How much does state aid mitigate employment losses? Local policy effects at a time of economic crisis

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\textbf{ABSTRACT}

We evaluate the effectiveness of the most extensive experiment of income redistribution, that is, the European Union regional policy, at a time of economic crisis. By exploiting geographical discontinuities in fund eligibility, we analyse comprehensive data on all publicly funded Italian projects at the municipality level. We find a positive impact of localized support to firms with a sizable increase in employment and the number of plants in intensively treated areas. The result is an important policy lesson concerning the effects of place-based policies at a time of a long-lasting recession, such as that engendered by the Covid-19 crisis.

\textbf{KEYWORDS}

European Union regional policy; spatial regression discontinuity design; recession; municipalities

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\textbf{INTRODUCTION}

Regional inequalities are large and they have even widened over the last decade (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 interregional disparities (Crescenzi et al., 2016). Iammarino et al. (2019) underline that increasing economic disparities are a severe threat to economic progress, social cohesion and political stability in Europe. Moreover, the upward trend in the regional divide has shown the deficiencies of 'people-centred' and space-blind policies that were supposed to spread prosperity and opportunity but were no longer sufficiently effective. A new developing strategy is proposed based on a place-based regional policy approach, with tailor-made policy actions linked to the specific needs, capabilities, knowledge-sets, assets and available resources of particular places (Bentley & Pugalis, 2014). They typically provide under-developed regions with infrastructure investment, incentives to increase labour market participation and skills, and subsidies to firms aimed at keeping existing firms and attracting new ones. Eventually, these policies are expected to increase the development of the low-income regions and lead to endogenous economic growth. Such public interventions are often characterized, especially in Europe, by the transfer of considerable financial resources to the most vulnerable areas to increase the attractiveness of the local economy and produce continuous innovation, also preventing out-migration of people and economic activities to more developed regions (Jofre-Monseny, 2014). A clear example of an explicit place-based approach is the Research and Innovation Strategies for Smart Specialisation (RIS3), a place-sensitive regional innovation policy strategy now fully implemented across European regions (Benner, 2020), focusing on knowledge and innovation, taking region-specific needs and resources into account, emphasizing selection and prioritization of domains (fields or areas), and aiming at diversified territorial specialization (Hassink & Gong, 2019). However, Capello and Kroll (2016, p. 1402) underline that ‘the move from theory to practice in smart specialization has highlighted many fragilities that do not allow to put in place RIS3 as was planned, and do not guarantee the achievement of the expected advantages’.

This is a more general problem in the implementation of place-based policies, where the empirical evidence on their impact is up to now often inconclusive and some economic theories predict their ineffectiveness and limits (Capello & Kroll, 2016; Dall’Erba & Fang, 2017; Glaeser & Gottlieb, 2008). However, this circumstance...
has not stopped policymakers from spending an increasing amount of money on them in the United States, Europe and Asia (Kline & Moretti, 2014a). An example is the EU regional policy, based on the Structural Funds and Cohesion Fund (also known as Cohesion Policy), that is arguably the most extensive and long-lived experiment of income redistribution across regions and countries. It is heatedly debated in the empirical literature whether it has been delivering what it promises (e.g., Becker et al., 2010; Iammarino et al., 2019). Moreover, the impact of place-based policies, included in the more general Cohesion Policy, has often been estimated in periods of economic expansion, but it can markedly change at different stages of the business cycle, and studies on the effects of place-based policies in times of crisis are still rare. In this respect, Italy is a particularly interesting case study because of the historical, economic and social divide between Southern and Centre–North regions.

Our paper determines whether, and to what extent, state aid reduced and contrasted the negative impact of the financial crisis in underdeveloped regions. The flexibility of this policy, which in Italy is declined not only at the sectoral and dimensional level, but also with respect to the regions and some specific regional targets, while intervening, obviously in different ways, both in the less developed regions and in the remaining ones (with some predetermined limitations), makes it an instrument that can be fully included in place-based territorial development policies. This is a key policy issue in light of the likely harsh socio-economic consequences of the long period of economic crisis and also to counteract the effect that the Covid-19 crisis will bring about on the most fragile European regions. In this study we tackle the endogeneity of government spending by exploiting the geographical discontinuities in the Italian regional aid map, which ex ante determines the areas where state aid to firms is permitted. State aid is allowed to promote the expansion of the economic activities of enterprises located especially in less-favoured regions, in particular by encouraging firms to set up new establishments there (European Commission, 2006). Within eligible areas, we exploit geographical discontinuities in funds available as well as in gross grant equivalent (GGE), which sets the maximum proportion of a firm’s investment that can be subsidized by public funds and differs across areas and policy targets ranging from 10% to 60%. We employ a fuzzy spatial regression discontinuity design (fuzzy SRDD), which compares nearby areas with similar characteristics but differs in the extent to which they could support local firms for the period 2007–15.

The paper’s contribution to the literature on the effects of place-based policies is threefold: first, it presents an impact evaluation of state aid in a period of economic crisis. This is an important point because it gives indications on the anti-cyclical effectiveness of state aid. Second, the study offers new elements with respect to the internal validity of the impact estimation as it combines a fuzzy SRDD conducted at a very fine geographical level with the examination of a very detailed and accurate dataset on state aid intensity. Third, the paper, unlike most previous literature, uses a natural experiment to directly link funds received with firm-related outcomes (a notable exception is Freedman, 2015). As the Italian government used most Cohesion Policy funds for infrastructure and human development as a substitute for national ordinary spending during the Great Recession (e.g., Agency for Territorial Cohesion, 2017; European Policies Research Centre (EPRC), 2010a), our estimates (roughly) isolate the causal impact of public support to firms during the crisis.

Overall, we find that public support to firms had a sizable positive impact on employment and the number of plants in the least developed regions with a limited cost per job. These findings suggest that the observed increase in regional inequalities during the Great Recession is not due to the ineffectiveness of place-based policies aimed at supporting firms, but rather to the pronounced reduction of public funds to the least developed regions that in times of economic crisis need more rather than less public support for their distressed economies.

CONCEPTUAL FRAMEWORK AND THE PREVIOUS LITERATURE

Regional policy: theoretical approach and empirical evidence

Place-based policies try to favour 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). From the political point of view, in the face of large and persistent differences in labour market outcomes across regions, equity rationales are popular among policymakers: by subsidizing disadvantaged areas, governments hope to help the disadvantaged residents of those areas (Kline & Moretti, 2014b). On the other hand, economists have traditionally expressed little support for place-based programmes, fearing they will generate large distortions in economic behaviour (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 labour, housing prices equalling the cost of producing a house, and low migration costs making consumers indifferent between locations. Under this set of assumptions, place-based policies targeting deprived areas simply shift economic activities from one locality to another leading to a zero-sum game (Kline & Moretti, 2014a). The spatial equilibrium model suggests that bringing economic activities to the least productive places, lowers overall productivity (Glaeser, 2008) and local prices adjust so that local workers are unlikely to capture the policy benefits fully (Moretti, 2011). Further, recent articles on the quantitative spatial economics literature have shown that EU transfers have improved welfare (Blouri & von Ehrlich, 2020) and that there exists scope for welfare-enhancing spatial policies even when spillovers are common across locations (Fajgelbaum & Gaubert, 2020).
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 (Neumark & Simpson, 2015). 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 addition, the spatial equilibrium model is based on the strict assumption that workers are mobile. Nevertheless, there is strong empirical evidence that even persistent local job loss has small out-migration effects (Bartik, 2019). This implies that local workers are able to capture a significant part of the economic rent generated by the place-based policy.

The most famous, extensive and long-lasting place-based policy worldwide is arguably the EU regional policy, which underpins place-based policies in Italy and in the other EU countries. 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 & Fratesi, 2004). The European Commission considers large regional imbalances as unacceptable for equity and political reasons (Dall’Erba & Le Gallo, 2008), and accordingly the EU regional policy devotes vast resources to the development and structural adjustment of the Convergence regions, that is, the regions whose gross domestic product (GDP) per capita measured in purchasing power standards (PPS) is less than 75% of the EU average.5

Empirically, 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 & 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 on GDP of the regional transfers is positive, but with a limited magnitude (Becker et al., 2010; Cappelen et al., 2003; Pellegrini et al., 2013); the positive impact of the fund intensity on the growth of the Convergence regions decreases, the higher the regional transfers are (Cerqua & Pellegrini, 2018); and 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 & García-Lazo 2015). Further, interregional linkages and other factors promoting externalities are important for setting up effective regional development policies (Dall’Erba & Le Gallo, 2008).

As most evaluations of place-based policies have taken place in times of economic expansion, there is a clear need to evaluate the effectiveness of these public interventions in times of economic crisis. Indeed, several theoretical reasons suggest that the multipliers of place-based policies are likely to differ from those calculated in periods of growth. First, the vast presence of unused resources reduces the likelihood of tensions on the market for goods and labour prices, and therefore accentuates the real effects of regional policies (Austin et al., 2018). Moreover, the consequences of the crisis on the social ground reinforce the effects of policies in places where instead perverse spirals of high-unemployment levels have been triggered (Filippetti et al., 2019). In addition, the presence of negative shocks common to neighbouring areas diminishes the soothing effects of workers’ mobility and therefore amplifies the positive effects of local policy interventions.

There is also recent literature on place-based policy evaluations using data at a smaller geographical level concerning specific geographical areas within the EU jurisdiction. Ciani and de Blasio (2015) investigate the effectiveness of the Cohesion Policy on employment, population and house prices by using a difference-in-differences approach with continuous treatment. They find that EU funds did not offset the negative consequences of the economic crisis. Giua (2017) considers – in a sharp SRDD set-up – 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, some related literature looks at specific industrial policies financed with Structural Funds (e.g., Cerqua & Pellegrini, 2014; Criscuolo et al., 2019; Einio & Overman, 2020). 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.

Regional policy in a dual country at a time of recession

Place-based policies in Italy have a long history. Since the early 1950s in Italy the application of place-based policies has followed the pronounced geographical disparities, primarily the persistent backwardness of the regions making up the South. After a first period of pronounced catching up driven by a steep increase in productivity (Iuzzolino et al., 2013), the development gap between the North and the South of Italy came to an abrupt halt and has barely changed since the 1970s.

In the 2000s, the main target of Italian regional policy was still the Mezzogiorno.6 Still, as in several other EU countries, the financial crisis and economic downturn made the focus on the development of the least developed areas more formal than real: the need to redeploy resources to tackle the crisis led to major cutbacks in domestic regional policy funding (EPRC, 2009).7 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 additiveness with regard to the Cohesion Policy (Agency for Territorial Cohesion, 2017; EPRC, 2010a).

Despite sound evidence on a wide use of regional policy funds as a substitute for ordinary spending, the most deprived Italian 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: (1) the setting-up of a new establishment;

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(2) the extension of an existing establishment; (3) diversification of the output of an establishment into new, additional products; and (4) a fundamental change in the overall production process of an existing establishment (European Commission, 2006). The more deprived the area, the larger the funds available and the permissible GGE for firms’ investment. The GGE ranges 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 aid eligibility in Italy for the programming period 2007–13. It shows that other than the Convergence, phasing-out or phasing-in regions, other selected areas were eligible for state aid but with much fewer funds available and a more limited GGE. The map confirms that aid intensity is concentrated in the Mezzogiorno regions and that the Convergence regions benefit from the highest GGE. 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 programmes and work incentives.

Despite these regional interventions, empirical evidence from recent papers is mixed. For instance, Arbolino et al. (2020) analyse regional data with panel data models to investigate whether the Cohesion Policy contributed to the resilience of Italian regional labour markets. They find a positive impact that strongly depends on the heterogeneous quality of regional institutions. Albanese et al. (2020) adopt several evaluation strategies to investigate the local total factor productivity (TFP) growth in Southern Italy during the crisis. They find that local TFP seems to be somewhat unresponsive to EU programmes. The use of the EU regional policy funds in the South of Italy as a substitute for ordinary spending (Agency for Territorial Cohesion, 2017; EPRC, 2010a) combined with the possibility of substantially supporting firms only in the most deprived regions allows us to (roughly) isolate the impact of public support to firm policies. Assessing whether this type of support has helped to re ABS emerge, the number of plants (a plant is an enterprise or part thereof, e.g., a factory, warehouse or office), 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 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 precise locating of all plants within multi-plant firms, removing any measurement error due to the use of firm-level data and the skewness towards medium-large firms caused by the use of balance-sheet data.

In addition, we also collect data on several pre-treatment variables: the population in 2007 from ISTAT, the number of employees, the average number of employees per local unit, the percentage of employees working in the secondary sector and the workplace employment rate in 2007 from ASIA, the per capita income in 2007 from the Italian Ministry of Economy and Finances, and log changes in the number of employees and of income for pre-treatment period 2001–07.

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 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 programme implementation was prolonged 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 programmes were mainly due to lengthy and inefficient project appraisal and

### DATA AND METHODS

**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 (8092) and stable boundaries. Fund assignment and payment data come from the recently developed *OpenCoesione* dataset. This database contains the fulfillment 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 allocate at the municipality level payments relative to all projects funded by the Structural Funds and co-financed by national funds during the 2007–13 programming period. Furthermore, projects that are exclusively funded by national sources (in particular, the *Fondo per lo Sviluppo e la Coesione*) are included. By the end of 2015, 908,095 projects were partially or entirely financed for a total of €55.52 billion (€25.80 billion by the Structural Funds and €29.72 billion by the Italian government). 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 2007–15 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 primary 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 or office), 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 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 precise locating of all plants within multi-plant firms, removing any measurement error due to the use of firm-level data and the skewness towards medium-large firms caused by the use of balance-sheet data.
procurement processes, coupled with high staff turnover (European Commission, 2016a).19

Although the vast majority of resources targeted infrastructure, urban regeneration and human capital development and training, 16.1% of the transfers (€8.93 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 project category ‘incentives to productive units’. These funds were mostly allocated on the basis of the state aid rules but they also include the exceptions presented in the previous section. As we are primarily

Figure 1. Regional aid map for the programming period 2007–13.
Note: A few dozens of Northern municipalities eligible for state aid up to 31 December 2008 are reported in the map as non-e-ligible. Further, some of the municipalities not located in the Convergence regions were eligible for state aid only for part of their territory.
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 (e.g., subsidies aimed at hiring young people, long-term unemployed or women), while the extension of an existing establishment is the category with the highest average amount per project. Many projects fall into a mix of the main categories or because there was not enough information to classify them correctly. Overall, it emerges a huge difference in the per capita amount paid of state aid between Centre–North and Southern regions. The former ones received an average of €60.61, while Southern regions received an average of €254.03.

**Evaluation strategy**

Our main goal is basically to test whether more intensively incentivized areas benefited from larger growth and the extent of such difference in growth during the crisis. To this aim, we exploit the geographical discontinuities in funds available and in the permissible GGE ceilings among Convergence and non–Convergence regions. In particular, as highlighted in Figure 2, there are two well-defined geographical discontinuities: the one between the Convergence regions Campania and Apulia and Molise and Lazio and the Basilicata’s discontinuity. Therefore, we focus the analysis on the three inland Convergence regions, that is, Campania, Apulia and Calabria, and the four non–Convergence regions surrounding them, that is, Lazio, Abruzzo, Molise and Basilicata. Except for Lazio, the other three non–Convergence regions are part of the Mezzogiorno and can be considered as economically fragile regions (Iammarino et al., 2019). Their GDP per capita was only slightly above the 75% threshold, and therefore they could benefit from a much lesser extent of public funds to support their firms. Figure 2 maps the distribution of the per capita amount of transfer deciles for all projects (panel A) and for the projects under the category of incentives to productive units (panel B). The latter map shows a strong (but not perfect) spatial relationship between the amount paid per capita of state aid and the differences in eligibility and maximum GGE reported in Figure 1. This suggests that the rules determining the regional aid map are good predictors of the amount per capita of the incentives to productive units and could be effectively used to instrument such amount. Therefore, we implement a fuzzy SRDD where the geographical discontinuities become instrumental variables for state aid intensity. In such an evaluation framework, location acts as the forcing variable allowing us to exploit the discontinuous change in eligibility to receive state aid at the geographical border. Nearby areas share the same geography, climate, access to transportation, agglomeration benefits, and access to specialized labour resources to fund works already planned, which were supposed to be co-financed by European Union funds.

| Nature of financed projects | Italy | Centre–North | South | Convergence regions | Three inland Convergence regions |
|-----------------------------|------|--------------|-------|---------------------|-------------------------------|
| Purchase of goods           | No. of projects | 31,720 | 2617 | 29,103 | 28,668 | 20,171 |
|                            | Overall amount paid (€ millions) | 3492.7 | 678.9 | 2813.8 | 2586.0 | 1790.0 |
| Realization and purchase of services | No. of projects | 304,788 | 189,954 | 114,834 | 102,805 | 79,536 |
|                            | Overall amount paid (€ millions) | 16,283.7 | 6304.5 | 9979.1 | 8753.3 | 6322.8 |
| Realization of public works | No. of projects | 30,126 | 6654 | 23,472 | 19,020 | 13,344 |
|                            | Overall amount paid (€ millions) | 21,956.5 | 4381.7 | 17,574.9 | 15,594.7 | 10,789.7 |
| Aid to subjects other than production units | No. of projects | 463,930 | 415,044 | 48,886 | 17,449 | 15,358 |
|                            | Overall amount paid (€ millions) | 3325.2 | 1443.6 | 1881.6 | 1223.1 | 1051.8 |
| Incentives to productive units | No. of projects | 77,414 | 42,841 | 34,573 | 22,774 | 18,491 |
|                            | Overall amount paid (€ millions) | 8928.8 | 2798.5 | 6130.3 | 5520.0 | 4209.9 |
| Purchase of share equity investments and capital licenses | No. of projects | 117 | 16 | 101 | 24 | 16 |
|                            | Overall amount paid (€ millions) | 1528.4 | 402.0 | 1126.3 | 1223.1 | 1051.8 |
| All categories              | No. of projects | 908,095 | 657,126 | 250,969 | 190,740 | 146,916 |
|                            | Overall amount paid (€ millions) | 55,515.3 | 16,009.2 | 39,506.1 | 34,411.8 | 24,831.3 |

Note: A total of 24,764 projects were exclusively funded by national sources. We included these projects in the analysis because they used national resources to fund works already planned, which were supposed to be co-financed by European Union funds.
and supplies (Hagedorn et al., 2015); the key feature that sets these locations apart is the difference in eligibility and maximum GGE. The key identification assumption that underlies this evaluation strategy is that the potential outcomes are independent of state aid intensity for municipalities that are close to the Convergence regions’ boundaries, conditional on pre-treatment characteristics (Keele & Titiunik, 2015). Another important assumption is that municipalities must not be able to (precisely) manipulate their location relative to the treatment border (von Ehrlich & Seidel, 2018). Both assumptions are expected to hold in our context as the Convergence status is assigned at the regional level (NUTS-2) and we have tested that there were not statistically significant income per capita differences in 2007 around the Convergence regions’ boundaries ($p$-value = 0.75).

In our context, the fuzzy SRDD 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 2007–13 programming period. The multiple geographical discontinuities in eligibility and maximum GGE ceiling can be used to instrument the amount paid of state aid per municipality. Our primary goal is to examine the impact of public transfers for the projects under the category of incentives to productive units with respect to firm-related outcomes.

To do so, we run the following equation:

$$\Delta y_i = \alpha + \beta Transfers_i + f(geo\ dist_i) + X_i'\gamma + \eta_{ir}$$

where $\Delta y_i$ is the log change in the outcome variable between 2007 and 2015 of the $i$th municipality; $Transfers_i$ is the per capita amount of state aid to productive units; $X_i'$ are pre-treatment income and firm variables; and $\eta_{ir}$ is the error term. $f(geo\ dist_i)$ is the SRDD polynomial, which controls for smooth functions of geographical location. We employ a second-order polynomial in latitude and longitude which allows comparison of

| Type of ‘incentives to productive units’ projects | Italy | Centre–North | South | Convergence regions | Three inland Convergence regions |
|-----------------------------------------------|------|---------------|-------|---------------------|---------------------------------|
| New establishment                              | 5804 | 3100          | 2704  | 1724                | 1305                            |
|                                              | 1092.6 | 296.0         | 796.7 | 649.4               | 426.9                           |
| Extension of an existing establishment         | 1204 | 211           | 993   | 732                 | 576                             |
|                                              | 869.9 | 65.1          | 804.7 | 739.6               | 616.5                           |
| Modernization                                 | 5762 | 3012          | 2750  | 2209                | 365                             |
|                                              | 515.4 | 278.8         | 236.6 | 198.2               | 105.5                           |
| Diversification and reactivation               | 751  | 158           | 593   | 12                  | 8                               |
|                                              | 90.9  | 23.4          | 67.5  | 12.7                | 6.8                             |
| Purchase of training and other services        | 13,095 | 10,105        | 2990  | 898                 | 897                             |
|                                              | 293.6 | 195.3         | 98.3  | 82.0                | 81.9                            |
| R&D&I                                         | 7801 | 6198          | 1603  | 1277                | 1005                            |
|                                              | 1774.5 | 945.5         | 829.0 | 802.3               | 613.7                           |
| Work incentives                               | 24,264 | 9509          | 14,755| 9416                | 8487                            |
|                                              | 1052.3 | 105.7         | 946.6 | 830.6               | 637.0                           |
| Other                                         | 18,733 | 10,548        | 8185  | 6506                | 5848                            |
|                                              | 3239.7 | 888.7         | 2351.0 | 2205.1              | 1721.6                          |
| All categories                                | 77,414 | 42,841        | 34,573 | 22,774              | 18,491                          |
|                                              | 8928.8 | 2798.5        | 6130.3 | 5520.0              | 4209.9                          |
|                                              | 121.73 | 60.61         | 254.03 | 332.32              | 351.66                          |

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’.

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observations that are very close to each other and absorbs all smooth variation in the outcome (Dell, 2010). As suggested above, in our preferred specification we instrument Transfers by a dummy variable for being part of a Convergence region, a dummy variable for being part of a Phasing-out region (i.e., Basilicata) and the maximum GGE ceiling (Figure 1).

RESULTS

In this section we first present the impact estimates using as outcome variables the log change in workplace employment and number of plants during the period 2007–15. We then differentiate the results by sector of activity.

Table 3. Firm-related estimates.

| log change in workplace employment | log change in the number of plants |
|-----------------------------------|------------------------------------|
| (1)                               | (2)                                |
| Coefficient                       | 0.00017                            |
| Standard error                    | (0.00007)**                        |
| Cost per job                      | €28,369                            |
| Instruments                       | 1                                 |
| First stage                       | 29.78                              |
| Sargan–Hansen test (p-value)      | n.a.                               |
| Observations                      | 2011                               |

| (3)                               | (4)                                |
|-----------------------------------|------------------------------------|
| Coefficient                       | 0.00019                            |
| Standard error                    | (0.00007)**                        |
| Cost per job                      | €25,504                            |
| Instruments                       | 3                                 |
| First stage                       | 38.82                              |
| Sargan–Hansen test (p-value)      | 0.52                               |
| Observations                      | 2011                               |

Note: Robust standard errors are reported in parentheses and are clustered at the NUTS-3 level. f(geo dist.) is specified as a second-order polynomial in latitude and longitude. The first-stage statistics is the Kleibergen–Paap rk Wald F-statistic. The critical value for 10% maximal instrumental variables (IV) size of Stock and Yogo (2005) weak identification test is 22.30 for columns (2) and (4). The state aid instrument is a dummy variable for being part of a Convergence region (columns 1 and 3), with the addition of a dummy variable for being part of a Phasing-out region (i.e., Basilicata) and the maximum gross grant equivalent (GGE) ceiling in columns (2) and (4). We used a truncation method, wherein extreme values (observations in the first and last centiles) are recoded to lowest or highest reasonable values (the value of the first centile and the value of the 99th centile, respectively) to the relative dependent variable.

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

Main estimates

Table 3 reports the fuzzy SRDD estimates of log change in workplace employment and number of plants with respect to public transfers to firms. We show two specifications for each dependent variable: columns (1) and (3) present the estimates with only a dummy variable for being part of a Convergence region as instrument for the log change in workplace employment and the log change in number of plants, respectively. On the other hand, the estimates reported in columns (2) and (4) use the three instruments described in the previous section and, for this reason, represent our preferred specification. With three instruments and one endogenous variable the model is overidentified and we can compute the Hansen
The $F$ test. The $p$-value from the Hansen test is above 0.1. Hence, the Hansen test does not reject instrument validity. Further, the Kleibergen–Paap rk Wald $F$-statistic suggests that our instruments are not weak, and contrarily are relevant.

Results are consistent across specifications and show that there is a positive relationship between incentives to productive-unit intensity and firm-related outcome variables. Looking at our preferred specification (column 2), we find that, on average, an increase in per capita public transfers to firms by €1 leads to a growth in workplace employment of +0.019%. As the average amount of per capita public transfers was €249.20, we get that, on average, public transfers to firms increased workplace employment by 4.73% (0.00019*249.20). Similarly, we get an average increase in the number of plants of 2.74% (0.00011*249.20). These estimates are statistically significant at the 5% level. We use the log change in workplace employment estimate to derive the cost per job of the state aid to firms during the economic crisis. We find that the transfers increased employment by 185,795 units in the seven regions under analysis and this corresponds to an estimated cost per job of €25,504.24. This estimate is in line or lower than was previously estimated for other industrial policies carried out during periods of economic expansions in Italy (Andini & de Blasio, 2016; Bonfino & Greenbaum, 2014; Cerqua & Pellegrini, 2014). Similarly, the estimate reported in column (4) allows deriving the impact of state aid on the number of plants. The transfers to productive units brought about additional 35,876 plants with respect to the counterfactual scenario with zero transfers.

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) for public transfers to firms during an economic recession. Overall, our findings show that the behaviour of firms is highly and positively influenced by state aid during an economic crisis. This result is coherent with what found by Bachtrögler et al. (2020) for Italy and with what was theoretically hypothesized in the conceptual framework section: localized public support to firms has a sizable positive impact at a time of economic crisis, when the presence of unused resources is vast.

### Estimates by sector

We complement the analysis by investigating the heterogeneity of our findings by sector of activity and report the estimates in Table 4. Column (1) presents the estimates concerning workplace employment, while column (2) shows those on the number of plants. The estimates are positive but not statistically significant for the tertiary sector, while we detect a positive and statistically significant impact on manufacturing, mining and other industry. The cost per job estimates suggest a much higher cost per job in manufacturing with respect to services. However, the low cost per job in the tertiary sector might be partially due to the presence of high local multipliers from manufacturing (Cerqua & Pellegrini, 2020; Moretti, 2010). These findings show that the Cohesion Policy was able to soften the negative impact of the Great Recession on both sectors.

### ROBUSTNESS

In this section we subject our results to a wide set of robustness checks and summarize the results of interest in Table 5. First, we test the sensitivity of the estimates to different SRDD polynomials. Rows (1) and (2) of Table 5 replace the quadratic polynomial in latitude and longitude with a linear and a cubic polynomial, respectively. In both instances, coefficients show no sizable

### Table 4. Average income elasticity estimates at the geographical border.

|                      | log change in workplace employment | log change in the number of plants |
|----------------------|------------------------------------|------------------------------------|
|                      | (1)                                | (2)                                |
| Manufacturing, mining and other industry | Coefficient: 0.00042 (0.00015)** | 0.00045 (0.00018)** |
|                      | Standard error: n.a.               | n.a.                               |
|                      | Cost per job: €68,181 (n.a.)       | €63,846 (n.a.)                      |
|                      | Instruments: 1                      | 3                                  |
|                      | First stage: 10.50                  | 4.06                               |
|                      | Hansen J-p-value: n.a.             | 0.39                               |
|                      | Observations: 1854                  | 1854                               |
| Tertiary sector | Coefficient: 0.00227 (0.0171)       | 0.00093 (0.00077)                   |
|                      | Standard error: n.a.               | n.a.                               |
|                      | Cost per job: €3202 (n.a.)         | €7094 (n.a.)                        |
|                      | Instruments: 1                      | 3                                  |
|                      | First-stage: 2.16                   | 4.08                               |
|                      | Hansen J-p-value: n.a.             | 0.03                               |
|                      | Observations: 1904                  | 1904                               |

Note: See Table 3.
Table 5. Robustness checks.

| Type of robustness check                                      | Coefficient | Standard error | Cost per job |
|---------------------------------------------------------------|-------------|----------------|--------------|
| (1) Lat-long first-order polynomial                           | 0.00021     | (0.00007)**    | €23,354      |
| (2) Lat-long third-order polynomial                           | 0.00019     | (0.00007)**    | €25,113      |
| (3) Univariate forcing variable                               | 0.00021     | (0.00010)**    | €23,628      |
| (4) LLMs as units of analysis                                 | 0.00020     | (0.00010)*     | €24,172      |
| (5) Only municipality funds                                   | 0.00025     | (0.00010)**    | €19,873      |
| (6) All project categories                                    | 0.00005     | (0.00002)**    | €16,531      |
| (7) Regressions weighted by population in 2007                 | 0.00019     | (0.00008)**    | €24,953      |
| (8) Regressions weighted by the number of plants in 2007       | 0.00017     | (0.00008)**    | €27,789      |
| (9) Removal of municipalities affected by L’Aquila earthquake in 2009 | 0.00016     | (0.00006)**    | €33,995      |
| (10) Removal of Lazio                                         | 0.00020     | (0.00009)**    | €28,255      |
| (11) Spatial sorting effect                                   | 0.00025     | (0.00010)**    | €19,276      |
| (12) Placebo border (50 km north)                             | 0.00003     | (0.00017)      | –            |

Note: All specifications include pre-treatment covariates. To save space, covariate estimates are omitted. Standard errors are adjusted for heteroskedasticity and clustered at the NUTS-3 level. LLMs, local labour markets.

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

differences with respect to the baseline estimates. Further, we use the Euclidean distance to the boundary (i.e., the shortest distance to the boundary from each municipality centroids) as forcing variable instead of latitude and longitude. The estimates reported in row (3) confirm the robustness of our main findings.

We also verify whether using local labour markets (LLMs) rather than municipalities as unit of analysis affects our results. LLMs are subregional geographical areas (aggregation of adjacent municipalities where the bulk of the labour force lives and works) defined on a functional basis: the key criterion being the proportion of commuters who cross the LLM boundary on their way to work. Estimates reported in row (4) are in line with our main estimates but they exhibit higher standard errors as the number of LLMs (193) is much smaller than the number of municipalities (2011).

In the main analysis we reallocated the spending relative to provincial or regional projects to the municipalities on the basis of the 2007 population and we have carried out the analysis summing these payments to the payments at the municipality level. This way we have accounted for all the payments, but the consideration of projects at higher administrative levels might have caused measurement error. We now check the impact of Cohesion Policy only considering projects at the municipality level. The estimates are reported in row (5) of Table 5. These estimates are in line with our main analysis and suggest a lower cost per job estimates. An even lower cost per job is reported in row (6) of Table 5 where we consider all project categories rather than looking exclusively at the projects in the category ‘incentives to productive units’. By including all project categories, we are taking into account the effect of these projects on the territorial capital of places which might indirectly benefit firms’ growth.

We then check whether our results are sensitive to the way we weight observations. Rows (7) and (8) show the estimates we obtain if we weight municipalities according to population in 2007 and the number of plants in 2007, respectively. Both sets of estimates confirm that our firm-related findings are not much affected by the way we weight observations. We also check whether the results are influenced by the presence of municipalities severely hit by L’Aquila earthquake in 2009 (row 9) or whether the removal of Lazio’s municipalities (row 10) greatly affects our estimates. In both cases, the removal of such municipalities does not sizably affect the main estimates, even if the cost per job estimates are slightly larger.

Place based policies might give rise to the spatial sorting effect, that is, it is possible that some firms that would otherwise have 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, that is, those municipalities located within 10 km from the Convergence border. The estimates reported in row (11) of Table 5 supports the hypothesis that state aids did not cause significant displacement effects to neighbouring areas as we get an even lower cost per job estimate. Lastly, we run a placebo border test where we artificially shift the border 50 km to the north and find no visible disparities across the artificial boundaries (row 12).

Finally, notice that, although our period of study includes part of the 2014–20 Cohesion Policy resources, only 2% (€0.99 billion) of the 2014–20 EU resources were spent by the end of 2015. They approximately followed the geographical distribution of the previous programming period. Therefore, it is very unlikely that the exclusion of this relatively small amount of transfers significantly affects our estimates.
CONCLUSIONS

Despite the large amount of resources targeted to the least-developed regions, inequalities in the EU widened during the 2007–13 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 during the economic crisis 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.

Exploiting geographical discontinuities in fund eligibility and using a fuzzy SRDD approach, we analyse comprehensive data on all publicly funded Italian projects at a fine spatial scale. Our results can be summarized as follows: first, we confirm the positive effect of place-based employment policies also found in other studies (e.g., Cerqua & Pellegrini, 2014; Criscuolo et al., 2019), with a cost per job estimate that is in line or lower than that identified by studies carried out in periods of economic expansion (see the main estimates section). Second, our estimates suggest that the 7 inland regions under analysis have preserved about 186,000 jobs due to state aid. As these regions experienced a drop in employment during the period 2007–15 of about 230,000 units, such estimate suggests that Italian and EU funds have reduced the negative impact of the crisis on employment by 44.71% in the most deprived Italian regions. Further, supposing that all earmarked Italian and EU funds would have been spent during the 2007–15 period following the allocated resources shares, our estimates entail that the regions under analysis would have preserved another 45,000 jobs.

The results confirm that the use of place-based development policies that explicitly consider the characteristics of the territory and the firms located in it are effective, even during an economic crisis. Our empirical analysis has confirmed that market processes and space-neutral policies are no longer sufficiently effective (Iammarino et al., 2019) instead of those resulting in our analysis from place-based policies for private investments.

In light of our findings, we claim that the recent increase in inequalities between prosperous and left-behind regions is not due to the ineffectiveness of the EU regional policy, but rather to the strong reduction in additiveness of EU funds, which mostly damaged lagged-behind regions. The literature shows that spending cuts can be harmful in a recession because they risk derailing a recovery, and such ‘fiscal perversity’ was blamed, for instance, for prolonging the Great Depression in the United States (Gordon, 2018). This is an important policy lesson in light of the likely harsh socio-economic consequences that the Covid-19 crisis will bring about on the most fragile European regions.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. The passage of EU regional policy towards a place-based policy has experienced two main moments. The first was the influential Barca Report (Barca, 2009), which proposed and strengthened the paradigm of place-based policies for local and regional development, as opposed to the space-blind or place-neutral initiative: where the place-based approach reaffirms that place matters in terms of geography, institution, capability and resources, place-neutral policies, as business support initiatives, were given to firms irrespective of where they are located and of what sector they are in (Bentley & Pugalis, 2014). The second phase involved the transition to RIS3, focusing investment on innovation under the European Regional Development Fund (ERDF) programme for the period 2014–20.

2. One reason is that many of the main Cohesion Policy evaluation studies concern the two programming periods 1994–99 and 2000–06, characterized by a positive economic cycle, while the crisis period mainly concerned the Structural Funds programming cycle from 2007 to 2013. 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.

3. This aspect is politically central as uneven development reduces confidence in democratic institutions sparking the rise in populism (e.g., Bachtlr et al., 2017).

4. The Convergence region status is determined at the Nomenclature of Statistical Territorial Units (NUTS)-2 level (regions at this level are defined by minimum and maximum population thresholds of 800,000–3 million inhabitants and correspond to administrative divisions in EU member states) and in advance for a whole programming period of seven years. In the programming period 2007–13, Convergence regions received €199 billion, plus part of the Cohesion Fund, which amounted to €69 billion (European Commission, 2007).

5. This was made clear by the National Strategic Framework (NSF) 2007–13, a document that 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, seven-year strategic framework (Polverari, 2013).
The NFS 2007–13 ring-fenced 85% of the domestic regional policy budget to the eight Mezzogiorno regions (EPRC, 2010b) despite only four of them obtaining the Convergence status, that is, Campania, Apulia, Calabria and Sicily. 7. A similar reduction of resources was observed in Greece, the UK, Ireland, Latvia, the Netherlands, Spain and France (EPRC, 2010a, 2010b).

8. The form of 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 favourable terms, exemptions or reductions in taxes, social security or other compulsory charges, or the supply of land, goods or services at favourable prices (European Commission, 2006).

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

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

11. A few types of state aid 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 three 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. Our data cover all forms of public support.

12. Considering NUTS-2 regions, Becker et al. (2018) estimated the employment effect of EU regional policy before and after the crisis. They found that the effects are weaker during the crisis than before. However, they do not really isolate the impact of the Great Recession as they pool together the programming periods 2000–06 and 2007–13. A similar result is found by Bachtrögler (2016).

13. By analysing only state aid projects, we isolate the projects expected to impact firm outcomes directly. However, we cannot exclude the possibility that some other projects, especially those concerning the realization of public works, might indirectly affect firm outcomes. In the robustness section, we will consider all project categories to gauge the robustness of our estimates.

14. During the period 2007–15, 91 Italian municipalities were suppressed and 36 new municipalities were created, but only one of these new municipalities was created in the Mezzogiorno. We use the 2011 municipality map (the year of the census) with 8092 municipalities. 15. These figures do not include the 2273 projects at the national level or with a localization abroad. See Appendix A in the supplemental data online for the detailed construction of the sample.

16. Another possibility would be to use commitments rather than actual payments. However, commitments include also funds that may be cancelled (decommitted) or not entirely completed.

17. The use of workplace employment rather than the employment of resident people allows the consideration of job creation as a proxy for the broader local development of the treated areas (Giua, 2017).

18. 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.

19. 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).

20. Although Lazio’s economy is arguably stronger than that of the Mezzogiorno regions, we keep Lazio’s municipalities in the main analysis because of the border Lazio shares with Campania, as well as because Lazio’s NUTS-3 regions bordering with Campania, that is, Latina and Frosinone, have a GDP per capita similar to those of Abruzzo and Molise. In one of the robustness exercises reported in the robustness section, we remove the Lazio’s NUTS-3 regions not bordering with Campania and find that our estimates are not much affected.

21. When studying treatment assignments that change discontinuously at a geographical border, it is common for multiple administrative or political borders to perfectly overlap (Keele et al., 2017). Therefore, 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 aid, but also by ‘irrelevant’ regional-specific treatments (e.g., differences in regional taxation or administrative differences). Note, however, that, as Cohesion Policy funds were largely used to compensate the fall in ordinary spending in Southern regions, the assumption that the estimate of $\beta$ represents a good approximation of the causal effect of state aid is strengthened. Further, the tax base of the regional tax on productive activities (Imposta Regionale Attività Produttive – 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). During the period 2007–15 there was little in-between variation in the tax base of IRAP for the regions under analysis; therefore, it is unlikely that this significantly affected firms’ behaviour. Lastly, the use of intra-regional
discontinuities as an instrument additionally lessens worries about the validity of this assumption.

22. By differentiating the outcome variable we lower the variance in the SRDD estimator (Lee & Lemieux, 2010) taking into account pre-treatment differences in the dependent variable. Further, we condition on pre-treatment income and firm variables to account for the potential bias due to pre-treatment differences (Frölich & Huber, 2019).

23. A potential alternative is to use the Euclidean distance to the boundary (i.e., the shortest distance to the boundary from each municipality centroids) as forcing variable. However, as shown by Keele and Titunik (2015), using a one-dimensional distance metric can lead to bad matches.

24. Considering that in 2015 the average number of employees was 2043.67, the average number of plants was 668.93 and the average population was 9455.50, we find that, on average, each municipality increased employment by 92.39 units (2043.67 – 2,043.67/(1 + 0.0473)), which multiplied by the number of municipalities suggests additional employment for 185,795 units (92.39*2011) and an estimated cost per job of €25,504 (€249.20*9455.50*2011)/185,795).

25. The precise geographical disaggregation of the 2014–20 projects was not available at the time of the analysis.

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