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Abstract: *Regional inequalities are large and have widened during the Great Recession. As they prompt people and economic activities to migrate from lagging regions, central governments around the world transfer large amounts of resources in order to prevent these phenomena from occurring. In this paper, we evaluate the effectiveness of the most extensive and long-lived experiment of income redistribution across regions and countries, i.e., the EU regional policy, at a time of economic crisis. Exploiting geographic discontinuities in funds eligibility and using a spatial regression discontinuity design, we analyze comprehensive data on all publicly funded Italian projects at the municipality level. We find a positive and significant impact on employment and number of plants in the least developed regions. However, the impact turns largely negligible when the gap between more and less intensively treated areas is relatively small. Moreover, the EU regional policy appears not to have had any effect on local average income.*

JEL codes: C21; H25; R11

Keywords: EU regional policy; spatial regression discontinuity design; recession; municipalities

1. Introduction

Regional inequalities are large and they have even widened over the last decade (see Alvaredo et al. 2018). In the European Union (EU), the Great Recession and the related imperatives of tight fiscal policies have generated an interruption in the historical trend towards decreasing inter-regional disparities (Crescenzi et al. 2016). As economic inequalities prompt out-migration of people and economic activities from lagging to more developed regions, central governments around the world transfer large amounts of resources to their less-developed regions in an attempt to prevent these phenomena from occurring (Jofre-Monseny 2014). Such resources target disadvantaged geographic

areas rather than disadvantaged individuals and are called place-based policies (see Barca et al. 2012). Place-based policies typically provide under-developed regions with infrastructure investment, incentives to increase labor market participation and skills, and subsidies to firms to locate/remain in deprived areas as well as to innovate and reduce the environmental impact. Although the evidence on the impact of place-based policies is inconclusive and some economic theories predict their ineffectiveness (see Glaeser and Gottlieb 2008; Dall'Erba and Fang 2017), this did not stop policy-makers from spending an increasing amount of money on them in the US, in Europe and Asia (Kline and Moretti 2014a). The EU regional policy, based on the Structural Funds and the Cohesion Fund (aka the Cohesion Policy), is arguably the most extensive and long-lived experiment of income redistribution across regions and countries. This policy has been created and developed to aid the regions that do not benefit from the economic and political integration necessary for the implementation of the single market and the single currency (Dall'Erba and Le Gallo 2008). It aims to promote the economic, territorial and social cohesion, narrow the disparities in terms of development among regions and make the opportunities of citizens even. Though, it is heatedly debated whether it has been delivering what it promises (see, for instance, Pellegrini et al. 2013; Iammarino et al. 2017). In this paper, we investigate whether the observed increase in regional inequalities is due to the ineffectiveness of the EU regional policy or whether without this policy the gap between poor and rich regions would have widened even more. In this respect, Italy is a particularly interesting case study because of the historical economic and social divide between Southern and Centre-North regions.

The endogeneity of government spending makes it difficult to draw a causal interpretation from empirical evidence (Suárez-Serrato and Wingender 2016), particularly when public funds are used to tackle temporary or permanent negative shocks. The major difficulty of this literature is to identify a truly exogenous shock that allows a correct quantitative evaluation of public funds. In this study, we exploit the geographic discontinuities in the Italian regional aid map, which determines the areas where state aids to firms are permitted.[1] State aids are allowed to promote the expansion of the economic activities of enterprises located in the less-favored regions, in particular by encouraging firms to set up new establishments there (European Commission 2006). Within eligible areas we also exploit geographic discontinuities in gross grant equivalent, which sets the maximum proportion of a firm's investment that can be subsidized by public funds and differs across areas ranging from 10% to 60%. We employ a spatial regression discontinuity design (RDD), which compares nearby areas with similar characteristics but differing in the extent to which they could support local firms for the

[1] State aid is defined by the EU as an advantage in any form whatsoever conferred on a selective basis to undertakings by national public authorities.

period 2007-2015. This allows us to test whether the Cohesion Policy counteracted the negative impact of the financial crisis and economic downturn, which hit the hardest the real sector and the highly productive but financially fragile SMEs (Camagni and Capello 2015), which constitute the backbone of the Italian economy.

Overall, we find that the Cohesion Policy had a positive and significant impact on employment and number of plants in the least developed regions. However, the impact turns largely negligible when the gap between more and less intensively treated areas is relatively small. Besides, the Cohesion Policy appears not to have had any effect on local average income.

The remainder of the paper is structured as follows. In Section 2 we discuss the theoretical issues and previous empirical literature. Section 3 illustrates the data employed and the empirical strategy adopted. The results are reported in Section 4, while robustness checks and concluding remarks make up Sections 5 and 6.

2. Conceptual framework and previous literature

Place-based policies try to favor the establishment of new businesses and the growth of already existing ones to foster economic activity and tap into under-utilized resources in localities and regions (Pike et al. 2016). The place-based approach seeks to make places more reliant on local and regional endowments and less dependent on exogenous or external economic interests (Barca et al. 2012). From the political point of view, place-based policies are consistent with social and economic cohesion, which is one of the main political goals of most developed societies (Camagni and Capello 2015). In the face of large and persistent differences in labor market outcomes across cities and regions, equity rationales are popular among policymakers: by subsidizing disadvantaged areas, governments hope to help the disadvantaged residents of those areas (Kline and Moretti 2014b). This aspect is politically central as uneven development reduces confidence in democratic institutions spurring the rise in populism (see, for instance, Bachtler et al. 2017).[2] On the other hand, economists have traditionally expressed little support for place-based programs, fearing they will generate large distortions in economic behavior (Busso et al. 2013). Most concerns derive from the adoption of the spatial equilibrium model, which assumes firms hiring workers to the point where wages equal the marginal product of labor, housing prices equaling the cost of producing a house, and low migration costs making consumers indifferent between locations. Under this set of assumptions, place-based

[2] The analysis of recent electoral outcomes from the UK, the US, France, Austria, Germany and Italy, show that populism takes hold not among the poorest of the poor, but in a combination of poor regions and areas that had suffered long periods of decline (see Rodríguez-Pose 2018).

policies targeting deprived areas simply shift economic activities from one locality to another leading to a zero-sum game, where the benefits enjoyed by the target locality come at the expense of other areas (Kline and Moretti 2014a). In addition, local prices adjust so that local workers are unlikely to fully capture these benefits (Moretti 2011). Likewise, the spatial equilibrium model suggests that bringing economic activities to the least productive places, lowers overall productivity (Glaeser 2008) and resources should be pushed to areas that are more productive and where the elasticity of productivity with respect to agglomeration is higher (Glaeser and Gottlieb, 2008). In line with this view, governments should focus on place-neutral policies which equip poor people with the capabilities to access opportunities wherever they arise.

From an efficiency point of view, the main rationale for location-based policies is the existence of spatial market failures, such as agglomeration economies, knowledge spillovers, and spatial mismatch (see Neumark and Simpson 2015). In a dynamic setting, the existence of significant agglomeration economies has the potential to shift a locality from a bad equilibrium (small agglomeration, low productivity) to a good equilibrium (large agglomeration, high productivity). If the attraction of new businesses to an area generates localized productivity spillovers, then the provision of subsidies may be able to internalize the externality. In this case, government intervention may be efficient from the point of view of a locality (Moretti 2011). Enhancing access to markets and suppliers, both by way of investment in transport infrastructure and by attracting sectors which are best suited to the locally accessible markets and suppliers, would confer additional resilience to residents in more isolated and deprived areas (Doran and Fingleton 2015). In addition, the spatial equilibrium model is based on the strong assumption that workers are mobile. Although the US labor force can be considered rather mobile (Glaeser and Gottlieb 2008), this is not the case for most developed countries, where union agreements often restrict the ability of firms to offer lower wages in regions of higher unemployment (Faini 1999), and labor's economic position, for instance in the housing market, and ties of social reproduction, for instance through family and the education of children, form attachments to places that militate against mobility (Pike et al. 2016). This implies that local workers are able to capture part of the economic rent generated by the place-based policy. Place-based policies have also the potential to curb the migration of skilled human capital to leading regions, which severely weakens innovative capacities in lagging regions (see Dotti et al. 2013).

2.1. The EU regional policy and previous literature

Although the European regional policy dates back to 1975, its relevance widely increased with the 1988 landmark reform, which followed the accession of Greece, Spain and Portugal to the EU and the widening of regional disparities within the EU over the previous 15 years. Since then, the

importance of the EU regional policy has not ceased to increase. The rationale behind it is that the single European market unleashes centripetal economic forces and therefore brings greater benefits to the European core, leaving poorer regions increasingly behind (Rodríguez-Pose and Fratesi 2004). The European Commission considers large regional imbalances as unacceptable for equity and political reasons (Dall'Erba and Le Gallo 2008), and accordingly the EU devotes more than one third of its budget to the least developed regions. The EU regional policy consists in a set of regional investment programs: the European Regional Development Fund (ERDF), the European Social Fund (ESF), and the Cohesion Fund (CF). The ERDF is the major regional fund and contributes to a wide range of policy funding initiatives including transport, innovation, funding for SMEs, energy and environment, and urban regeneration. The ESF is focused on skills, human capital development and training, with particular emphasis on the most vulnerable groups in society. The CF is only used in the poorest member states whose GNI per inhabitant is less than 90% of the EU average and provides funding in order to help undertake major structural and infrastructure adjustments (McCann and Ortega-Argilés 2013). The bulk of the EU regional policy concerns the development and structural adjustment of the Convergence regions, that is, the regions whose GDP per capita measured in purchasing power standards (PPS) is less than 75% of the EU average. The Convergence region status is determined at the NUTS-2[3] level and in advance for a whole programming period of seven years. In the programming period 2007-2013, Convergence regions received 199 billion Euros, i.e., 57.5% of the overall 346.5 billion Euros spent through the Cohesion Policy, plus part of the CF, which amounted to 69 billion Euros (European Commission 2007).

A large and growing body of literature has investigated the Cohesion Policy contribution to economic growth and convergence (see the meta-analysis by Dall'Erba and Fang 2017). Yet, after more than 30 years of policy intervention, no general consensus has been reached. Nevertheless, there is a growing bulk of evidence that the average impact of the regional transfers on GDP is positive, but with a limited magnitude (Cappelen et al. 2003; Becker et al. 2010; Pellegrini et al. 2013); the positive impact of the funds intensity on the growth of the Convergence regions is decreasing the higher are the regional transfers (Becker et al. 2012; Cerqua and Pellegrini 2017); and that there is a positive relationship between absorptive capacity - human capital and good institutions – and the effectiveness of the Cohesion Policy (Becker et al. 2013; Rodríguez-Pose and Garcilazo 2015).

[3] NUTS stands for 'Nomenclature of Statistical Territorial Units'. NUTS-2 regions are defined by minimum and maximum population thresholds of 800 thousand to 3 million inhabitants and correspond to administrative divisions in EU member states.

There is also a recent literature using data at a smaller geographical level concerning specific geographic areas within the EU jurisdiction.[4] Ciani and de Blasio (2015) investigate the effectiveness of the Cohesion Policy on employment, population and house prices in the local labor systems located in Southern Italy exploiting the variability in payments for the 2007-2013 programming period. They use a difference-in-differences approach with a continuous treatment and find that these funds did not offset the negative consequences of the economic crisis. Giua (2017) considers - in a spatial RDD setup - the differences in employment growth across municipalities on the two sides of the Convergence border using Census data and finds a positive impact on employment over the 1991-2001 period.

Lastly, a related literature looks at specific industrial policies financed with Structural Funds (see, among others, Bronzini and de Blasio 2006; Cerqua and Pellegrini 2014; Criscuolo et al. 2018; Einiö and Overman 2016). Although systematic empirical evidence is sketchy, most studies find a positive impact on employment, investment and plant survival prospects but a negligible effect on productivity.

2.2. Regional policy in Italy

Italy has been marked in its economic development by pronounced geographical disparities and fluctuating processes of stability and change in those disparities. The clearest aspect is the persistent backwardness of the regions making up the South (Iuzzolino et al. 2013). The marked North-South duality of the socio-economic situation has made the achievement of socio-economic 're-balancing' an explicit objective of the Italian Constitution since 1947 (art. 117).

Measures in support of the South of Italy (aka Mezzogiorno) date back to the early 1950s, when the Italian Government created the 'Cassa del Mezzogiorno', a public agency devoted to financing public infrastructures and industrial development in the eight southern regions. However, after a first period of pronounced catching up driven by a steep increase in productivity (see Iuzzolino et al. 2013), the development gap between the North and the South of Italy came to an abrupt halt and barely changed since the 1970s. The 'Cassa del Mezzogiorno' ceased its operations in 1992 and was replaced by alternative regional policies targeting the South (e.g., the Law 488/1992 for the funding of selected investment projects) partially financed by the Cohesion Policy.

[4] Although extending the findings of this stream of research to the entire EU is harder, this type of analysis suffers to a lesser extent the data limitation and unobserved heterogeneity issues of previous literature (see Bachtler and Wren 2006).

In 2000s, the main target of the Italian regional policy was still the Mezzogiorno. This was made clear by the National Strategic Framework (NSF) 2007–2013, a document requested by the Structural Funds regulations for the 2007–2013 period, which affirmed a unitary regional policy that would merge both strands of regional policy - EU (funded by the Structural Funds) and domestic (funded by the Fund for Under-utilized Areas) - into a single, 7-year strategic framework (Polverari, 2013). The NFS 2007–2013 ring-fenced 85% of the domestic regional policy budget to the eight Mezzogiorno regions (EPRC 2010) despite only four of them obtained the Convergence status, i.e., Campania, Apulia, Calabria and Sicily, plus Basilicata and Sardinia in transitional 'phasing out' and 'phasing in' support, respectively.[5] Still, the financial crisis and economic downturn made the focus on the development of Mezzogiorno more formal than real: the need to redeploy resources to tackle the crisis led to major cutbacks in domestic regional policy funding (EPRC 2009). In the South, the regional policy ended up financing investments that in the remainder of the country were undertaken via ordinary (i.e., non-regional policy) resources, and which resulted in a loss of additionality with regard to the Cohesion Policy (EPRC 2010).[6] Indeed, ordinary capital expenditure in southern regions has had a decreasing trend over the last decade presenting a much lower per capita level when compared to other regions (Agency for Territorial Cohesion 2017).

Despite sound evidence on a large use of regional policy funds as a substitute of ordinary spending, the Italian most deprived areas were the only ones where substantial direct support to firms was allowed. Regional investment aid to firms is aid awarded for an initial investment project relating to: i) the setting-up of a new establishment; ii) the extension of an existing establishment; iii) diversification of the output of an establishment into new, additional products; iv) a fundamental change in the overall production process of an existing establishment (European Commission 2006).[7] The more deprived the area, the larger the funds available and the permissible aid ceilings for firms' investment. The aid ceilings range from 10% to 40% for large enterprises, from 20% to 50% for medium-sized enterprises, and from 30% to 60% for small enterprises. Figure 1 maps the heterogeneity in state aids eligibility in Italy for the programming period 2007-2013. The map shows

[5] As the per capita GDP of Convergence regions becomes higher than 75% of the EU average, "phasing-in" or "phasing-out" transitional programs are put in place, reducing the amount of funds available to former Convergence regions (Di Cataldo 2017).

[6] In addition, the Italian Government and the European Commission signed the Cohesion Action Plan (PAC), which was implemented in three successive phases since December 2011, that is an agreement which reduced the domestic co-financing rate of the programs (and thus the total amount of resources of these programs) for the Convergence regions and Sardinia (EPRC 2013).

[7] The form of the aid is variable: grants, low-interest loans or interest rebates, state guarantees, the purchase of a share-holding or an alternative provision of capital on favorable terms, exemptions or reductions in taxes, social security or other compulsory charges, or the supply of land, goods or services at favorable prices (European Commission 2006).

that other than the Convergence, phasing-out or phasing-in regions, other selected areas were eligible for state aids but with much less funds available and a more limited aid ceiling.[8] The map confirms that aid intensity is concentrated in the Mezzogiorno regions and that the Convergence regions benefit from the highest aid ceilings. Moreover, other forms of public support to firms are available through the Cohesion Policy irrespective of their location, such as incentives to research, development and innovation (R&D&I), training programs and work incentives.[9]

Insert Figure 1

Assessing whether public support to firms has helped reverting the negative path-dependency of the least-developed Italian regions is remarkably important in a time of a long-lasting recession, which led to high uncertainty about fundamentals discouraging investment (Fajgelbaum et al. 2017).

3. Data and methods

3.1. Datasets and descriptive statistics

We have assembled a rich database with municipality-level data. Municipalities represent the lowest administrative units in Italy and are a natural starting point for our analysis because of their large number (8,092) and stable boundaries.[10] Funds assignment and payments data come from the recently developed OpenCoesione dataset. This database contains the fulfilment of the investments (both planned and actual) with accurate implementation timeframes, funds used, places, and subjects involved. These features of the OpenCoesione dataset allow us to geo-reference payments relative to all projects funded by the Structural Funds and co-financed by national funds during the 2007-2013 programming period. Also, projects that are exclusively funded by national sources (in particular, the

[8] The main selection criteria of those areas were: low population density regions, areas in geographical isolation, NUTS-3 regions with less than 100,000 population which have either a GDP per capita of less than the EU average or which have an unemployment rate which is higher than 115 % of the national average, and areas in serious relative decline, when compared with other comparable areas. In any case, state aids in each country could not exceed an overall population coverage of 42 % of the country population (see European Commission 2006).

[9] A few types of state aids are allowed even outside of the boundaries of the state aid map. For instance, the de minimis regulation allows small amounts of aid – less than €200,000 over 3 rolling years – to be given to an undertaking for a wide range of purposes. Also aid for research, development and innovation (R&D&I) can fall outside the scope of Article 87 of the Treaty of Amsterdam due to the existence of innovation spillovers, i.e., positive externalities to R&D&I spend and innovation, which cannot be internalized by the investing company. Our data cover all forms of public support.

[10] During the period 2007-2015, 91 Italian municipalities were suppressed and 36 new municipalities were created. Only one of these new municipalities was created in the Mezzogiorno, while the vast majority of them were due to municipality merges among small municipalities located in Northern Italy. We use the 2011 municipality map (the year of the census) with 8,092 municipalities and we disaggregate the data at the municipality status in 2011 for those municipalities which were subject to merge between 2012 and 2015.

'Fondo per lo Sviluppo e la Coesione') are included. By the end of 2015, 908,484 projects were partially or entirely financed for a total of €55.64 billion (€25.86 billion by the Structural Funds and €29.78 billion by the Italian government).[11] Although 95.5% of the projects occurred at the municipality level, in some cases they referred to the higher administrative levels of provinces or regions. Following Ciani and de Blasio (2015), in these cases, we reallocate the spending to the municipalities on the basis of the 2007 population. All variables relative to payments are expressed in per-capita values. They are calculated dividing the total amount of funds received by a municipality, province or region during the 2007-2015 period by the resident population of the same municipality, province or region in 2007. We consider up to 2015 to take into account that in each programming period two more years are allowed to absorb all the funds.

As main outcome variables we use workplace employment (workers in the plants located in the municipalities) and the number of plants (a plant is an enterprise or part thereof, e.g., a factory, warehouse, office),[12] which come from the Statistical Register of Active Enterprises (ASIA) archive. ASIA is produced by the Italian National Institute of Statistics (ISTAT) and covers the universe of firms and employees of industry and services[13] in each municipality. This is possible by integrating information coming from both administrative sources, managed by public agencies or private companies, and statistical sources owned by ISTAT (Consalvi et al. 2008). The use of the ASIA plant-level data allows precisely locating all plants within multi-plant firms, removing any measurement error due to the use of firm-level data. We complement the analysis using the average income as outcome variable obtained from the Italian Ministry of Economy and Finances (MEF) archive.

In addition, we also collect data on several pretreatment variables: the population density in 2007 from ISTAT, the number of employees per 1,000 residents and the percentage of employees working in the secondary sector in 2007 from ASIA, the logged income in 2007 from MEF, and log changes in the number of employees per 1,000 residents and of income for pretreatment period 2001-2007.

Table 1 reports the number of projects and the overall amount paid between 2007 and 2015 for all project categories financed by Italian and EU funds. This table confirms that the vast majority of

[11] These figures do not include the 2,273 projects at the national level or with a localization abroad. See Appendix A for the detailed construction of the sample.

[12] The use of workplace employment rather than the employment of resident people allows considering job creation as a proxy for the broader local development of the treated areas (Giua 2017).

[13] Considering the NACE Rev.2, ASIA includes all plants with the exception of those classified as section A 'agriculture, forestry and fishing', section O 'public administration and defense, compulsory social security', division 94 'activities of membership organizations', section T 'activities of households as employers; undifferentiated goods- and services-producing activities of households for own use', section U 'activities of extraterritorial organizations and bodies', public institutions and non-profit institutions.

resources targeted the South of Italy and in particular the Convergence regions, which received 62.1% of the overall transfers by 2015. If we consider allocated resources instead of payments, the percentage of funds destined to the Convergence regions was much higher (72.8%). However, the rate of program implementation was very slow and by the end of 2015, payments from the Structural Funds to cover expenditure amounted to only 79.4% of the funding available. The severe delays in implementing programs were due to lengthy and inefficient project appraisal and procurement processes, coupled with high staff turnover (European Commission 2016a).[14]

Insert Table 1

Although the vast majority of resources targeted infrastructure, urban regeneration and human capital development and training, 16.1% of the transfers (€8.95 billion) accrued directly to productive units. Table 2 reports the geographical distribution of the number of projects and the overall amount paid between 2007 and 2015 for the different types of the project category 'incentives to productive units'. These funds were mostly allocated on the basis of the state aids rules but they also include the exceptions presented in Section 2.2. As we are primarily interested in the effect of public funds on firms, we decided to consider all public money which accrued to firms between 2007 and 2015. Work incentives turn out to be the most common type of these projects, while extension of an existing establishment is the category with the highest average amount per project. Many projects are classified under the label 'other' either because they were a mix of the main categories or because there was not enough information to classify them properly.

Insert Table 2

3.2. Evaluation strategy

Our main goal is to test whether more intensively incentivized areas experienced a larger growth. To do this we exploit three geographic discontinuities in state aid ceilings among Centre-South regions starting from the geographic discontinuity between the Convergence regions Campania and Apulia and Molise and Lazio which is the more sizable one. We then analyze whether Basilicata' economy suffered from being less intensively financed than the surrounding regions. Lastly, we investigate whether Southern regions caught up with the rest of Italy looking at the border splitting Lazio and Abruzzo from Molise and Campania. Figure 2 illustrates the geographic discontinuities of interest

[14] Other causes of the delays in expenditure were the negative effects of the crisis on the ability of both public authorities and private enterprises to find co-financing, political discontinuity in national and regional governments and inadequate administrative capacity combined with the excessive complexity of procedures (European Commission 2016b).

and it maps the distribution of the per-capita amount of transfers deciles for all projects (Panel A) and for the projects under the incentives to productive units' category (Panel B). As expected, Table B1 of Appendix B confirms that the discontinuities in the eligibility to receive state aids led to statistically significant higher intensities of funds for all discontinuities under analysis. This result guarantees that discontinuities in the eligibility status translate into clear-cut discontinuities in funds. This is not always warranted for policies, such as the Cohesion Policy, which operate through the voluntary participation of local actors applying for policy support by submitting projects to be financed (Giua 2017).

Insert Figure 2

Locations separated by a regional border share the same geography, climate, access to transportation, agglomeration benefits, and access to specialized labor and supplies; the key feature that sets these locations apart is the difference in policies on the two sides of the border (Hagedorn et al. 2015). In this context, the spatial RDD is the best suited methodology for testing whether the local economy performed better in highly-subsidized areas with respect to moderately-subsidized areas during the 2007-2013 programming period. The basic idea behind the spatial RDD is to interpret the distance to the regional border as an assignment variable that decides about aid intensity, i.e., location acts as the forcing variable allowing us to exploit the discontinuous change in eligibility to receive state aids at the geographical border. We start the analysis with a binary treatment analysis where we average out the impact of the policy over a large number of locations in order to get accurate point estimates. This analysis will retrieve the local average treatment effect (LATE) β of being eligible for large amount of state aids to firms instead of a moderate one for a group of comparable treated and control municipalities.[15] To do so, we run equation (1)

$$(1) \qquad y_{irb} = \alpha + f(geographic\ location_{ir}) + \beta D_r + \mu_r + \phi_b + \varepsilon_{irb}$$

where y_{irb} is the outcome variable of the i^{th} municipality in region *r* along segment *b* of the eligibility boundary, D_r is the binary indicator variable for treatment which is unity in case of the regions with

[15] The state aids discontinuities of interest coincide with the public budget discontinuities set for other Cohesion Policy projects, such as infrastructure investment, which are expected to indirectly favor local businesses. This would mean that the LATE parameters would pick up both the effect of state aids and of other policies indirectly targeted to the development of an improved business environment. Although we cannot empirically disentangle these two effects, the evidence (presented in Section 2.2) that Cohesion Policy funds were largely used to compensate the fall in ordinary spending in Southern regions, strengthens the assumption that our LATE parameters will represent a good approximation of the causal effect of state aids.

the higher relative aid ceilings zero else, μ_r are the regional fixed effects, ϕ_b is a set of boundary segment fixed effects[16] and ε_{irb} is the error term. $f(geographic\ location_{ir})$ is the RDD polynomial, which controls for smooth functions of geographic location. In the specification of $f(\cdot)$ we use the two-dimensional RDD in latitude-longitude space proposed by Dell (2010). We employ a 2nd order polynomial in latitude and longitude[17] which allows comparing observations which are very close to each other and absorbs all smooth variation in the outcome.[18]

Besides, by differentiating the outcome variable we lower the variance in the RDD estimator (Lee and Lemieux 2010) taking into account pre-treatment differences in the dependent variable as reported in equation (2)

$$(2) \quad \Delta y_{irb} = \alpha + f(geographic\ location_{ir}) + \beta D_r + \mu_r + \phi_b + \varepsilon_{irb}$$

where Δy_{irb} is the log change in the outcome variable between 2007 and 2015 of the i^{th} municipality in region *r* along segment *b* of the eligibility boundary.

Table 3 examines a variety of pretreatment characteristics, using regressions of the form described in equation (1) and shows that there are some pre-existing differences on each side of the geographic discontinuities. This is why in equation (3) we condition on income and firm-level variables (X'_{irb}), accounting for the potential bias due to pretreatment differences (see Frölich and Huber 2018)

$$(3) \quad \Delta y_{irb} = \alpha + f(geographic\ location_{ir}) + \beta D_r + X'_{irb}\gamma + \mu_r + \phi_b + \varepsilon_{irb}\ .$$

Insert Table 3

The key identification assumption that underlies our spatial RDD strategy is that the potential outcomes are independent of treatment assignment for municipalities that are close to the boundary that separates highly-subsidized from moderately-subsidized municipalities, conditional on pretreatment characteristics (Keele and Titiunik 2016). Under this assumption, β is obtained by

[16] Each boundary segment dummy denotes which segment of the state aid change boundary is the closest to the municipalities' centroids.

[17] Letting x denote longitude and y denote latitude, this polynomial is $x + y + x^2 + y^2 + xy$.

[18] Another approach is to reduce the two-dimensional vector of each location into the scalar distance to the boundary. Nevertheless, this alternative specification implies that a treated observation close to one segment of the border will be compared to a control observation close to a different segment of the border (Kudamatsu 2018).

estimating the discontinuity in the empirical regression function at the point where the treatment variable (higher relative aid ceilings) switches from 0 to 1.

Another important assumption is the so-called compound treatment irrelevance assumption (Keele and Titiunik 2016). When studying treatment assignments that change discontinuously at a geographic border, it is common for multiple administrative or political borders to perfectly overlap (Keele et al. 2017). In our application, the compound treatment irrelevance assumption states that potential outcomes depend only on the jump in the eligibility to receive different intensity of public funds. Nevertheless, the discontinuities of interest overlap with the regional borders and this might imply that the outcomes of interest might be affected not only by the jump in the eligibility to receive different intensity of state aids, but also by 'irrelevant' regional-specific treatments (e.g., differences in regional taxation or administrative differences). Note, however, that the tax base of the regional tax on productive activities (IRAP), which is the tax applied to all taxpayers engaging in productive or professional activities, is centrally set and regional governments cannot exploit full autonomy in changing it (Lagravinese et al. 2018).[19] Besides, during the period 2007-2015 there was little regional variation in the tax base of IRAP for the regions under analysis and it is unlikely that this would affect much firms' behavior. Finally, differentiating the outcome variables and adding pretreatment covariates and regional fixed effects should minimize the extent of this potential issue.

4. Results

In this section we first present the estimates of the coefficient β of equation (3) using the log change in workplace employment, number of plants, and average income during the period 2007-2015 as outcome variables. We then investigate the timing of the impact, differentiate the results by sector and plot the relationship between funds intensity and outcomes.

4.1. Main results

Table 4 reports the spatial RDD estimates of the impact of the Cohesion Policy on workplace employment (Panel A), number of plants (Panel B), and average income (Panel C) for all the discontinuities of interest. We present two specifications: columns (1), (3) and (5) present the estimates based on equation (2), while the estimates reported in columns (2), (4) and (6) are based on equation (3), i.e., they include pretreatment covariates X'_{irb} among the right-hand side variables, and for this reason are our preferred specification. Results are consistent from both specifications and

[19] Regional governments can choose to vary the base tax rate of IRAP by 0.92 percentage points in both directions and can differentiate this surtax by business sectors.

show that workplace employment is considerably higher in intensively treated areas growing 14.4 to 19.4% faster than less-intensively treated areas (columns 1 and 2 in the upper panel), while the number of plants growth is as large as 5.5 to 7.1% higher in intensively treated areas (columns 1 and 2 in the middle panel) when considering the border splitting Campania and Apulia from Lazio and Molise.[20] The higher effect of the policy on workplace employment compared to the number of plants implies a positive policy impact on the intensive margin (incumbent hiring more workers) as well as on the extensive margin (higher net entry).

Insert Table 4

When we consider smaller gaps in aid ceilings among neighboring municipalities, we find that the positive policy impact halves and it is only statistically significant at the 10% level (columns 5 and 6) in the case of the North-South discontinuity or it even turns negligible in the case of the Basilicata discontinuity (columns 3 and 4). Our findings show that the behavior of firms is much more influenced by more generous policies, particularly during an economic crisis.

On the other hand, we find no evidence of a significant discontinuity in average income at any of the discontinuities we consider. This result was expected in light of the strong reduction in ordinary spending in the Mezzogiorno which limited substantially the additionality of the Cohesion Policy.

4.2. Timing of the impact

In the main analysis we evaluated the impact of the Cohesion Policy over an 8-year period. As we have data on each year for all dependent variables as well as for the intensity of funds, we are able to trace the policy effect through time. In Figure 3 we plot the local average treatment effect estimates and the associated 95% confidence intervals separately for each year from 2008 to 2015. The timing of the policy response generates additional insights on how firms respond to public support at a time of economic crisis. Considering the largest discontinuity, we see that the impact turned positive and statistically significant after 4 and 6 years for workplace employment and the number of plants, respectively. This pattern seems to follow the timing of the intensity of payments which, although increased every single year, it turned out statistically significant from zero at the 5% level only in year 6.

[20] Actually, considering the large negative impact of the Great Recession in Italy, such estimates demonstrate that the Cohesion Policy allowed Convergence regions to limit the fall of local plants and employment levels rather than to achieve economic growth.

Concerning the Basilicata discontinuity, we observe no impact throughout the 8-year period even if there is a significant gap in payments in 2015. When we look at the North-South divide, we see a positive impact from year 4 onwards but this is statistically significant at the 5% level only in a few instances. Although the workplace employment growth in the last 3 years mirrors the substantial increase in payments over the same period, the coefficients are statistically significant only at the 10% level.

Insert Figure 3

4.3. Sectoral results

In this section we investigate the heterogeneity of the findings by sector of activity and report the estimates in Table 5 for all discontinuities under analysis. Regarding the Basilicata border, we detect the lack of statistical significant estimates for each sector, which is in line with the results presented in Section 4.1. When considering the other two discontinuities, the effect on local manufacture is positive but not statistically significant, while the impact on service is large and statistically significant at the 5% level in almost all instances. There is also some evidence in favor of a growth of the construction sector; however, the high standard errors make some of the estimates not statistically significant at the 5% level.

Insert Table 5

These findings show that the Cohesion Policy was not able to revamp the manufacturing sector in lagging areas during the period 2007-2015. Indeed, the strong international competition coupled with the deep economic crisis made state aids less effective in supporting the tradable sector. Manufacturing firms are on average larger and much more capital intensive than firms in the tertiary sector. Such features make manufacturing firms less responsive to public incentives, unless they are of a particularly sizable magnitude.

4.4. What is the relationship between funds intensity and firms' growth?

The intensity of payments is strongly heterogeneous across municipalities, depending on the regional aid map, the business structure and the capacity of local governments of supporting local firms. We expect that the higher the funds intensity the higher economic growth of local firms. The role of heterogeneity is analyzed by extending the standard spatial RDD to the case of continuous treatment. This approach is a modified version of the continuous RDD framework proposed by Cerqua and

Pellegrini (2017) and we will focus only on the dose-response functions (DRFs) at the discontinuities under analysis. The DRF shows the relationship between Δy_{irb} and the funds intensity t_i on both sides of each border discontinuity. Assuming that the impact β of the treatment is heterogeneous and depends on t_i, we extend equation (3) and obtain equation (4)

$$\Delta y_{irb} = \alpha + f(geographic\ location_{ir}) + \beta_1 D_r + \beta_2(t_i) + \beta_3(t_i)D_r + X'_{irb}\gamma + \mu_r + \phi_b + \varepsilon_{irb} \quad (4)$$

where $\beta_2(\cdot)$ and $\beta_3(\cdot)$ are sufficiently smooth polynomials of t_i. In the specification of $\beta_2(\cdot)$ and $\beta_3(\cdot)$ we use the second-order polynomial in t_i.

A simple way to graphically represent the DRF is to draw the curve described by the intensity coefficients of our model. Using the estimates from equation (4), Figure 4 shows the DRF of the change in workplace employment and in the number of plants with respect to the payments intensity, both with the 90 percent confidence bands. Each panel concerns one of the discontinuities under analysis.[21]

Our main hypothesis is confirmed, as there is a positive relationship between payments intensity and the firm-related outcome variables in all cases. This relationship is steeper in the less-treated areas.[22] On the other hand, there is evidence that more intensively treated areas managed to maintain the pre-crisis employment and plant levels, while the other areas suffered from large losses, particularly those municipalities which did not manage to secure considerable amounts of public funds.

Insert Figure 4

5. Robustness

In this section we subject our results to a wide set of robustness checks and summarize the results of interest in Table 6. For the sake of brevity, we focus on the largest discontinuity, i.e., the border splitting Campania and Apulia from Lazio and Molise; however, also the results relative to the other discontinuities (reported in Tables B2 and B3 of Appendix B) are broadly confirmed. First, we simulate a move of the border by 50 km to either side, to check whether moving the spatial threshold

[21] The payments intensity variable has been censored at the 2nd and 98th percentiles to limit the influence of outliers.

[22] This result is due to two reasons. First, there is more variability in the receipt of funds in the less treated regions. Second, there is, to a certain extent, measurement error in the aid intensity variable for the Convergence regions due to the presence of a few large projects which were recorded as regional projects but which were actually directed only to some undisclosed firms within the region.

away from the actual border leads to statistically significant estimates. This placebo test is reported in rows (1) and (2) and show no statistically significant effect in the proximity of these pseudo borders, confirming that the effect we are picking up is not spurious.

Insert Table 6

We then test the sensitivity of the estimates to different RDD polynomials. Row (3) of Table 6 replace the quadratic polynomial in latitude and longitude with a linear polynomial $(x + y)$, while row (4) reports the estimates obtained using a cubic polynomial in latitude and longitude $(x + y + x^2 + x^3 + y^2 + y^3 + xy + x^2y + xy^2)$. In row (5) we also check the sensitivity of the estimates to the adoption of the Euclidean distance to the boundary (i.e., the shortest distance to the boundary from *i*'s location) as univariate forcing variable with a 2nd order polynomial. In all instances, coefficients show no sizable differences with respect to the baseline estimates.

Place based policies might give rise to the spatial sorting effect, i.e., it is possible that some firms that would otherwise had chosen to locate in the less treated areas decided to locate in the adjacent more intensively treated ones to obtain a larger public support. Spatial sorting increases the treatment coefficients when the distance from the boundary of the municipalities included in the models is small (Giua 2017). To test it, we removed from the analysis the municipalities which could be the most affected by this potential issue, i.e., those municipalities which border with the discontinuity of interest. The estimates are reported in row (6) of Table 6 and are not significantly different from those shown in Table 4. This finding supports the hypothesis that state aids did not cause significant displacement effects to neighboring areas.

We then check whether our results are sensitive to the way we weight observations. Rows (7) and (8) show the estimates we get if we weight municipalities according to the number of plants in 2007 and to the resident population in 2007, respectively. Both set of estimates confirm that our firm-related findings are not affected by the way we weight observations, while the average income coefficient stays negative and it becomes statistically significant different from zero at the 5% level. Besides, row (9) demonstrate that unweighted regressions lead to estimates which are larger than the one presented in Table 4.

We also check whether results are influenced by the presence of big cities such as Rome and Naples, which could be less influenced by place-based policies. Indeed, firms located in larger and denser cities benefit from agglomeration economies which make them more productive (see, for instance, Glaeser 2008) irrespective of government policies. Removing these cities, we find that firm-related

outcomes are not affected, while the average income coefficient stays negative and it becomes statistically significant different from zero at the 10% level (row 10).

Finally, notice that, although our period of study includes part of the 2014-2020 Cohesion Policy resources, only 2% (€0.99 billion) of the 2014-2020 EU resources were spent by the end of 2015. Even though the precise disaggregation of these projects is still not available at the municipality level, they approximately followed the geographic distribution of the previous programming period. Thereby, it is very unlikely that the exclusion of this relatively small amount of transfers significantly affects our estimates.

6. Concluding remarks

Despite the large amount of resources targeted to the least-developed regions, inequalities in the EU have widened during the 2007-2013 programming period, which coincided with the Great Recession. In this paper, we investigate whether this observed pattern is due to the ineffectiveness of public support to firms' investment or whether without this support the gap between poor and rich regions would have widened even more. In this respect, Italy is a particularly interesting case study because of the historical economic and social divide between Southern and Centre-North regions.

Exploiting geographic discontinuities in funds eligibility and using a two-dimensional spatial RDD, we analyze comprehensive data on all publicly funded Italian projects at a fine spatial scale. We find a positive and significant impact on employment and number of plants in the least developed regions. However, the impact turned largely negligible when the gap between more and less intensively treated areas was relatively small. Several checks confirm the robustness of the estimates. These findings highlight the importance of place-based policies in counteracting the negative business cycle for the least developed regions. Nonetheless, at a time of economic crisis, localized policies positively influence firms' behavior only when the most economically fragile areas benefit from substantial eligibility differences with respect to more developed areas. Moreover, the strong international competition coupled with the deep economic crisis made state aids less effective in supporting the revamp of manufacturing.

In light of our findings, the fact that the Great Recession led many governments to reduce resources towards their least-developed regions, can be considered as one of the main determinants of the increase in regional inequalities.

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Appendix A. Data construction

The OpenCoesione data package updated to 30-06-2017 consists of all 918,334 projects financed through the Structural Funds and co-financed by national funds during the 2007-2013 programming period. It also includes the 43,114 projects exclusively funded by national sources (in particular, the 'Fondo per lo Sviluppo e la Coesione') during the 2007-2013 programming period. Hence, the overall number of projects considered is 961,448. We then proceed with the removal of certain categories of projects:

- We remove the 645 projects with localization abroad. As our focus is on the Italian territory, such projects are not considered.
- Then we remove the 1,628 projects at the national level. As our source of heterogeneity is the geographical variation, these projects would be of no help in estimating the effect of the policy.
- Lastly, we drop the 50,662 projects without any payment by the end of 2015. As our dependent variables refer to the end of 2015, projects implemented at a later date did not have any impact on the local economy.
- Of the remaining 908,513 projects, 867,386 are at the municipality level, 21,022 projects are at the provincial level and 20,105 projects are at the regional level. As our unit of analysis is the municipality and all variables relative to payments are expressed in per-capita values, we divide the total amount of funds received by a municipality, province or region during the 2007-2015 period by the resident population of the same municipality, province or region in 2007 and then sum these values for each municipality.

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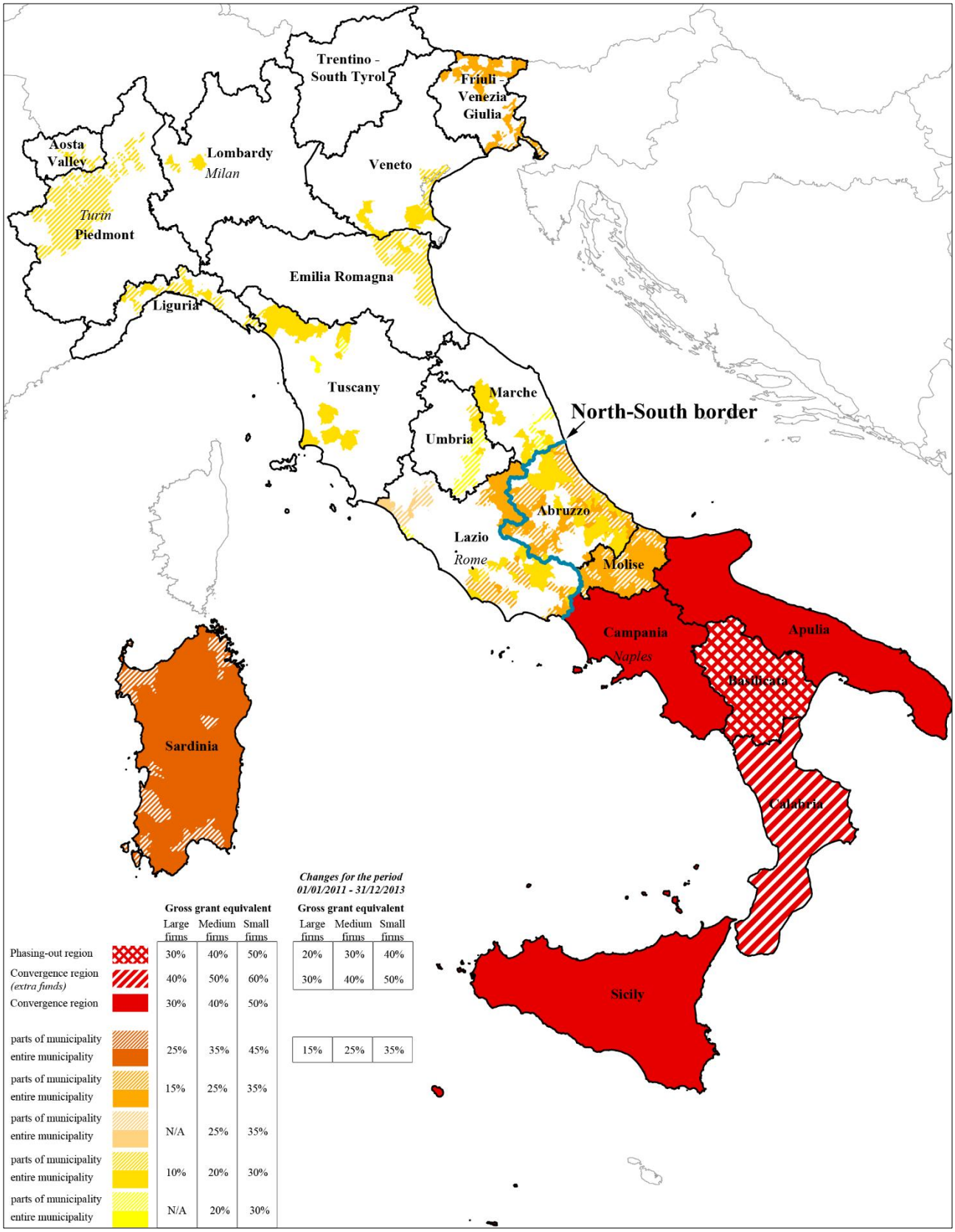
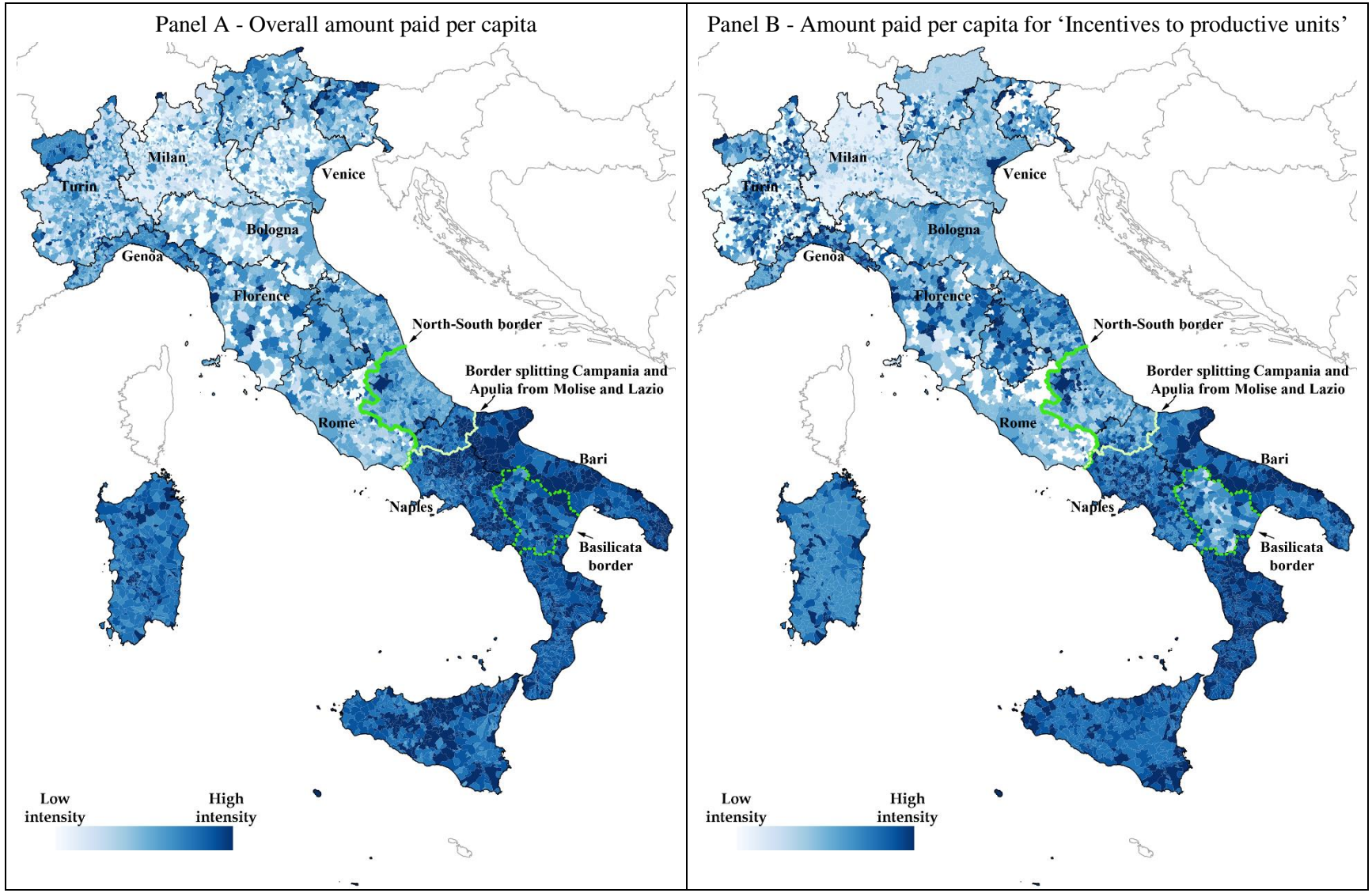
Figure 1. Regional aid map for the programming period 2007-2013



Notes: A few dozens of Northern municipalities that were eligible for state aids up to 31/12/2008 are reported in the map as non-eligible.

Figure 2. Geographic distribution of per capita payments (both Structural Funds and Italian government co-financing) during the period 2007-2015 for all projects or for only the 'incentives to productive units' projects: municipality deciles



Notes: Per capita payment variables are measured in deciles. Empty municipalities did not receive any funding between 2007 and 2015.

Figure 3. Timing of the impact

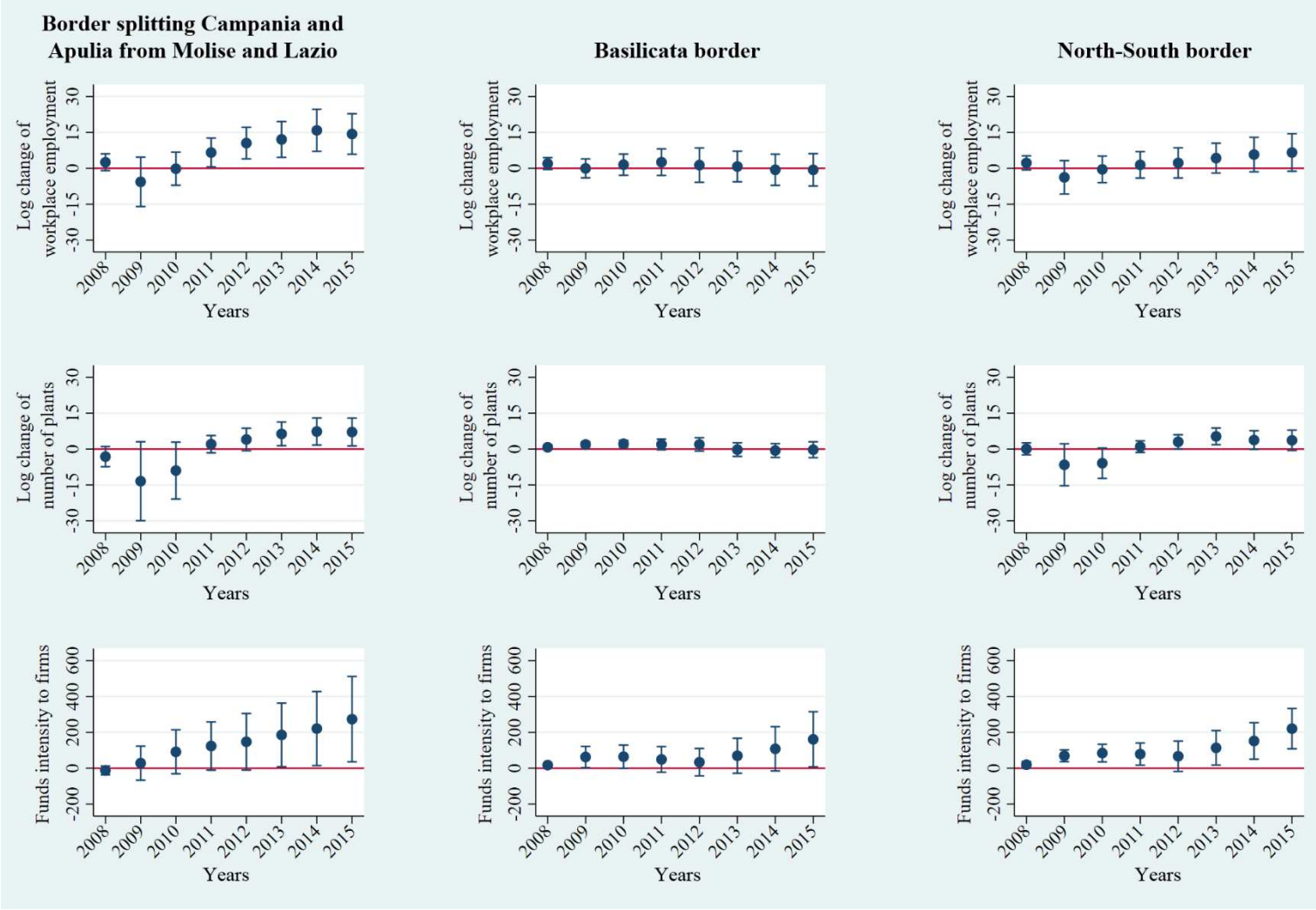


Figure 4. The effect of treatment intensity on local economy growth

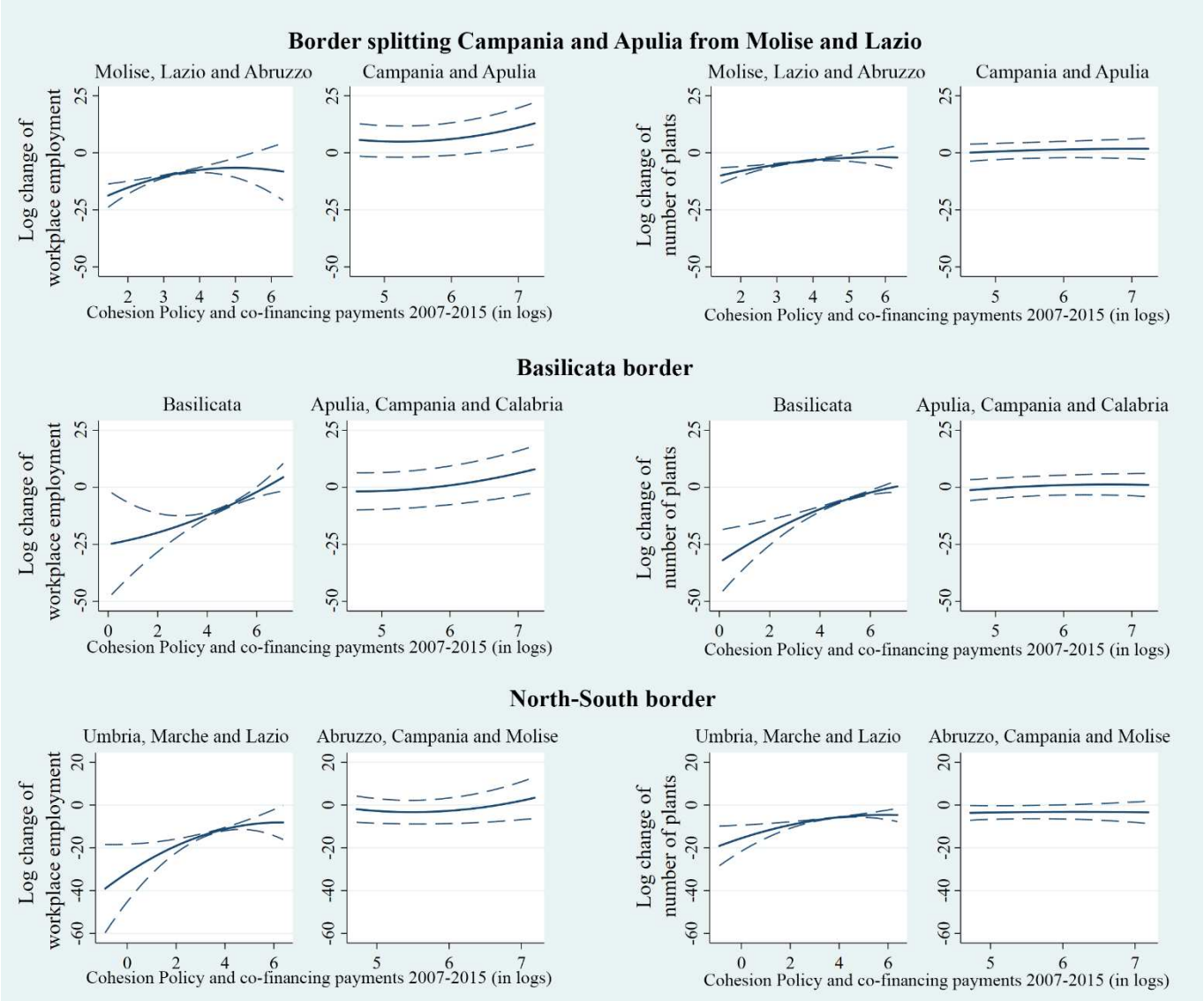


Table 1. Number of projects and the overall amount paid between 2007 and 2015 for all project categories financed by Italian and EU funds

Nature of financed projects		**Italy**	**Centre-North**	**South**	**Convergence regions**
Purchase of goods	*N projects*	31,750	2,617	29,133	28,680
	Overall amount paid (million €)	3,496.4	678.9	2,817.5	2,587.1
Realization and purchase of services	*N projects*	304,814	189,976	114,838	102,802
	Overall amount paid (million €)	16,315.0	6,305.3	10,009.8	8,783.7
Realization of public works	*N projects*	30,272	6,660	23,612	19,128
	Overall amount paid (million €)	22,007.7	4,382.1	17,625.6	15,632.7
Aid to subjects other than production units	*N projects*	463,949	415,053	48,896	17,448
	Overall amount paid (million €)	3,327.0	1,443.1	1,883.9	1,223.1
Incentives to productive units	*N projects*	77,580	42,907	34,673	22,873
	Overall amount paid (million €)	8,950.5	2,800.9	6,149.6	5,538.9
Purchase of share equity investments and capital licenses	*N projects*	119	17	102	25
	Overall amount paid (million €)	1,544.0	402.1	1,141.8	750.2
All categories	*N projects*	908,484	657,230	251,254	190,956
	Overall amount paid (million €)	55,640.5	16,012.3	39,628.2	34,515.8

Table 2. Number of projects and the overall amount paid between 2007 and 2015 for the different types of the project category 'incentives to productive units'

Type of 'incentives to productive units' projects		**Italy**	**Centre-North**	**South**	**Convergence regions**
New establishment	*N projects*	5,810	3,100	2,710	1,728
	Overall amount paid (million €)	1,102.7	296.0	806.7	659.3
Extension of an existing establishment	*N projects*	1,211	211	1,000	738
	Overall amount paid (million €)	876.3	65.1	811.1	745.9
Modernization	*N projects*	5,764	3,014	2,750	2,209
	Overall amount paid (million €)	515.4	278.8	236.6	198.2
Diversification and reactivation	*N projects*	751	158	593	12
	Overall amount paid (million €)	90.9	23.4	67.5	12.7
Purchase of training and other services	*N projects*	13,138	10,146	2,992	900
	Overall amount paid (million €)	294.0	195.9	98.1	81.8
R&D&I	*N projects*	7,802	6,197	1,605	1,280
	Overall amount paid (million €)	1,774.5	947.0	827.5	800.8
Work incentives	*N projects*	24,371	9,535	14,836	9,498
	Overall amount paid (million €)	1,057.0	106.0	951.0	835.0
Other	*N projects*	18,733	10,546	8,187	6,508
	Overall amount paid (million €)	3,239.7	888.7	2,351.0	2,205.2
All categories	*N projects*	77,580	42,907	34,673	22,873
	Overall amount paid (million €)	8,950.5	2,800.9	6,149.6	5,538.9

Table 3. Balance checks

	Border splitting Campania and Apulia from Molise and Lazio		**Basilicata border**		**North-South border**	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Population density in 2007	4,172	(1,887)**	-2,272	(1,218)*	4,086	(1,180)***
Number of employees per 1,000 residents in 2007	-186.6	(95.0)*	-8.5	(41.6)	-169.1	(78.0)**
Log changes in the number of employees per 1,000 residents (2001-2007)	0.002	(0.054)	0.030	(0.032)	0.045	(0.041)
Percentage of employees working in the secondary sector in 2007	-0.209	(0.076)***	0.066	(0.060)	-0.126	(0.079)
Logged average income in 2007	0.165	(0.124)	-0.159	(0.103)	0.151	(0.102)
Log change of average income (2001-2007)	-0.011	(0.015)	-0.012	(0.009)	0.010	(0.011)

Notes: All estimates are obtained using regressions of the form described in equation (1) and include a 2nd order RDD polynomial in latitude and longitude. Heteroskedasticity-robust standard errors in parentheses.

Table 4. Binary impact at the geographic discontinuities of interest

		Border splitting Campania and Apulia from Molise and Lazio		**Basilicata border**		**North-South border**	
		(1)	(2)	(3)	(4)	(5)	(6)
Growth rate in workplace employment	Coefficient	19.36	14.35	0.39	-0.64	8.31	6.61
	Standard Error	(4.52)***	(4.32)***	(3.82)	(3.45)	(4.02)**	(4.00)*
	Control variables	No	Yes	No	Yes	No	Yes
	R-squared	0.1733	0.2393	0.0421	0.0936	0.2357	0.3084
	Observations	1,628	1,628	1,349	1,349	1,701	1,701
Growth rate in the number of plants	Coefficient	5.45	7.13	0.19	-0.27	2.16	3.67
	Standard Error	(2.86)*	(2.97)**	(1.69)	(1.69)	(2.22)	(2.17)*
	Control variables	No	Yes	No	Yes	No	Yes
	R-squared	0.2211	0.2594	0.0825	0.1289	0.3051	0.3633
	Observations	1,628	1,628	1,349	1,349	1,701	1,701
Growth rate in average income	Coefficient	-1.80	-2.06	0.33	-0.45	-0.30	0.01
	Standard Error	(1.24)	(1.34)	(1.09)	(0.94)	(0.92)	(0.92)
	Control variables	No	Yes	No	Yes	No	Yes
	R-squared	0.0575	0.1707	0.0665	0.1961	0.0761	0.1405
	Observations	1,628	1,628	1,349	1,349	1,701	1,701

Notes: All specifications include border-segment fixed effects and regional fixed effects. All regressions are weighted by workplace employment in 2007. Heteroskedasticity-robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1.

Table 5. Binary impact at the geographic discontinuities of interest by sector

		Border splitting Campania and Apulia from Molise and Lazio			**Basilicata border**			**North-South border**		
		Manufact-uring	Construc-tion	Tertiary sector	Manufact-uring	Construc-tion	Tertiary sector	Manufact-uring	Construc-tion	Tertiary sector
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Growth rate in workplace employment	Coefficient	4.88	9.49	20.13	-9.01	-3.86	-2.96	0.18	21.94	6.43
	Standard Error	(9.99)	(13.95)	(5.18)***	(6.45)	(6.37)	(4.54)	(8.95)	(10.83)**	(4.27)
	Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	R-squared	0.0584	0.1107	0.1802	0.0521	0.1110	0.1732	0.0649	0.1149	0.1702
	Observations	1,562	1,552	1,622	1,320	1,319	1,348	1,629	1,621	1,701
Growth rate in the number of plants	Coefficient	3.11	12.55	8.31	-2.95	-3.15	-1.11	2.34	0.60	7.27
	Standard Error	(4.32)	(7.24)*	(3.20)***	(3.77)	(4.30)	(1.82)	(4.69)	(5.21)	(2.28)***
	Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	R-squared	0.1227	0.1690	0.1742	0.1414	0.1423	0.1651	0.1189	0.1215	0.2150
	Observations	1,564	1,554	1,628	1,321	1,319	1,349	1,631	1,623	1,701

Notes: All specifications include border-segment fixed effects and regional fixed effects. All regressions are weighted by workplace employment in 2007. Heteroskedasticity-robust standard errors in parentheses.

***p<0.01, **p<0.05, *p<0.1.

Table 6. Robustness checks - Border splitting Campania and Apulia from Molise and Lazio

	Growth rate in workplace employment		Growth rate in the number of plants		Growth rate in average income	
Type of robustness check	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
(1) Border moved 50 km above the actual border	-2.05	(2.68)	-0.59	(1.58)	-0.42	(0.53)
(2) Border moved 50 km below the actual border	1.67	(1.85)	0.26	(1.04)	0.47	(0.50)
(3) First-order polynomial	12.53	(4.41)***	5.71	(2.78)**	-2.41	(1.25)*
(4) Third-order polynomial	12.70	(4.99)**	6.63	(2.92)**	-2.44	(1.72)
(5) Euclidean distance as forcing variable	11.09	(4.14)***	6.81	(2.91)**	-0.84	(1.17)
(6) Spatial sorting effect	15.05	(4.68)***	8.03	(3.02)***	-1.95	(1.41)
(7) Regressions weighted by number of plants in 2007	15.92	(4.00)***	6.90	(2.63)***	-2.52	(1.25)**
(8) Regressions weighted by resident population in 2007	15.91	(4.16)***	6.28	(2.47)**	-3.04	(1.15)***
(9) Unweighted regressions	19.96	(5.31)***	11.64	(2.94)***	0.22	(0.89)
(10) Removal of large municipalities	13.82	(4.05)***	6.43	(2.84)**	-2.53	(1.37)*

Notes: To save space, covariate estimates are omitted. All specifications include pretreatment covariates, border-segment fixed effects and regional fixed effects. Heteroskedasticity-robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1.

Table B1. Intensity of treatment differences

	Border splitting Campania and Apulia from Molise and Lazio		**Basilicata border**		**North-South border**	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
All payments	1,557.8	(528.8)***	658.2	(474.8)	1,154.7	(370.7)***
Payments relative to 'incentives to productive units' projects	267.0	(121.9)**	240.1	(90.5)***	201.0	(52.6)***

Notes: All estimates are obtained using regressions of the form described in equation (2) and include a 2nd order RDD polynomial in latitude and longitude. Heteroskedasticity-robust standard errors in parentheses.

Table B2. Robustness checks – Basilicata border

Type of robustness check	Growth rate in workplace employment		Growth rate in the number of plants		Growth rate in average income	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
(1) Border moved 50 km above the actual border	-2.20	(1.95)	-2.34	(1.02)**	-0.82	(0.39)**
(2) Border moved 50 km below the actual border	N/A		N/A		N/A	
(3) First-order polynomial	2.00	(3.38)	0.69	(1.44)	-0.63	(0.88)
(4) Third-order polynomial	-4.39	(3.46)	-1.00	(1.93)	-0.69	(0.94)
(5) Euclidean distance as forcing variable	-0.46	(7.39)	3.34	(3.18)	-3.58	(2.39)
(6) Spatial sorting effect	-0.10	(4.28)	-1.00	(1.92)	0.06	(0.95)
(7) Regressions weighted by number of plants in 2007	-0.08	(2.88)	1.12	(1.53)	-0.40	(0.81)
(8) Regressions weighted by resident population in 2007	0.83	(2.69)	2.08	(1.49)	-0.41	(0.73)
(9) Unweighted regressions	-1.26	(3.41)	3.33	(1.63)**	-2.87	(0.64)***
(10) Removal of large municipalities	-1.06	(3.50)	-0.28	(1.69)	-0.23	(0.93)

Notes: See notes of Table 6.

Table B3. Robustness checks – North-South border

	Growth rate in workplace employment		Growth rate in the number of plants		Growth rate in average income	
Type of robustness check	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
(1) Border moved 50 km above the actual border	-0.55	(1.89)	-1.22	(1.10)	-0.05	(0.46)
(2) Border moved 50 km below the actual border	1.24	(1.95)	-1.04	(1.17)	0.58	(0.36)
(3) First-order polynomial	7.86	(3.82)**	4.19	(2.06)**	0.36	(0.95)
(4) Third-order polynomial	5.18	(5.45)	3.05	(3.19)	0.37	(1.16)
(5) Euclidean distance as forcing variable	12.13	(3.53)***	9.26	(2.21)***	-0.32	(0.98)
(6) Spatial sorting effect	6.73	(4.20)	4.30	(2.02)**	-0.75	(0.98)
(7) Regressions weighted by number of plants in 2007	6.01	(3.36)*	2.44	(1.97)	0.02	(0.88)
(8) Regressions weighted by resident population in 2007	6.67	(3.23)**	2.34	(1.90)	0.02	(0.84)
(9) Unweighted regressions	3.79	(4.57)	1.48	(2.89)	1.34	(0.77)
(10) Removal of large municipalities	4.74	(3.87)	2.61	(2.11)	-0.31	(0.86)

Notes: See notes of Table 6.