on individual income of structural projects that requires a long-time horizon. The complementarity between the static and dynamic analyses suggests that our study bridges the gap between the streams of work which consider cohesion funds to be ineffective or to be a valid growth mechanism. Our finding that it takes up to five years after the first payment to observe a significant and lasting impact of cohesion funds on per-capita income growth does not contradict previous research. Rather, it provides a clearer understanding of the time needed to observe a positive effect.

Our findings are robust to several checks such as the presence of negative weights in the staggered adoption, the exclusion of the Sicilian municipalities to avoid inclusion of other sources of financing received by this special statute region, the exclusion of years 2007 and 2008 because of the n+2 spending rule, the period ending in 2019 due to the start of the COVID 19 crisis and the inclusion of the municipalities in Basilicata in the Objective 1 regions.

The discussion of the results focuses on whether if we assume that cohesion policies reduce the disparities in income growth rates between the Objective 1 regions and the other regions, then they will also have reduced the income inequalities among the citizens of the municipalities in the Objective 1 regions. Higher income levels as the result of receipt of cohesion funds might benefit only specific segments of the population and potentially could increase income inequalities within and between regions. Work in this direction focuses on intra-regional disparities and shows that although cohesion policies have a positive impact on income growth, they increase inter-regional income inequalities. Therefore, the allocation of EU cohesion funds should be evaluated also from an equity perspective to assess how the gains they provide are distributed among citizens. We add to this stream of work by assessing the effect of cohesion policies on the income inequalities within Objective 1 regions. First, we estimate the effect of the EU cohesion policies on municipal income growth rate for different levels of revenue, from €10, 000 to up to €120, 000. We find that while the inequality between the low- and middle-income groups seems to have increased, the gap between the middle- and high- income groups has narrowed. This suggests that it is difficult to predict the effect of EU cohesion policies on inequality. To infer the effect of EU cohesion policies on income inequality, we constructed the frequently used Gini and Atkinson inequality indexes. We observe an increase in both inequality indexes, which starts from the first payment and grows over time.

Some studies show that EU cohesion policies boost economic growth (Pellegrini et al., 2013, Pieńkowski and Berkowitz, 2016) and per-capita GDP (Coppola et al., 2020), while others find little evidence of an effect on employment (Martin and Tyler, 2006) or growth (Coppola and Destefanis, 2015, Pupo and Aiello, 2009) or a complete lack of effectiveness (Mohl and Hagen, 2010, Rodriguez-Pose and Fratesi, 2004). These mixed results are due to the time span and level of territorial disaggregation considered, the estimation technique and the counterfactual employed. The availability of more data makes it possible to increase the territorial disaggregation to the local labor system[3] or municipality level. We extend the work of Giua (2017) and Atella et al. (2023) by considering the two most significant funding periods (2007-2013 and 2014-2020) and conducting a municipality level analysis. We focus on the four Objective 1 regions in Italy which allows us to control for confounding factors such as industrial structure (Percoco, 2017), territorial capital (Fratesi and Perucca, 2019, Fratesi et al., 2014), human capital (Becker et al., 2013), institutions and governance (Arbolino et al., 2020) which might have an influence on the effects of cohesion policies on regional economies.

Another novelty of our study is the estimation method employed. In contrast to regression discontinuity estimation methods (Giua, 2017), the diff-in-diff approach used

[3] Local labor systems (SLL) represent a territorial grid whose boundaries, independent of administrative divisions, are defined by daily commuting flows between home and work. The level of disaggregation in SLLs is greater than that of regions and provinces but less than that of municipalities, as an SLL typically includes multiple municipalities. Looking at SLLs, Ciani and De Blasio (2015) highlight that regional transfers in Italy during the 2007-2013 programming period did not have significant effects on local population growth or housing prices, and had a limited impact on employment. In a similar context, Albanese et al. (2021) find that Total Factor Productivity (TFP) growth is not highly responsive to European funding and that the effectiveness of cohesion policy is linked to spending composition issues.

in the present study allows us to include all of the municipalities in the Objective 1 regions regardless of their size. Also, the long-time horizon (23 years, from 2000 to 2022) allows us to estimate a dynamic diff-in-diff (event-study) model. The per capita income growth rate dynamics in the years following disbursement of the funds are interesting and reconcile the previous mixed results about the effectiveness of cohesion policies.

The paper is organized as follows. Section 2 discusses the data and the variables used. Section 3 describes the empirical strategy. Sections 4 and 5 present empirical results and provide some robustness checks. Section 6 offers a discussion of the results and section 7 concludes the paper.

2 Institutional framework, data, and variables

The objective is to analyze the impact of EU cohesion policy funding during the periods 2007-2013 and 2014-2020 on the growth rate of per capita income in the municipalities in Objective 1 regions, namely Calabria, Campania, Apulia, and Sicily.

Cohesion policy is the main measure implemented by the EU to promote sustainable and inclusive economic development, reduce the disparities among regions, and improve the quality of life of citizens. The aim is to use targeted investments to support economic growth, involve increases in funding across programming periods. Each funding cycle has specific objectives, funds, and priorities in terms of areas of intervention. In general, the financial resources allocated by the EU must be spent within two years of the ending of a programming cycle in line with the n+2 rule. The n+2 rule was imposed to ensure timely and effective use of EU funds and prevent the accumulation of unspent resources which could jeopardize the planning and implementation of future projects.

During the two programming periods analyzed in this work, most of the funding was allocated to less developed regions, highlighting the significant territorial heterogeneity in Europe. Although all EU regions are eligible for support, community regulation categorizes them into three groups based on per-capita GDP which determines the type of support they receive from cohesion policies. Specifically, Objective 1 (or Objective Convergence) regions benefit the most from European regional measures which are aimed at supporting development in NUTS II regions with per-capita GDP less than 75% of the EU average.

The highest level of funding from the ERDF (European Regional Development Fund) and the ESF (European Social Fund) goes to the less developed regions, followed by the transition regions, and then the most developed regions which receive the fewest resources (Crucitti et al., 2024). It is important to note that all cohesion policy programs are co-financed by the Member States. The EU finances up to 85% of the cohesion fund (CF) programs, and between 85% and 50% of the ERDF and the ESF finance, depending on the category of the region and the level of development of the Member State.

In Italy, EU regional policy is aimed primarily at the Southern (or Mezzogiorno) regions. During the two programming cycles analyzed (2007–2013 and 2014–2020), the regions of Calabria, Campania, Apulia, and Sicily were categorized as Objective 1 regions.

2.1 Dependent variable

The Italian Ministry of Finance (MEF) provides yearly data on the declared incomes of residents in each Italian municipality. For the four Objective 1 regions we collected municipality data for the period 2000-2022 on:

1) the amount of income from dependent work (Dependent work income) which is income derived from employment by another person or organization including continuous collaborations, productivity bonuses (if subject to regular taxation), social security payments from INPS or other entities, supplementary pension benefits, and compensation for socially useful work under favorable conditions;[4]

2) the amount of income from self-employment (*Self-employment income*) which is the positive difference between earnings and revenue derived from professional or artistic activities and the expenses related to conducting the activities. After deducting losses sustained in previous periods, this amount contributes to the total taxable income;

3) the amount of income attributable in ordinary accounting to the entrepreneur, calculated by subtracting from the ordinary accounting business income the amount due to the shareholders or partners in the family business or the entrepreneur's spouse, and any business losses recorded in ordinary accounting. The final total is the entrepreneur's taxable income;

4) the amount of income attributable to the entrepreneur in simplified accounting, calculated by subtracting from the simplified accounting business income the amount due to family members or the entrepreneur's spouse, and any business losses from participation in partnerships or similar entities.[5] The sum of the last two categories of income is *Entrepreneur income*.

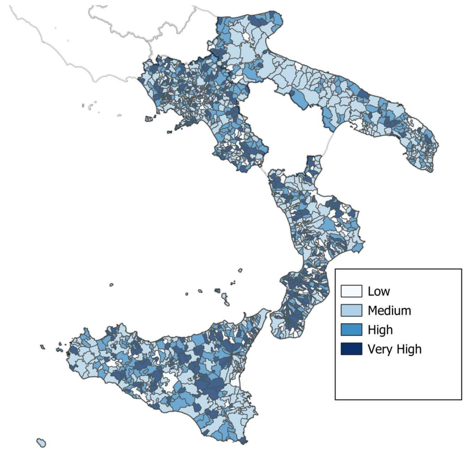
The sum of these income categories represents the total income of the municipality's residents, net of pension income. We consider the growth rate of this total real per-capita income (i.e., deflated and divided by the resident population). We will refer to this variable as *Income Growth*.

Figure 1 depicts the geographical distribution of the average real per-capita income growth rate (2000–2022) in the Italian Objective 1 region municipalities, based on MEF data. The darker the color, the higher the municipality growth rate. We can note that coastal and urban municipalities have higher income growth rates; this is related to their more dynamic economic opportunities and stronger tax base due to their combination of dependent, self-employed, and entrepreneurial incomes. The lower income growth rates typical of inland and rural areas are indicative of persistent economic problems, and limited ability to attract investment or support diversified economic activities. This geographic distribution highlights significant territorial disparities within individual regions.

[4] Includes productivity bonuses taxed at the regular rate but excludes those subjects to the reduced 10% tax rate

[5] Since 2017, income is determined according to the cash principle, i.e. based on actual inflows and outflows. From 2018, up to 40% of losses from previous periods in simplified accounting can be deducted, while prior losses can be fully deducted in the first three years of activity. In ordinary account, losses from previous periods are deductible up to 80%.

Figure 1: Geographical distribution of the municipal per-capita income growth rate



Note. The map shows the graphical distribution of the average per-capita income growth rate from 2000 to 2022 for each municipality in the Italian Objective 1 regions (Apulia, Calabria, Campania, Sicily). Growth rates are categorized as Low, Medium, High, or Very High using a quantile-based classification.

2.2 Main regressor

Our regressor of interest is the funding received by Objective 1 region municipalities during the period 2000-2022. Funding data are from OpenCoesione, an open government initiative of the Department for Cohesion Policies and the South which provides data on projects funded by Italy's cohesion policies. It aims at transparency in providing data and information on projects funded by national and European resources including amounts allocated, project timelines, and project status. OpenCoesione provides data on programming cycles starting in 2000, but, for the programming cycle 2000-2006, only data from FSC fundings are available.

The 2007-2013 and 2014-20 programming cycles include respectively 955,506 and 1,040,335 projects involving public funding of approximately €94 billion and €156 billion. The unit of analysis is the municipality. To obtain a coherent and relevant sample for the empirical analysis, the raw data were cleaned based on the following criteria.

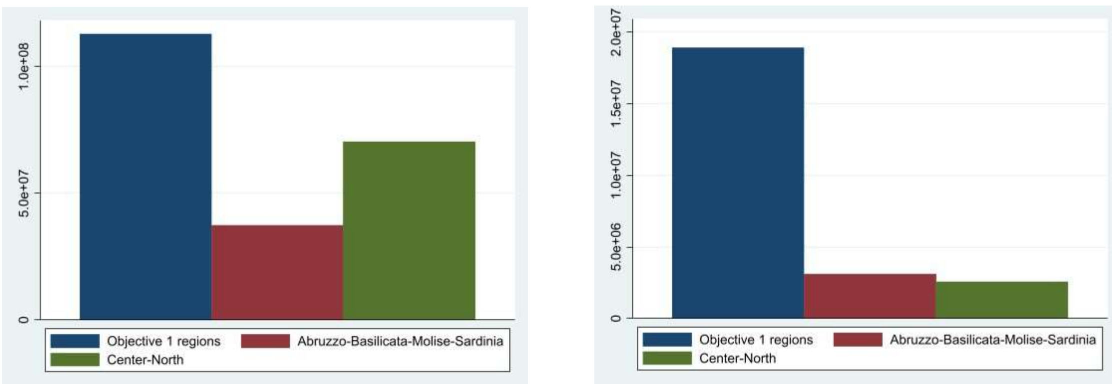
First, we excluded projects with multiple implementing entities (e.g. several municipalities or a municipality and other administrative entities), which reduced our sample to around 1.5 million projects. Second, we excluded projects that were not implemented during our study period (2007 to 2020) and projects where the start or end dates were unclear. Third, we excluded European Territorial Cooperation (ETC) projects and projects that involved "All Municipalities."

Next, we focused on project related payments for each municipality during the two programming cycles, spanning 2000 to 2022. Our project related payments include EU transfers to fund EU-awarded projects, co-financing contributions from central government in the form of reimbursements for costs already incurred on EU-funded projects, and the cohesion fund amounts allocated to each municipality's region and province. We collected information on 933,758 projects during the 2007-2013 cycle, and 593,833 during the 2014-2020 cycle to a total of approximately 1.53 million projects.

Figure 2 graphs 2a and 2b depict the difference between total funding (European and national) and European funding received by Objective 1 region municipalities, the Mezzogiorno regions of Abruzzo, Basilicata, Molise, and Sardinia, and the Center-North regions of Italy, respectively.

Figure 2: Total funding e EU funding

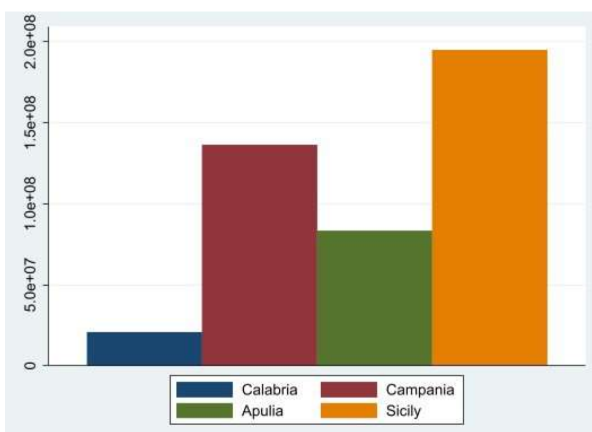
(a) Total funding (b) EU funding



Note. Graph 2a shows total financing (EU and national) received by Objective 1 region municipalities, the Mezzogiorno regions of Abruzzo, Basilicata, Molise and Sardinia, and in the Center-North of Italy. Graph 2b shows the mean of the EU financing received by Objective 1 region municipalities, the Mezzogiorno regions of Abruzzo, Basilicata, Molise and Sardinia, and the Center-North of Italy. Period: 2007-2022.

It can be seen that Objective 1 regions received a larger share of the funding than both the other Southern Italian regions and the rest of Italy. Figure 3 provides information on the total funding received by each Objective 1 region and shows that the highest level of finance went to Sicily followed by Campania, Apulia, and Calabria.

Figure 3: Total funding by Objective 1 regions

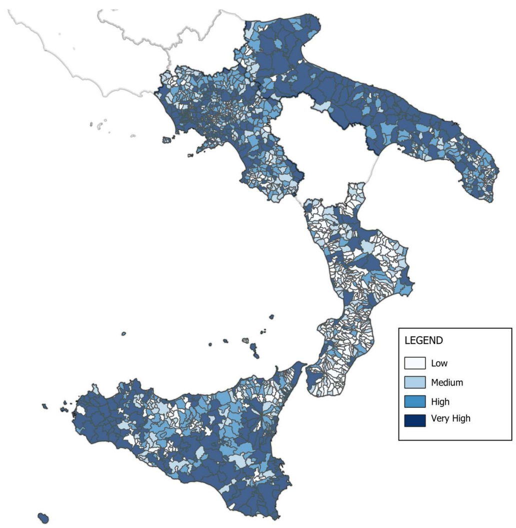


Note. The Graph shows the total financing by Objective 1 regions. Period: 2007-2022.

Figure 4 depicts the territorial distribution of the average payments received by the Objective 1 region municipalities between 2007 and 2020 (the programming cycles 2007-

2013 and 2014-2020) based on OpenCoesione data. The values range from zero to €237 billion are classified as Low, Medium, High, and Very High using a quantile-based approach. The darker the shading, the higher the payments. The darker shaded areas are concentrated mainly in areas that benefited from significant public investment in the form of infrastructure projects and economic development policies. The light shading indicates much lower levels of funding. It can be seen that except for Calabria, most of the municipalities in Objective 1 region received substantial payments in line with the aim of cohesion policies to consistently allocate resources across the territory.

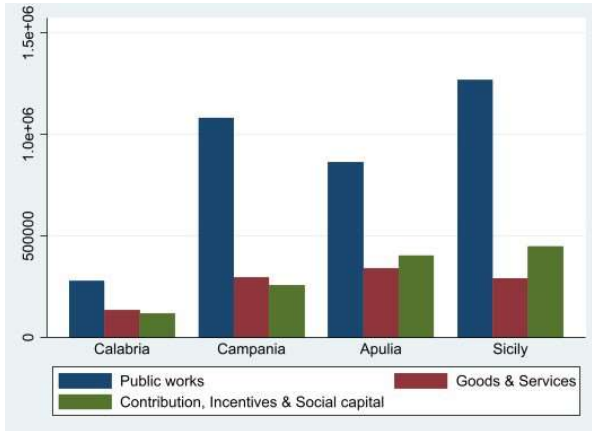
Figure 4: Geographical distribution of municipality payments in the programming cycles 2007-2013 and 2014-2020



Note. The map illustrates the geographical distribution and level of the payments received by the municipalities in the Objective 1 regions (Apulia, Calabria, Campania, Sicily). For each project, we gathered on project profile, implementing entity, funding modality, and type of investment. Some sectors benefited from structural funds in the form of funding for public works, goods and services, grants, incentives, and venture capital (see Figure 5).

For each project, we gathered data on project profile, implementing entity, funding modality, and type of investment. Some sectors benefited from structural funds in the form of funding for public works, goods and services, grants, incentives, and venture capital (see Figure 5).

Figure 5: Total funding by sector



Note. The graph shows the total financing by sectors. Period: 2007-2022.

Since our unit of analysis is the municipality, we constructed our dataset by aggregating all the information collected for each Objective 1 region municipality, using the ISTAT (Italian National Institute of Statistics) classification of administrative units. We then built a panel providing data on historical payments related to municipality projects in the period 2007 to 2022. The pre-treatment period is 2000 to 2006, during which no financing is accounted for.

Since funding was paid in installments during the period 2007 to 2022, we can identify each municipality's treatment status, beginning with the year of receipt of the first payment. The years prior to this date are to be considered pre-treatment periods.

2.3 Control variables

The empirical analysis considers several time-varying variable controls for municipality characteristics. They include resident municipality population (*Pop*) which captures a dimensional aspect, share of female population (*Female pop*) which captures a gender aspect of the population, share of population with a university degree (*University edu*) which captures a human capital aspect of the municipality population.[6] Table 1 presents the descriptive statistics of the variables.

Table 1: Descriptive statistics

	Obs	Mean	Std.Dev.	Min	Max
Income growth	26143	0.015	0.061	-0.401	1.207
Pop	36802	10.226	34.19	0.147	995.743
Female pop	36766	0.511	0.012	0.427	0.567
University edu	36766	0.095	0.038	0.008	0.374

Note. Descriptive statistics of the variables. They are calculated at municipal level in the Objective 1 regions, namely Calabria, Campania, Apulia and Sicily. Period: 2000-2022.

[6] Except for data on resident population, the data used to construct the control variables are from the 2001, 2011, and 2021 censuses. Resident population data are yearly data.

3 Empirical strategy

The analysis is aimed at investigating whether and how the allocation of EU cohesion funds has affected per-capita income growth in Italy's Objective 1 region municipalities. We focus on the 2007-2013 and 2014-2020 programming periods. To allow for a sufficiently long pre-treatment period we consider the payments received by these municipalities from 2000 to 2022 (the most recent available information). We employ a Two-Way Fixed Effects (TWFE) model and use the different timings of the payments to the Objective 1 municipalities as a source of temporal variability. We identify receipt of payment as the treatment. Since payment dates vary, TWFE models allows for comparison over time of the per-capita income growth rate in those municipalities that received the payment (treatment group) with municipalities that had not yet to receive payment,[7] and municipalities not eligible for funding (control group). The staggered nature of our dataset enables us to exploit temporal variability within the treatment group. Also, in our sample of Objective 1 region municipalities only one municipality did not receive any funding, which means that comparison of the outcome variable involves treated municipalities at different times.

The equation estimating the ATE of fund disbursement on citizens' income growth rate between the treated and control groups is written as:

$$Y_{it} = \beta_1 Treatment_{it} + \alpha_{it} + \delta_{it} + X_{it} + \epsilon_{it} \qquad (1)$$

where Y_{it} is the per-capita (real) income growth rate at year t in municipality i. $Treatment_{it}$ takes the value 1 for each payment year and 0 otherwise; α_i is a set of municipality fixed effects which control for heterogeneity in the cross-sectional dimension and allow us to account for unobservable time-invariant factors that could bias the estimates; δ_t is the set of year fixed effects which control for unobservable events specific to each year, which might affect all municipalities in the same way. X_{it} is a vector of the control variables, namely resident population (*Pop*), share of female population (*Female pop*), share of population with a university degree (*University edu*), and ϵ_{it} is the error term. Under the parallel trend assumption, the coefficient β_1 measures the ATE of the disbursement of cohesion funds on the outcome.

The parallel trend assumption is crucial for the validity of the diff-in-diff approach. It requires that in the absence of treatment, the difference in the outcome between the treated and control groups is constant over time. To test the parallel trend hypothesis, we use an empirical design based on dynamic specification of the diff-in-diff. Specifically, we implement the estimation of an event-study model which allows for comparison of the trajectories of the outcome measure for the treated and control groups in each year before and after disbursement of the funds. This allows us to test the validity of the parallel trend assumption and to capture important dynamics of the growth measure year by year after the treatment. The dynamic specification is:

[7] E.g., if municipality *i* receives payments in years 2007-2010 and 2013-2017 then in those years it is in the treatment group and in 2000-2006, 2011-2012, and 2018-2022 it is in the control group.

$$Y_{it} = \sum_{t=-n}^{+n} v_t \cdot D_{it} + \alpha_{it} + \delta_{it} + X_{it} + \epsilon_{it} \quad (2)$$

where Y_{it} is the per-capita income growth rate in municipality i at time t and D_t is a set of event-time dummies which take the value of 1 for treated municipalities if the year t is the k period before/after the first payment. Therefore, t_0 is the year of the first payment. To evaluate the policy measure dynamic, we assume that the effects of the payments extend beyond the years of the payment. Therefore, following the first payment (beginning of the treatment), the event-time dummies for the post treatment period will take the value of 1 even if in some of those years the payment is zero. As is usual in this type of analysis, we consider the omitted category to be the year before the first payment D_{-1}; the remaining coefficients v_t measure the difference in the per capita income growth rate before and after the payments received by the treatment group of municipalities. n is the number of estimated lags/leads. In all the specifications we consider municipality (α_i) and year (δ_t) fixed effects, and then include all the above control variables. ϵ_{it} is the error term.

4 Results

4.1 Average treatment effect (ATE)

Table 2 presents the results of the ATE estimation based on equation 1. In all the columns, the dependent variable is the municipal per-capita income growth rate with standard errors clustered at the municipal level. In columns 1 and 2 the regressor of interest is the *Treatment* dummy which is positive and significantly different from zero. In parsimonious specifications such as the one in column 1 (which controls only for municipality and year fixed effects), the per-capita income growth rate grows about 0.338 percentage points (p.p) more in the treatment group (municipalities receiving payments) than in the control group (payments not yet received, namely not-yet treated). The inclusion of the control variables (specification in column 2) does not change the magnitude, or significance, of the coefficients of interest. This suggests that omitted variables bias is not a problem. Among the controls, resident population has a negative and significant impact on the per-capita income growth rate and share of female population and share of population with a university degree have positive signs.

Table 2: Average Treatment Effect

	(1)	(2)	(3)	(4)
Dep. Var.:	Income growth	Income growth	Income growth	Income growth
Treatment	0.00338**	0.00337**		
	(0.00166)	(0.00166)		
Payments			0.000287***	
			(0.000110)	
Funds absorption				0.0249***
				(0.00715)
Pop		-0.00107**	-0.00103**	-0.00107**
		(0.000431)	(0.000425)	(0.000431)
Female pop		0.232***	0.227***	0.233***
		(0.0746)	(0.0752)	(0.0748)
University edu		0.0740*	0.0719*	0.0737*
		(0.0430)	(0.0431)	(0.0429)
Observations	26,143	26,143	26,006	26,142
No. Municipalities	1,519	1,519	1,519	1,518
Municipality FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes

Note. Estimation of the Average Treatment Effect (ATE) based on equation 1. The dependent variable is the municipal per-capita income growth rate. *Treatment* is a dummy that takes the value 1 in the years where municipality receive the payments, and 0 otherwise. *Payments* is the yearly (real) payments (in natural log) received by each municipality. *Funds absorption* is the proportion of yearly payments received by each municipality and the total funding allocated to the municipality from 2007 to 2022. The period of analysis is 2000 to 2022. The control variables include resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with a university degree in the municipality (*University edu*). All specifications include fixed effects for year and municipality; coefficients not reported here. Standard errors in parentheses clustered at the municipality level. Coefficient significance levels are indicated by * (10% significance), ** (5% significance), and *** (1% significance).

These findings suggests that EU cohesion policies have been effective for enhancing the rate of growth of municipality per-capita income and confirm the results in Coppola et al. (2020) and Di Caro and Fratesi (2022). The magnitude of the results is relevant and corresponds to around one quarter of the mean of the municipality per-capita income growth rate (1.5%).

The binary variable *Treatment* estimates the causal relationship between the EU funding received and the municipality per-capita income growth rate. It exploits the variation in municipality treatment status — receives the payment/does not receive the payment. This takes no account of heterogeneity in the amount of funding received and invested in the different municipality projects. We exploit this heterogeneity and employ a diff-in-diff (DiD) with continuous treatment (Atella et al., 2023, Ciani and De Blasio, 2015, Di Caro and Fratesi, 2022, Ferrara et al., 2022). The regressor of interest (Payments) is the yearly (real) payments (in natural log)[8] received by each municipality which proxies for the intensity of the treatment. Table 2 column 3 presents the estimation results and shows that a 10% increase in the amount of the payment received generates an increase in the municipal per-capita income growth rate of almost 0.03 percentage points in the treatment

[8] To avoid losing zero values in the data (cases of no funding received), we add 1 before taking the logarithm.

group compared to the control group.

To increase the robustness of our analysis, we include an additional dependent variable: the ratio of yearly payments received by each municipality to its total funding between 2007 and 2022. Since it reflects the share of funding that flowed into the real economy, this variable proxies for the municipality's capacity to absorb funding (Bourguignon and Sundberg, 2006) (Arnaoutoglou, 2021, Kersan Sˇkabi´c and Tijani´c, 2017). It also highlights the municipality's ability to efficiently and fully utilize the resources received (Funds absorption). In table 2 column 4 the coefficient of Funds absorption is positive and highly significant meaning that a 10% increase in the share of payment leads to an increase in the municipal per-capita income growth rate of 2.49 p.p. in the treatment compared to the control group.

4.2 Dynamic specification - Event study

We are interested in the dynamic of disbursement of EU payments on per-capita income growth rates in the Objective 1 region municipalities in the period 2000-2022. We estimate an event-study model based on equation 2 which allows us 1) to test the validity of the parallel trend assumption and 2) to examine the dynamic of the growth variable during the post-treatment period. We estimate 7 pre-treatment and up to 15 post-treatment periods (the highest number). Recall that the source of variation in the treatment status of the treated municipalities (almost the entire sample) comes from the staggered disbursement of payments which allows year-by-year comparison between the treated and not-yet treated municipalities.

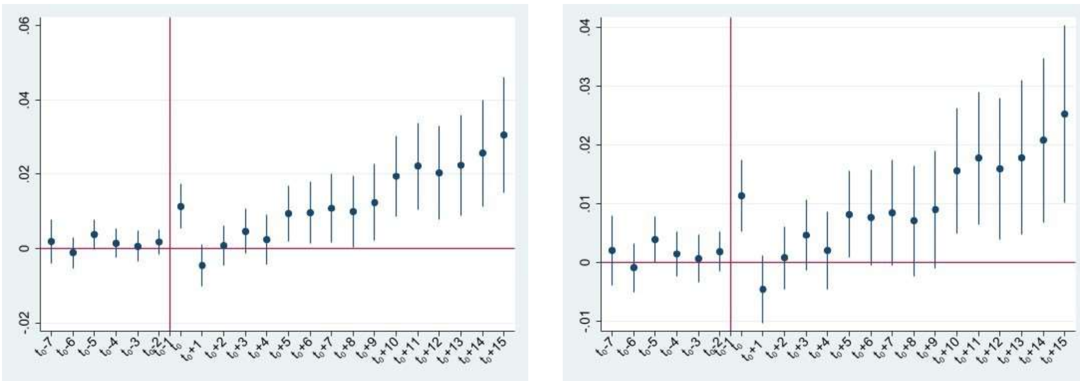
Figure 6 depicts the results of estimating equation 2. In both graphs we control for year and municipality fixed effects; graph 6b includes all the abovementioned control variables. Standard errors are clustered at the municipal level. Although both graphs show that the parallel trend hypothesis holds (confidence intervals from t_0 - 7 to t_0 - 2 are all around zero) we conduct an F-test to confirm the parallel trend assumption. The pre-treatment coefficients are jointly equal to zero, accepting the null (respective F-test p-values related to graphs 6a and 6b are 0.31 and 0.53) which suggests there is no significant difference in the municipal per-capita income growth rate trend between the two municipality groups before payments were received.

The findings from the analysis of the post-treatment dynamic are interesting and enhance the previous ATE analysis. Graph 6a shows that after a strong increase in the income growth rate in the first year of the payment (t_0), municipality per-capita income growth rate shows a not significant difference between the treated and untreated groups up to the fifth year after the first payment (t_0 +5). After that, we observe an increase (which grows larger over the long term) in the income growth rate increases in the treatment compared to the control group.

In graph 6b, which includes the control variables, the per-capita income growth rate starts increasing in the treatment (but not the control group) in the 10th year after the first payment.

Figure 6: Event-study

(a) Without controls (b) With controls



Note: The graphs show the estimated coefficients and confidence intervals based on equation 2. The dependent variable is per-capita income growth rate in Objective 1 region municipalities. We estimated 7 lags and up to 15 leads. The period of analysis spans 2000 to 2022. Both graphs include year and municipality fixed effects; graph 6b includes the control variables resident population in thousands (*Pop*), share of female population (*Female pop*), and share of population with a university degree (*University edu*). Standard errors clustered at municipality level. The points represent the estimated coefficients; the confidence intervals are at 90%. F-test p-values for all pre-treatment coefficients jointly equal to 0 are 0.527 and 0.538 for graphs 6a and 6b.

The income growth rate dynamics suggest that the first payment is used to finance structural investments and initial hiring which results in immediate income growth. After that, the effects of the project funding are not particularly evident until the fifth year after the first funding. However, the timing of these effects depends on the project type. The highly significant coefficient at t_0 might suggest a short-term project (e.g. purchase of goods and services or provision of training). Over the medium term, the coefficients are not significantly different from 0, which should be due to structural projects that initially generate investment costs and do not have an immediate positive effect on revenues. In the case of structural projects, it takes at least five years for such investment to have a positive effect on income. After the 10th year from the first payment this positive effect increases (graph 6b). Unfortunately, we cannot empirically test these propositions because we are not able to distinguish the payments by project type (in a single year, the payments for different types of projects overlap).

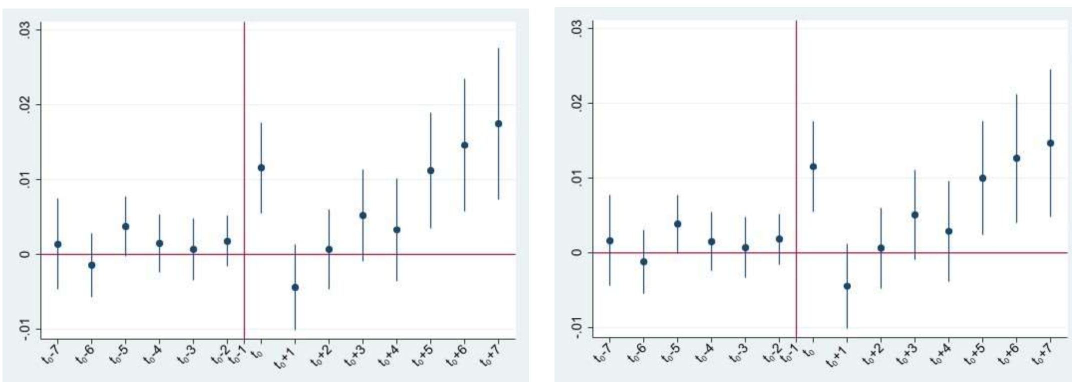
Therefore, we need to consider a long-time horizon and take account of the complementarity between static and dynamic analysis. Our study works to link evidence that finds cohesion funds ineffective and works that considers them a tool for growth. Figure 6 shows that it takes at least five years after the first payment for a significant and lasting effect of cohesion funds on per-capita income growth to emerge. Our findings do not contradict previous research; they work simply to clarify timing.

4.3 Control group

The diff-in-diff analysis was based on comparing the treated (those receiving the payments in any year) and not-yet treated municipalities (we recall that among municipalities within the Objective 1 regions only 1 is never treated, that is, does not receive any payment). Estimation of the event-study model implies that starting in 2014, all but one of the municipalities was treated. Therefore, after 2014, in the event study model, the comparison is between the treated municipalities and one untreated municipality. To control the potential bias due to this very small control group after 2014, we refined the analysis. First, we considered a time-span ending in 2014 to get a control group which included not-yet treated municipalities. Figure 7 depicts the results, which show a significant coefficient at t_0 and an increasing significant trend in the municipal per-capita income growth rate starting from $t_0 + 5$.[9]

Figure 7: Event-study - Up to 2014

(a) Without control (b) With controls



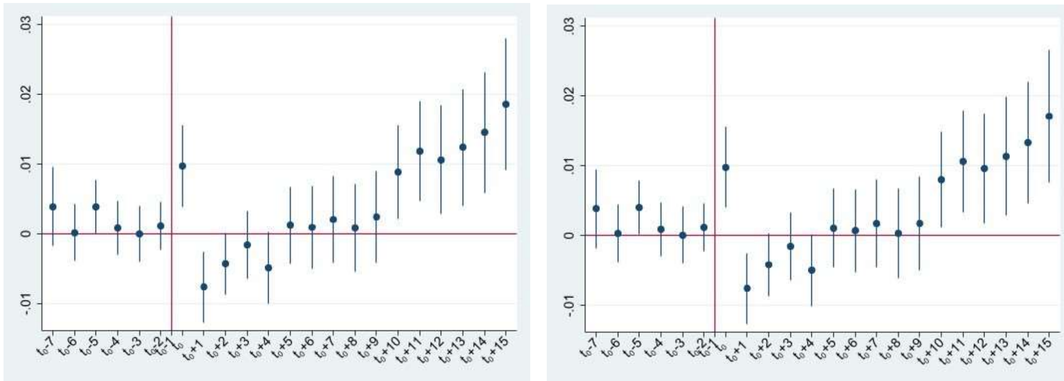
Note: The coefficients and confidence intervals are based on equation 2. The dependent variable is per-capita income growth rate in the Objective 1 region municipalities. We estimated 7 lags and up to 7 leads. The period of analysis spans 2000 to 2014. Both graphs include year and municipality fixed effects; graph 7b includes controls for resident population in thousands (*Pop*), share of female population (*Female pop*), and share of population with a university degree (*University edu*). Standard errors clustered at the municipality level. The points represent the estimated coefficients; the confidence intervals are 90%. The F-test p-values that all pre-treatment coefficients are jointly equal to 0 are 0.516 and 0.515 in graphs 7a and 7b, respectively.

This restricts the analysis to the 2007-2013 programming cycle, so we extended the control group to include the 67 never-treated municipalities in the rest of Italy. Multiplying these 67 by the 23 years of the time-span provided an additional 1,541 observations. Figure 8 graphs 8a and 8b depict the event study model results for the estimations without and with the control variables. We observe an increasing per-capita-income growth rate starting from the 10th year after the first payment.

[9] In this specification, we can estimate up to 7 post-treatment periods to 2014.

Figure 8: Event-study - Control group comprising also never treated municipalities

(a) Without control (b) With controls



Note. The coefficients and confidence intervals are based on equation 2. The dependent variable is per-capita income growth rate in the Objective 1 region municipalities, namely, Calabria, Campania, Apulia, and Sicily and never treated municipalities in the rest of Italy. We estimated 7 lags and up to 15 leads. The period of analysis spans 2000 to 2022. Both graphs include year and municipality fixed effects; graph 8b includes controls for resident population in thousand inhabitants (*Pop*), share of female population (*Female pop*), and share of population with a university degree (*University edu).* Standard errors clustered at the municipality level. The points represent the estimated coefficients; the confidence intervals are 90%.The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.569 e 0.563 for estimation in Graphs 8a e 8b, respectively.

4.4 Estimations robust to negative weights

In our analysis, the treatment (i.e. policy payments) is staggered over time, that is received at different times. De Chaise-Martin and d'Haultfoeuille (2020) and Goodman-Bacon (2021) highlight that conventional approaches might be inadequate for staggered treatments and could produce misleading results. Specifically, the treatment effect estimated using the traditional diff-in-diff approach is a weighted average of the treatment effect. Even if the overall treatment effect is positive, these weights can sometimes be negative which can lead to misleading estimates of the treatment effect where the average effect appears negative despite a positive impact of the intervention. The negative weights problem arises only if the treatment effects vary over time, leading to treated units acting as controls. In other words, if one group is treated in multiple periods and another group is not, the treated group might become a control. This treatment effect heterogeneity could bias the results.

To address the issue of negative weights in a staggered treatment setup, we implemented the linear model estimator proposed by Borusyak et al. (2021) which is robust to treatment effect heterogeneity.[10] Figure 9 depicts the results; table 3 presents the post-treatment point estimates of parameters. We can estimate from −5 to 6 event-time coefficients. Figure 9 shows that when taking account of heterogeneous treatment effects, the dynamic of the effects of the EU cohesion payments on the per-capita municipal income growth rate are the same as in the main analysis (Figure 6). The confidence intervals of all the pre-treatment coefficients include zeros which support the parallel trend assumption. This is further confirmed by the results of an F-test which suggests acceptance of the null hypothesis that all pre-treatment coefficients are jointly equal to zero (Table 3 last row). Graph 9a depicts

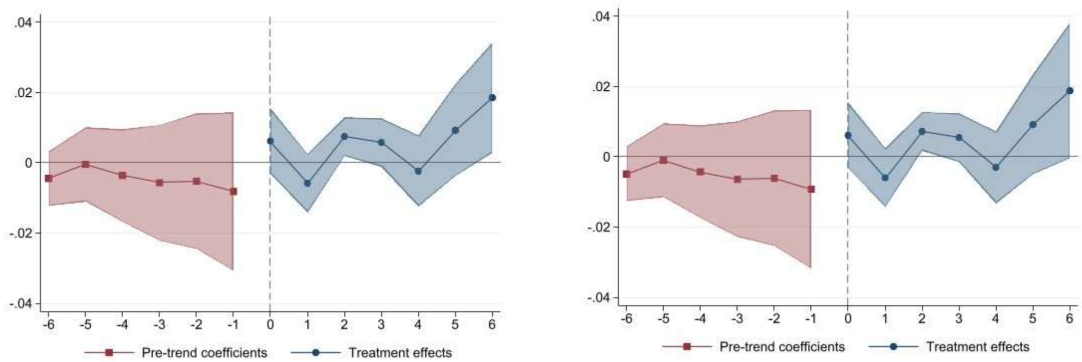
[10] We used the unofficial Stata command *did imputation* (Borusyak, 2023).

the estimations for the full sample of municipalities in the Objective 1 regions excluding the control variables; graph 9b includes the controls resident population, share of female population, and share of population with a university degree.

Although not significantly different from zero, the coefficient at t_0 is positive as in the standard event-study. The first positive and significant coefficient appears at $t_0 + 2$, showing an increase in the municipal per-capita income growth rate of 0.7 percentage points more in the treatment than in the control group. After $t_0 + 4$ this increases further with a significant coefficient at $t_0 + 6$.

Figure 9: Heterogeneous treatment

(a) Without controls (b) With controls



Note. The graphs report coefficients and confidence intervals estimated according to the Borusyak (2023) procedure. The dependent variable is the municipal per-capita income growth rate. Standard errors are clustered at municipal level. Dots refer to point estimates, spikes to 95% confidence intervals. The omitted category is the year before the first payment (t_0 - 1). We estimated event-time dummy variables for 6 years before and 6 years after the first payment. All the regressions control for municipality and year fixed effects; graph 9b includes controls for resident population in thousands (*Pop*), share of female population (*Female pop*), and share of population with a university degree (*University edu*). The sample includes the Objective 1 region municipalities. Period: 2000-2022.

Table 3: Estimates robust to heterogeneity treatment effects

Dep. Var.: Income growth	(1)	(2)
t_0	0.006	0.006
	(0.004)	(0.005)
$t_0 + 1$	-0.005	-0.006
	(0.004)	(0.004)
$t_0 + 2$	0.007***	0.007***
	(0.003)	(0.003)
$t_0 + 3$	0.005*	0.005
	(0.003)	(0.003)
$t_0 + 4$	-0.002	-0.003
	(0.005)	(0.005)
$t_0 + 5$	0.009	0.009
	(0.007)	(0.007)
$t_0 + 6$	0.018**	0.019*
	(0.008)	(0.01)
Observations	16,410	16,410
Municipality FE	Yes	Yes
Year FE	Yes	Yes
Controls	No	Yes
P-value F-test	0.46	0.47

Note. The table reports coefficients estimated according to the Borusyak (2023)'s procedure. The dependent variable is the municipal per-capita income growth rate. Standard errors are clustered at municipal level. We show only the post-treatment event-time dummy variables. All regressions include municipality and year FEs (coefficients not reported). Standard errors are in brackets. Estimation in column 2 contains the control variables as the resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with a university degree in the municipality (*University edu*). The last row of the table reports the p-value of the F-test, whose null hypothesis requires that all the pre-treatment coefficients are jointly equal to zero. The sample comprises municipalities in the Objective 1 regions, namely, Calabria, Campania, Apulia and Sicily. Period: 2000-2022. Significant coefficients are indicated by * (10% level), ** (5% level) and *** (1% level).

5 Robustness checks

5.1 Dropping the Sicilian municipalities

As a robustness we conducted the analysis to check the effect of EU cohesion fund payments on growth excluding the municipalities in Sicily which, as a special status region, may have benefited from other sources of funding. Table A.1 presents the results of the ATE estimates and although the coefficients are slightly smaller in magnitude and significance are in line with the baseline estimate in Table 2.

Figure B.1 depicts the per-capita income growth rate dynamic which is similar to the pattern observed for the full sample and confirms that the effects are over the long term.

5.2 Dropping 2007 and 2008

The EU rules that EU financial resources must be spent within two years of the end of a programming cycle (n+2 rule). This rule applied to the 2000-2006 programming period meaning that the funding must be spent by 2008 at the latest. This means that in years 2007 and 2008, 2000-2006 and 2007-2013 payments overlapped, making difficult to disentangle the effects of these two financing programs. Following Ciani and De Blasio (2015), we ran the analysis excluding years 2007 and 2008. The estimation results presented in table A.2 and depicted in figure B.2 confirm our main results.

5.3 Dropping the years after 2019 to account for the COVID 19 crisis

As a response to the COVID-19 pandemic, starting in 2020 Italy adopted a series of extraordinary measures to mitigate the economic and social impacts of the crisis. These measures included various emergency decrees which provided direct support for workers in the form of subsidies for self-employed individuals and seasonal workers, and tax breaks, temporary exemptions, and extraordinary contributions for businesses. The extension of the wage supplement scheme (*Cassa Integrazione Guadagni (CIG)*) was one of the main tools used to support workers experiencing difficulties and allowed temporary suspension of contracts without total loss of income. A temporary emergency income scheme was implemented to support economically vulnerable families that did not qualify for traditional assistance programs.

In addition to these measures, targeted incentives were introduced for sectors most severely affected by the pandemic such as tourism, restaurants, and culture, aimed at preventing permanent shutdowns and supporting their eventual recovery. These measures were complemented by fiscal actions, including deferral and suspension of tax and contribution payments to improve liquidity and financial sustainability of households and enterprises.

The social distancing measures imposed during the COVID-19 crisis also had a significant impact on local incomes and particularly in those municipalities that depended on tourism and trade. The enforced shutdowns of enterprises and restrictions on mobility affected local demand and caused significant contraction in the retail and restaurant services sectors, damaging economic and employment stability in many areas.

The temporary interventions introduced substantially affected municipality level economic flows and incomes and resulted in an exceptional and potentially biased economic framework. We therefore exclude from our analysis the years after 2019 to enable a more accurate assessment of the impact of cohesion policies on a context not subject to these extraordinary measures.

Appendix Table A.3 presents the results for the estimated ATE and Appendix Figure B.3 presents the results of dynamic specification. Estimation of the ATE shows an increase in the municipality per-capita income growth rate of 0.406 percentage points (parsimonious specification) and 0.426 percentage points (full specification) for the treatment group compared to the control group. These results confirm the findings from the baseline specification which show an increasing trend starting in the fifth year after the first payment.

5.4 Including the municipalities in Basilicata

Since the first programming cycle of the European Union's cohesion policies 2000-2006, the Objective 1 regions have included Basilicata. However, for the 2007-2013 cycle Basilicata was classed as a "phasing out" region eligible for reduced amounts of funding. This reclassification was due to entry to the EU of countries with low levels of per-capita GDP.[11] During the 2014-2020 cycle, Basilicata lost its "phasing-out" status and was reincluded in the regions Objective 1 (less developed) regions[12] Between 2007 and 2024, the value related to the projects supported in Basilicata exceeds €22 billion, €18 billion of which were allocated in the 2014-2020 period.[13]

As an additional robustness check, we ran an analysis including the municipalities in Basilicata. Appendix table A.4 presents the results of the ATE estimations; the *Treatment* dummy shows that rate of growth of per-capita GDP increased by 0.307 percentage points and 0.305 percentage points following EU financing, slightly less than in the baseline estimation (Table 2). Appendix Figure B.4 depicts the treatment dynamic which is similar to that depicted in Figure 6.

6 Discussion of results

Our findings suggest that it is likely that cohesion policies which increase the long-term income growth rate have helped to reduce the disparities in income growth between Objective 1 regions and others. In turn, this suggests that EU cohesion policies have supported the EU's goal of more balanced and integrated development across different geographical and social contexts. However, it is possible that the higher incomes resulting from the receipt of cohesion funds might have benefited only certain segments of the population, and potentially might have increased the income inequalities among and within regions. This underlines the importance of evaluating the allocation of EU cohesion funds from an equity perspective to assess how the gains from these initiatives are distributed among citizens within regions.

Analysis of income disparities among regions shows that different policies produce different income inequality and income growth patterns. In the case of individual well-being (in which income inequality plays an important part), Ferrara et al. (2022) examined how EU regional well-being and GDP growth have been affected by cohesion policy funding. Their findings show that higher levels of funding have diminished marginal returns

[11] A region can lose its Objective 1 status for two reasons: first, if it is marginally below the 75% per-capita GDP threshold in the previous period, it might perform better than other regions and pass the threshold. Second, the EU's expansion into Eastern Europe lowered the 75% threshold in absolute terms, meaning that the level of per-capita GDP which previously classed the region as Objective 1 no longer applies.

[12] Source:https://politichecoesione.governo.it/it/politica-di-coesione/la-programmazione-2014 2020/strategie-2014-2020/.

[13] Source: https://opencoesione.gov.it/it/coesione/territori/basilicata-regione.

for GDP growth and that well-being levels barely change across funding levels. This indicates that the reaction to increased transfers differs between GDP and the broader aspects of well-being and suggests that cohesion policies might have multidimensional effects that go beyond economic growth.

The direct relationship between intra-regional income distribution and place-based policies was investigated by Lang et al. (2022). The authors demonstrate that while EU cohesion policies promote economic growth and increase regional average disposable household income, they also cause a slight rise in regional inequality. Specifically, cohesion policies tend to benefit the relatively wealthier households in the funded regions more than the poorer households. This increased inequality is driven mainly by the faster income growth achieved by more highly educated individuals compared to that achieved by citizens with lower levels of education.

Our research adds to work on income inequality by focusing on the impact of EU cohesion policies on income inequalities within Italy's Objective 1 regions.

We investigated how the municipal income growth rate responses to cohesion policy transfers for different income classes. We estimated an event study model including as the dependent variable the per-capita income growth rate for different income classes. We used MEF income data for zero to over €120,000 per year. We constructed ascending income brackets.[14] We excluded the €0 to €10,000 bracket because those who earn these amounts tend to benefit from subsidies and tax exemptions.

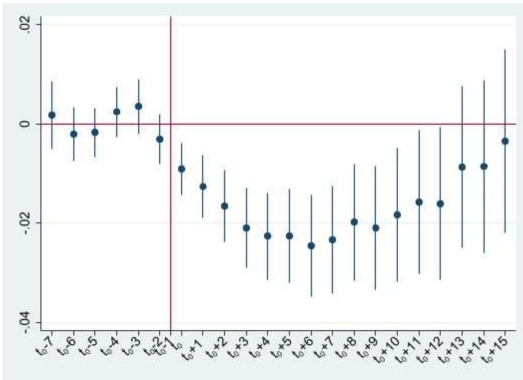
For each annual income class, we calculated the municipality per-capita income growth rate; Figure 10 depicts the event-study model estimation results.

The graphs show that all the pre-treatment confidence intervals are around zero supporting the validity of the parallel trend assumption. The F-test results show also that the pre-treatment coefficients are jointly equal to zero (p-values beneath figure 10). Graphs 10a, 10e and 10f show a negative per-capita income growth rate trend, meaning that in the extreme income classes, cohesion policies have had a negative impact on the income growth rate. In the cases of middle-income classes (€15,000−26,000 and €26, 000−55, 000), the pattern is positive and continually increasing. The income class €55, 000-75, 000 shows no significant impact of cohesion policies on the income growth rate.

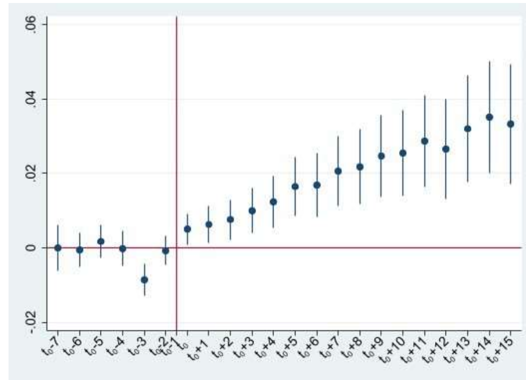
[14] The intervals are €0-10,000, €10,000-15,000, €15,000- 26,000., €26,000-55,000, €55,000-75,000, €75,000-120,000, and over €120,000.

Figure 10: Event-study- Different ranges of income

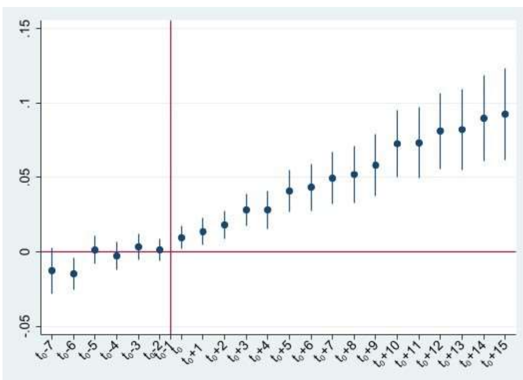
(a) 10,000-15,000



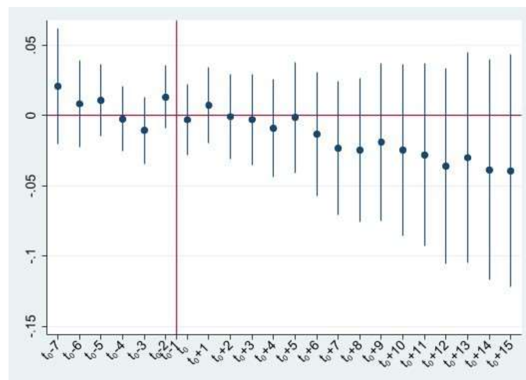
(b) 15,000-26,000



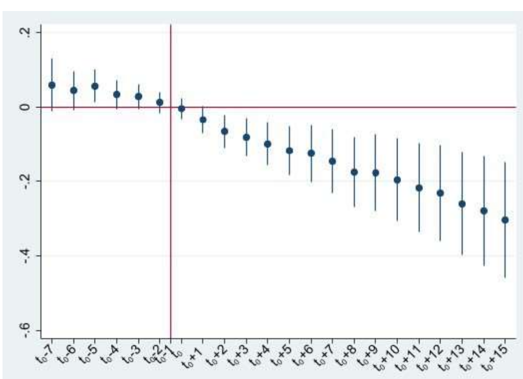
(c) 26,000-55,000



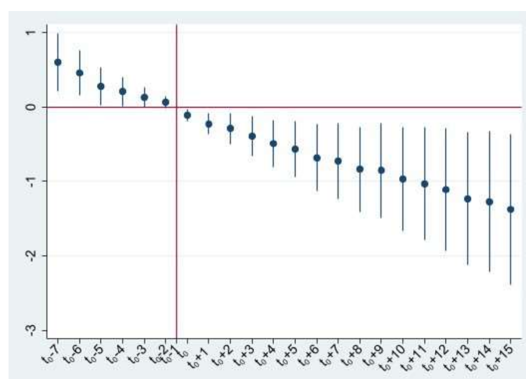
(d) 55,000-75,000



(e) 75,000-120,000



(f) >120,000



Note. The coefficients and confidence intervals are based on equation 2. The dependent variable is per-capita income growth rate in the Objective 1 region municipalities, namely, Calabria, Campania, Apulia, and Sicily, in different classes of income. We estimated 7 lags and up to 15 leads. The period of analysis spans 2000 to 2022. Both graphs include year and municipality fixed effects; graph 8b includes controls for resident population ('000) (Pop), share of female population (Female pop), and share of population with a university degree (University edu). Standard errors clustered at the municipality level. The points represent the estimated coefficients; the confidence intervals are 90%. The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.447, 0.021, 0.209, 0.664, 0.567 and 0.111 for the estimates in Graph 6a and 6b, respectively.

Graphs a-f show that a widening gap in inequality between the low- and middle-income groups and a narrowing inequality gap between the middle- and higher-income groups. This means that evaluating the effect of EU cohesion policies on inequality is not straightforward. We considered the Gini and Atkinson inequality the most appropriate indexes which are frequently used for our data, since they are reliable in the case of income data aggregated by income class.[15]

To calculate the Gini index, we considered the income distribution in each municipality aggregated by income brackets. Since the data are organized in income intervals, we used a method that relies on taxpayer frequency and total income in each bracket.[16] The Gini index varies between 0 and 1. The greater the Gini index value, the greater the level of inequality.

To calculate the Atkinson index, we analyzed the income distribution across predefined income brackets for each municipality.[17] The Atkinson index is computed as 1 minus the adjusted mean, which represents the proportion of total income the population would be willing to sacrifice to achieve an equal distribution.[18] It varies between 0 and 1, the greater the Atkinson index value, the greater the level of inequality.

Figure 11 depicts the territorial distribution of the income inequality indexes in the Italian Objective 1 regions for the period 2000–2022. The indexes are Low, Medium, High, and Very High, based on a quantile approach. Map (a) depicts the Gini index, highlighting a concentration of higher inequality in inland areas and certain urban zones, with coastal regions generally exhibiting more moderate levels of inequality. Map (b) presents the Atkinson index, which emphasizes the inequality in the most disadvantaged population groups.

Although the spatial patterns related to the two indexes are broadly similar, the Atkinson index reveals greater intensity in specific areas. On both maps, the darker shades indicate territories with the highest levels of inequality. The geographical differences between the two maps depend on the specific sensitivity of the indexes. The Gini index (a) is more

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[15] Measures based on percentiles such as the 80/20 and 90/10 ratios, require access to specific income distribution data not available in the MEF dataset. Additionally, in our case the percentile-based measures are not suitable since they focus on the extremes of the income distribution, whereas the previous analysis shows that EU policies also affect the intermediate income classes.

[16] We began by arranging the income brackets in ascending order and calculated the cumulative taxpayer frequencies and cumulative incomes for each bracket, normalized to the total income. These values allowed us to compute the Lorenz curve using the area trapezoid method which represents the cumulative income distribution relative to the cumulative taxpayer distribution. The Gini index is calculated as 1 minus the area under the Lorenz curve, reflecting the degree of inequality in the municipality income distribution.

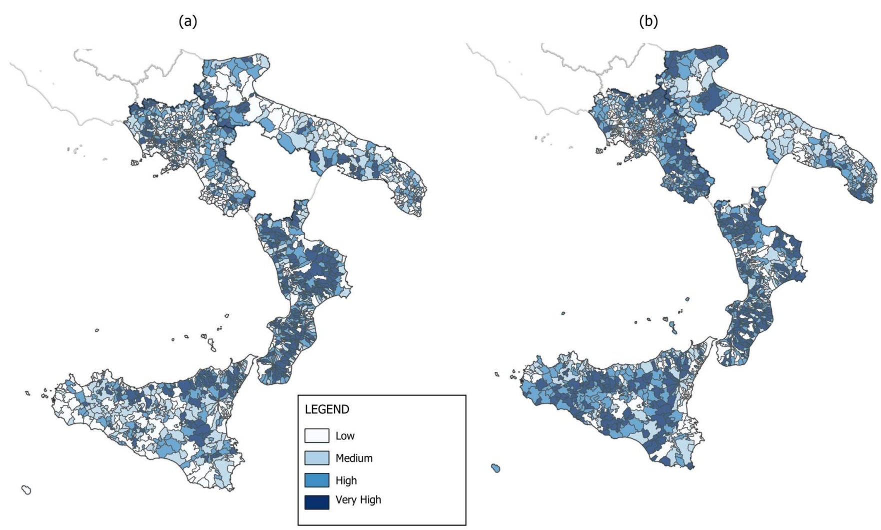
[17] This index requires a parameter ϵ between 0 and 1, which reflects the level of inequality aversion, with higher values of ϵ giving more weight to lower incomes. We chose the intermediate value of ϵ of 0.5. We arranged the income brackets in ascending order, and for each bracket we calculated the ratio of average income in that bracket to overall average income. Next, we increased this ratio to the power of $1-\epsilon$ and weighted each result by taxpayer frequency in that bracket. The weighted results were summed and normalized by the total number of taxpayers

[18] To protect taxpayer anonymity, in the case of only 1 to 3 taxpayers within a given income bracket in a municipality, administrative data report "missing values" for number of taxpayers and their income. To account for these privacy restrictions, we imputed missing values by assuming 2 taxpayers and using twice the average income per-capita in that bracket, calculated from provincial data for the corresponding year as in Coccorese and Dell'Anno (2024)

sensitive to inequality in the middle part of the income distribution and shows a more uniform distribution. The Atkinson index (b) tends to emphasize disparities in the low-income brackets, highlighting concentrations of "Very High" inequality in economically vulnerable regions. These differences reflect the methodological priorities of the indexes: the Gini is descriptive, while the Atkinson is normative and flexible (Cowell, 2011).

Figure 12 shows the event-study estimates of the Gini (a) and the Atkinson (b) inequality indexes. Under the parallel trend assumption (confirmed by acceptance of the null of the F-test that all the pre-treatment coefficients are jointly equal to 0 - see note to figure 12), both indexes display an increasing pattern over years among the treated compared to the untreated municipalities. This means that starting from the first payment, although the per-capita income growth rate increases after the treatment, underlining the effectiveness of the EU cohesion policies, the payments have different effects for different income classes and for some exacerbate the inequalities.

Figure 11: Geographical distribution of the Gini and Atkinson indexes

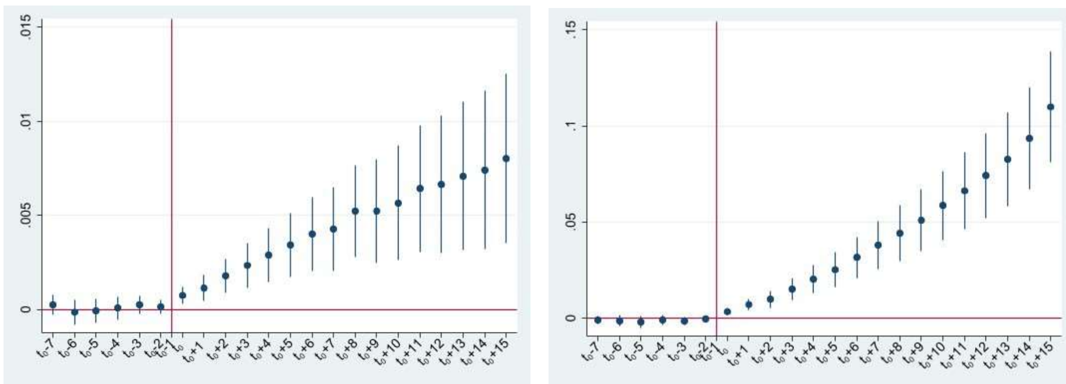


Note. Territorial distribution of economic inequality indices in the Objective 1 regions of Italy (Apulia, Calabria, Campania, Sicily). Map (a) is based on the Gini index, map (b) is based on the Atkinson index. Both indexes were calculated as the average of the values recorded during the period 2000-2022.

Investigating the mechanisms driving the observed increase in income inequality is beyond the scope of this study. However, Lang et al. (2022) have several suggestions about why these policies tend to benefit middle-income groups in supported regions. First, the policies might favor capital over labor. A significant portion of EU regional funds are allocated as investment subsidies and tax incentives. Depending on how easily capital can substitute for labor in beneficiary firms, new investments in capital might reduce the reliance on labor. Second, even if the policy measures support labor, there is no certainty about the type of jobs that will be created and the wages involved. Third, accessing place-based policies can require some initial investment. Compared to firms with limited human capital, larger and more productive firms employing highly skilled workers are generally better equipped to absorb these costs. Consequently, place-based policies might disproportionately benefit skilled workers, leaving low-skilled workers at the lower end of the income distribution gaining only minimally.

Figure 12: Event-study - Inequality measures

(a) Gini index (b) Atkinson index



Note. The graphs show the coefficients and confidence intervals estimated based on equation 2. The dependent variable is the Gini index in Graph 12a and the Atkinson index in Graph 12b. The sample includes the Objective 1 region municipalities of Calabria, Campania, Apulia and Sicily. We estimated 7 lags and up to 15 leads. The period of analysis spans 2000 to 2022. Both graphs include year and municipality fixed effects and controls for resident population in thousands (*Pop*), share of female population (*Female pop*), and share of population with a university degree (*University edu*). Standard errors clustered at the municipality level. The points represent the estimated coefficients; the confidence intervals are 90%. The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.651 and 0.291 for the estimates in Graph 12a and 12b, respectively.

7 Conclusions

This paper investigated the effectiveness of cohesion funds in Objective 1 regions and whether and how cohesion policies have affected the growth rate of municipality citizens' incomes. We exploited the staggered disbursement of multiple funding tranches across the programming periods 2007–2013 and 2014–2020, and employed a diff-in-diff approach to assess the impact of EU funding on the municipality per- capita income growth rate.

The ATE estimates indicate that on average, the municipality per-capita income growth rate rose by 0.357 percentage points more in municipalities that received funding compared to those that did not. This corresponds to around a quarter of the average per-capita income growth rate in the Objective 1 municipalities. Based on the yearly amounts of the payments received by each municipality, we found that a 10% increase in these payments resulted in an approximately 0.03 percentage point increase in municipality per-capita income growth. Our main result is reinforced by an analysis of the ratio of the yearly payments received by each municipality to its total funding allocated between 2007 and 2022 (which proxies for the municipality's capacity to absorb funds).

Estimation of an event study model supports the parallel trend assumption. The dynamic reveals an initial sharp increase in per capita income growth in the year of the first payment which suggests the short-term nature of some projects. It then follows an upward trend between the 5th and the 15th year after the first payment, probably reflecting the longer time required for structural projects to have an impact on income.

Our study highlights the complementarity between the short- and long-term effects of EU cohesion policies on the income growth rate and bridges between the streams of work that question the effectiveness of cohesion funds and support their effectiveness for fostering economic growth.

We ran some robustness checks to confirm the consistency of the results to extending the control group to include never-treated municipalities in the rest of Italy, the presence of negative weights in staggered adoption, the exclusion of Sicily from the sample (based on its potential access to alternative sources of funding), the exclusion of 2007 and 2008 due to the n+2 rule, restricting the time span to ending in 2019 prior to the onset of COVID-19 crisis and the inclusion of the municipalities in Basilicata in the Objective 1 region municipalities.

Our focus is the equitable distribution of funds. Although it seems that cohesion policies have reduced disparities in income growth rates among the regions that received funding, certain segments of the population may have benefited disproportionately more from this increased income which will have increased income inequalities. We analyzed the possibility of income inequalities among citizens in the Objective 1 regions. An event study model of municipality per-capita income growth rates in different income classes showed that cohesion policies have disproportionately benefited the middle-income groups (€15,000–€26,000 and €26,000–€55,000) with per capita income showing a positive and increasing growth trend. In contrast, we found that the low-income groups (below €15,000) and the highest income earners (above €75,000) showed either negative or negligible effects.

To quantify the broader inequality dynamics, we calculated the Gini and Atkinson indexes, using aggregate municipality income data. Our findings suggest that EU cohesion policies, while effective for driving growth, have also contributed to increasing income disparities. Both indexes display an upward trend for the treated compared to the untreated municipalities, signaling an exacerbation of inequality.

Although our findings highlight the effectiveness of cohesion policies for stimulating economic growth, they reveal their limited ability to address inequality. Our study shows that reducing inequalities and enhancing inclusiveness requires targeted interventions to ensure the equitable distribution of the benefits across income groups.

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APPENDIX

A Tables

Table A.1: Average Treatment Effect - No Sicily

	(1)	(2)
Dep. Var.:	Income growth	Income growth
Treatment	0.00331*	0.00332**
	(0.00173)	(0.00172)
Observations	19,238	19,238
Number of cod com	1,143	1,143
Municipality FE	Yes	Yes
Year FE	Yes	Yes
Controls	No	Yes

Note. Estimation of the Average Treatment Effect (ATE) follows equation 1. The dependent variable is the municipal per-capita income growth rate. *Treatment* is a dummy that takes the value 1 in the years where municipality receive the payments, and 0 otherwise. The period of analysis is 2000 to 2022. The sample excludes Sicilian municipalities. The control variables include resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with an university degree in the municipality (*University edu*). All specifications include fixed effects for year and municipality; coefficients not reported here. Standard errors in parentheses clustered at the municipality level. Coefficient significance levels are indicated by * (10% significance), ** (5% significance), and *** (1% significance).

Table A.2: Average Treatment Effect - Dropping 2007 and 2008

	(1)	(2)
Dep. Var.:	Income growth	Income growth
Treatment	0.00259*	0.00248*
	(0.00147)	(0.00145)
Observations	23,704	23,704
Number of cod com	1,519	1,519
Municipality FE	Yes	Yes
Year FE	Yes	Yes
Controls	No	Yes

Note. Estimation of the Average Treatment Effect (ATE) follows equation 1. The dependent variable is the municipal per-capita income growth rate. *Treatment* is a dummy that takes the value 1 in the years where municipality receive the payments, and 0 otherwise. The period of analysis is 2000 to 2022 and excludes the years 2007 and 2008. The control variables include resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with a university degree (*University edu*). All specifications include fixed effects for year and municipality; coefficients not reported here. Standard errors in parentheses clustered at the municipality level. Coefficient significance levels are indicated by * (10% significance), ** (5% significance), and *** (1% significance).

Table A.3: Average Treatment Effect - Up to 2019

	(1)	(2)
Dep. Var.:	Income growth	Income growth
Treatment	0.00406**	0.00402**
	(0.00187)	(0.00185)
Observations	23,148	23,148
Number of cod com	1,510	1,510
Municipality FE	Yes	Yes
Year FE	Yes	Yes
Controls	No	Yes

Note. Estimation of the Average Treatment Effect (ATE) follows equation 1. The dependent variable is the municipal per-capita income growth rate. Treatment is a dummy that takes the value 1 in the years where municipality receive the payments, and 0 otherwise. The period of analysis is 2000 to 2019. The control variables include resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with a university degree (*University edu*). All specifications include fixed effects for year and municipality; coefficients not reported here. Standard errors in parentheses clustered at the municipality level. Coefficient significance levels are indicated by * (10% significance), ** (5% significance), and *** (1% significance).

Table A.4: Average Treatment Effect - Including Basilicata

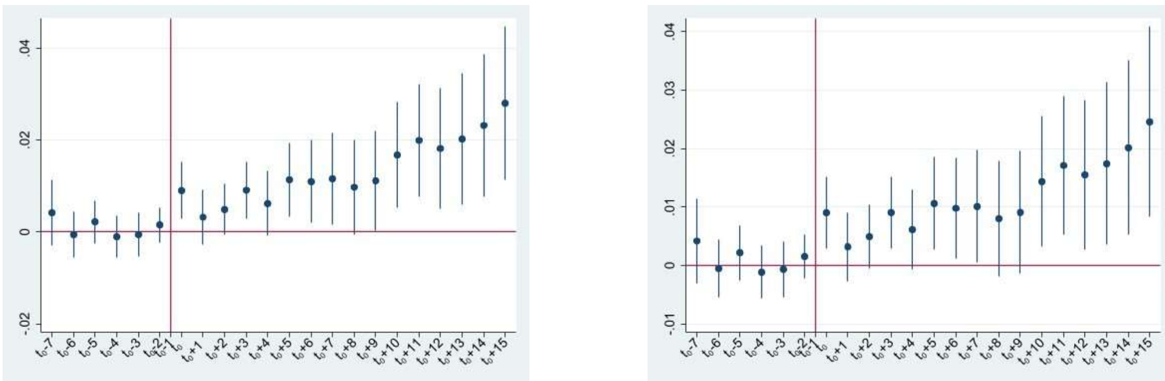
	(1)	(2)
Dep. Var.:	Income growth	Income growth
Treatment	0.00307*	0.00305**
	(0.00162)	(0.00161)
Observations	28,116	28,116
Number of cod com	1,641	1,641
Municipality FE	Yes	Yes
Year FE	Yes	Yes
Controls	No	Yes

Note. Estimation of the Average Treatment Effect (ATE) follows equation 1. The dependent variable is the municipal per-capita income growth rate. *Treatment* is a dummy that takes the value 1 in the years where municipality receive the payments, and 0 otherwise. The period of analysis is 2000 to 2022 and includes municipalities in Basilicata. The control variables include resident population in thousands (*Pop*), the share of female population in the municipality (*Female pop*), the share of population with an university degree (*University edu*). All specifications include fixed effects for year and municipality; coefficients not reported here. Standard errors in parentheses clustered at the municipality level. Coefficient significance levels are indicated by * (10% significance), ** (5% significance), and *** (1% significance).

B *Figures*

Figure B.1: Event-study - Excluding Sicily

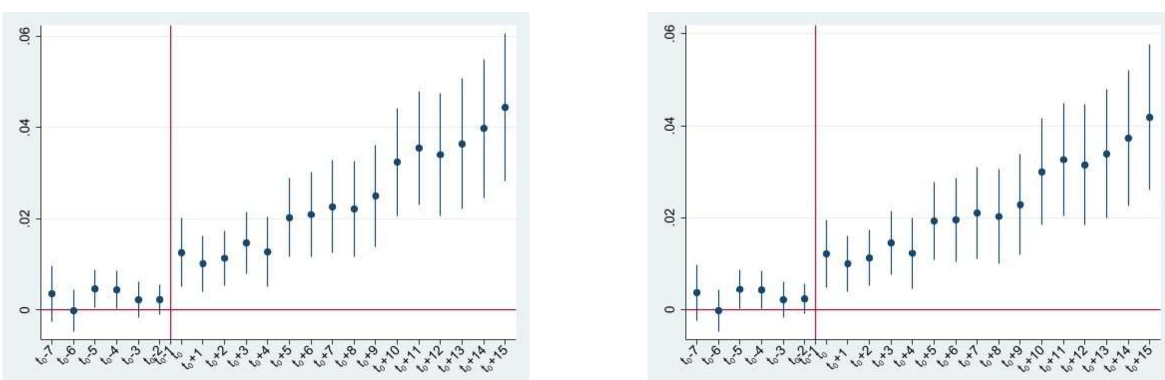
(a) Without controls (b) With controls



Note. Coefficients and confidence interval estimations based on equation 2. Dependent variable is per-capita income growth rate in the Objective 1 region municipalities of Calabria, Campania, and Apulia. We estimate 7 lags and up to 15 leads. Period of analysis 2000 to 2022. In both graphs, the specifications include year and municipality fixed effects; graph B.1b controls for resident population in thousands (*Pop*), share of female population (*Female pop*), and share of population with a university degree in the municipality (*University edu*). Standard errors clustered at the municipality level. The points represent the estimated coefficients; the confidence intervals are at 90%. The F-test p-values for all pre-treatment coefficients, being jointly equal to 0 are respectively 0.739 and 0.742 for graphs B.1a and B.1b.

Figure B.2: Event-study - Dropping 2007 and 2008

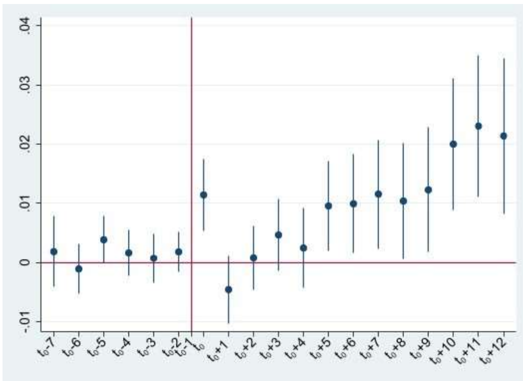
(a) Without controls (b) With controls



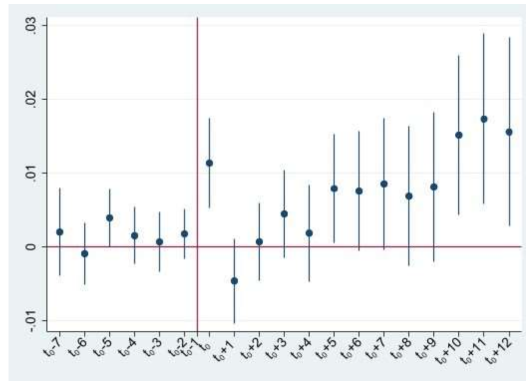
Note. The graphs show the coefficients and confidence intervals estimated based on equation 2. The dependent variable is the per-capita income growth rate in municipalities located in the Objective 1 regions, namely, Calabria, Campania, Apulia, and Sicily. We estimate 7 lags and up to 15 leads. The period of analysis spans from 2000 to 2022 and we exclude the years 2007 and 2008. The specifications in both graphs include year and municipality fixed effects; Graph B.2b contains control variables as: resident population in thousand, share of female population (*Female pop*), and share of population with a university degree in the municipality (*University edu*). Standard errors are clustered at the municipal level. The points represent the estimated coefficients; the confidence intervals are at 90%. The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.303 e 0.311 for estimation in Graphs B.2a and B.2b, respectively.

Figure B.3: Event-study - Up to 2019

(a) Without controls



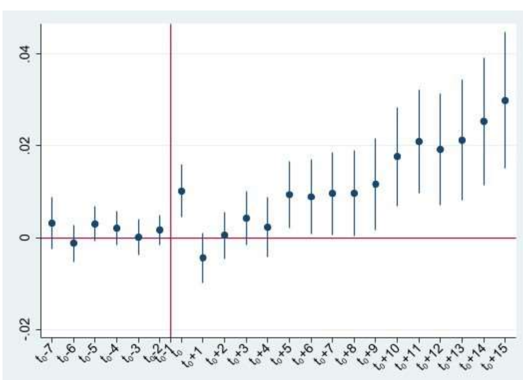
(b) With controls



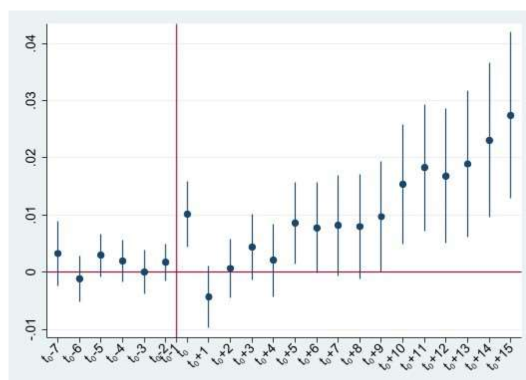
Note. The graphs show the coefficients and confidence intervals estimated based on equation 2. The dependent variable is the per-capita income growth rate in municipalities located in the Objective 1 regions, namely, Calabria, Campania, Apulia, and Sicily. We estimate 7 lags and up to 15 leads. The period of analysis spans from 2000 to 2019. The specifications in both graphs include year and municipality fixed effects; Graph B.3b contains control variables as: resident population in thousand (*Pop*), share of female population (*Female pop*), and share of population with a university degree in the municipality (*University edu*). Standard errors are clustered at the municipal level. The points represent the estimated coefficients; the confidence intervals are at 90%. The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.522 e 0.515 for estimation in Graphs B.3a and B.3b, respectively.

Figure B.4: Event-study - Including Basilicata

(a) Without controls



(b) With controls



Note. The graphs show the coefficients and confidence intervals estimated based on equation 2. The dependent variable is the per-capita income growth rate in municipalities located in the Objective 1 regions, namely, Calabria, Campania, Apulia, Basilicata, and Sicily. We estimate 7 lags and up to 15 leads. The period of analysis spans from 2000 to 2019. The specifications in both graphs include year and municipality fixed effects; Graph B.4b contains control variables as: resident population in thousand (*Pop*), share of female population (*Female pop*), and share of population with a university degree in the municipality (*University edu*). Standard errors are clustered at the municipal level. The points represent the estimated coefficients; the confidence intervals are at 90%. The p-value of the F-test that all pre-treatment coefficients are jointly equal to 0 is 0.452 e 0.463 for estimation in Graphs B.4a and B.4b, respectively.