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PLACE-BASED POLICY AND LOCAL TFP

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Abstract

Total Factor Productivity (TFP) explains most of the differences in income levels between territories. A major policy issue is whether place-based policies are capable of promoting TFP growth in backward areas. We provide some evidence of the effect of the European Regional Development Fund (ERDF) on local TFP growth in Southern Italy. Although TFP growth is on average rather unresponsive to EU programs, we provide some evidence of a positive effect for ERDF infrastructure investments and for areas with higher institutional quality and population density.

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Contents

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1 Introduction[1]

Total Factor Productivity (TFP) is a crucial variable to explain differences in income levels cross territories. Hsieh and Klenow (2010) underscore that TFP accounts for 50-70 percent of the cross-country income differences. Hornbeck and Moretti (2019) estimate large differences in TFP levels and growth rates across US metropolitan statistical areas (MSAs) and suggest that increases of local TFP bring substantial benefits to workers. Being a measure of the efficiency through which the factors of production are combined to produce the output, TFP is seen as reflecting many potential determinants (according to Caselli, 2005, it represents the "measure of our ignorance"): at the local level, these determinants range from the effectiveness of the transportation infrastructure to technological improvements and productivity spillovers from agglomeration economies. As lagging regions are characterized by low TFP, place-based (cohesion) policy is envisaged to tackle the causes that hider its growth.

To what extent are place-based interventions effective in reaching the goal of fostering local TFP growth? Unfortunately, this question has proved to be difficult to answer. The main reason is that TFP data are hard to get, because they need to be estimated using model-based techniques from firm-level archives. In this paper, we exploit the firm-level TFP estimates provided by Ciani et al. (2019), which are available for manufacturing firms (as in Hornbeck and Moretti, 2019) for the period between 1995-2015. For this analysis, we aggregate these firm-level productivity data at the level of the local labor market (LLM).

Evaluating the impact of the policy on local TFP represents a departure from previous studies, which have mostly focused on firm-level measures of TFP (Criscuolo et al., 2019). Our LLM-level proxy captures also the sources of productivity growth that are external to the firms, i.e., not specific to the actual firms that have been subsidized. This is a significant progress, as a large share of financing is spent on local transportation infrastructure and horizontal projects (such as those intended to spur local technological improvements, e.g., technological parks and broadband connections). Our measure of local TFP also reflects any productivity spillovers resulting from local agglomeration economies. Looking at the local TFP also supplements previous literature on area-wide outcomes, such as investment or employment (Neumark and Simpson, 2015). To the extent that TFP

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improvements due to the policy come hand in hand with the adoption of capital- or labor-saving technologies, the previous evidence might provide an underestimation of the overall policy impacts.

We link TFP data with an archive of European Regional Development Fund (ERDF) disbursements for the EU programming cycle 2007-2013. The ERDF is the main policy instrument available in the EU to tackle the roots of TFP underdevelopment, as it finances research and innovation activities as well as infrastructure investment. We focus on the South of Italy, the most backward area of the country; in fact, the ERDF allocations towards this region have been more generous and the LLMs are more similar to each other for a number of socio-economic features, with respect to their northern counterparts. As described in Ciani et al. (2019), southern TFP is substantially lower than that prevailing in the rest of the country; the estimated divide ranges between about 12 per cent (if labor input is measured as labor cost) and 30 per cent (if the number of employees is used in its place). Irrespective of the proxy of labor used for estimation, there has been a modest catching-up of the TFP of the South over the 1995-2015 period (between 5-7 per cent). Thus, it seems relevant to check whether cohesion money, which disproportionally benefit southern areas, are at least partly responsible for that.

We estimate the impact of ERDF programs on local TFP by using cross-LLM evidence that tackle omitted variable bias by using an extraordinary ample set of controls compounded with Belloni at al. (2014) double-selection procedure (LASSO). Using the same econometric framework, over the same period and across the same areas Ciani and de Blasio (2015) estimate that regional transfers had no detectable impact on local population and house prices and, at best, a modest effect on employment. Our main results indicate that ERDF 2007-2013 programs did not have a significant impact on local TFP growth. Yet, in an investigation of heterogeneous effects by type of expenditure, we find that the ERDF infrastructure investments did have a positive and significant impact on TFP growth, while this was not the case for incentives and public procurement spending. We finally show that some characteristics of the local context matter, in particular the quality of institutions and the existing degree of urbanization. The former feature could be particularly relevant in our case study, since Southern Italy generally performs very poorly both in the national and international comparison.[2]

The remaining of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 provides details on the ERDF program. Section 4 describes the data, in particular those on

[2] According to the 2017 European Quality of Government Index (Charron et al., 2014), all Southern Italian regions are in the last quarter of the distribution of institutional quality among European NUTS2.

TFP, and describes our empirical strategy. Sections 5-6 outline the results, which are corroborated with a full-fledged robustness analysis, and present some interesting dimension of heterogeneity. Section 7 concludes.

2 Literature review

This work contributes to the strand of literature that has tried to estimate the effectiveness of place-based policies (Neumark and Simpson, 2015). The results of these studies are mixed, but for the most part they suggest that place-based interventions have a limited impact and suffer from various drawbacks. In general, there is abundant evidence that many policies do not create new firms, jobs or investment, but simply move them over space and time (Freedman, 2013; von Ehrlich and Seidel, 2018), especially those focused on geographically limited areas. Results are also heterogeneous by policy instrument. Tax exemption policies and direct subsidies for hiring or investments seem to work little (Busso et al., 2013; Kolko and Neumark, 2010); when they work, the side effects could be greater than the direct benefits (Reynolds and Rohlin, 2015). Infrastructure policies seem to work better. For instance, the "Tennessee Valley Authority" has had a lasting effect in the development of a backward area of the United States (Kline and Moretti, 2014). Again, "Zones Franches Urbaines" in France seem to be more successful if they are located in areas with more infrastructure (Briant et al., 2015).

Much attention has been devoted to EU regional policy (Becker et al., 2010). On average, its effect seems positive and significant; however, there is much heterogeneity: positive results seem to be drawn by a handful of well-managed regions and with an educated labor force (Becker et al., 2013). With regard to Italy, the evidence found in previous works suggests that effectiveness was rather limited. Bronzini and de Blasio (2006) estimate a very small impact of a major incentive scheme (Law 488/1992, intended to subsidize firms located in economically depressed areas) on firms' investment, mostly due to anticipation effects. Also, Accetturo and de Blasio (2012) find that the "Patti Territoriali" program (in which local communities played a significant role in designing the development plan) were ineffective in fostering economic growth. Further, Andini and de Blasio (2014) conclude that the "Contratti di Programma" intervention (consisting in the Government approval and financing of industrial projects proposed by private firms) had limited impact on local growth, while stimulating spatial substitution from southern untreated areas to treated ones. Ciani and de Blasio (2015) find that European Structural Funds (ESF) had a very limited impact on employment, population and house prices in Southern Italy between 2007-2013, with modest effects on employment being connected to the acceleration and retargeting of payment started in 2011. Some evidence of a positive impact of overall EU funding on employment is only found in Giua (2017) who studies the EU 2000-2006 programming cycle and considers, in an RDD set-up, the differences in employment growth across municipalities on the two sides of the Objective 1 border. Overall, Accetturo and de Blasio (2019) review the evidence from 1995 onwards and conclude that it is quite hard to find rigorously-derived results in favor of effectiveness.

The evidence on the link between place-based policy and productivity is rather limited and generally not very favorable. Bernini and Pellegrini (2011) evaluated the impact of Law 488/92 on the performance of private firms and found evidence that the subsidies, while having some positive effects on employment and investment, had a negative impact on labor productivity and TFP growth (firms may have overshot the optimal amount of inputs in order to obtain the subsidy). Similarly, Criscuolo et al. (2019) found that a major program to support manufacturing jobs in the UK ("Regional Selective Assistance") had some positive effect on employment and investment by small firms, but not on their TFP. In a study of the Latvian economy, Benkovskis et al. (2018), focusing on funding received by firms from the ERDF, alone – excluding beneficiaries from the European Social Fund (ESF) or the Cohesion Fund (CF) – find that such projects had no average effect on TFP in the short run but a small positive effect with some time lag. In a wider study on six OECD countries (including Italy), Bachtrögler and Hammer (2018) merge newly-collected data on Structural Funds received by firms with a measure of their individual TFP; their analysis provides mixed evidence of the effectiveness of EU spending in promoting productivity growth (depending on the choice of the capital proxy used for the estimation of the production function). Contrasting evidence on the effectiveness of place-based policy in fostering productivity can be found in a recent paper by Brachert et al. (2019), which finds a positive impact on the district-level growth of gross value added and productivity by a prominent scheme ("Improving the Regional Economic Structure") realized in West Germany between 2000 and 2006.

3 The ERDF programs

The Structural Funds represent financial instruments of the EU regional policy, intended to pursue the goal of economic, social and territorial cohesion by narrowing the development disparities among regions and member states. For the period 2007-2013, the budget allocated to the Structural Funds amounted to around 278 billion euros, which represents 28 percent of the Community budget.[3] There are two Structural Funds: the ERDF provides support for the creation of infrastructures and productive job-creating investment, mainly for businesses; the ESF contributes to the integration into working life of the unemployed and disadvantaged sections of the population, mainly for social inclusion. In the period 2007-2013, they accounted, respectively, for 202 and 76 billion euros. In this paper we will focus on ERDF interventions alone, given our focus on the TFP of manufacturing firms.

The ERDF support programs addressing regional development, economic change and competitiveness throughout the EU. In Italy, the ERDF has financed 28 national and regional programs during the 2007-2013 cycle. Funding priorities have included research and innovation, SME support, and infrastructure investment. The bulk of expenditure has flown to the "Convergence Objective" areas, which were regions with GDP per capita less than 75 percent of the EU average. In Italy, they included five Southern regions (Apulia, Basilicata, Calabria, Campania and Sicily). The three remaining Southern regions (Abruzzo, Molise and Sardinia) were classified as "Competitiveness Objective" areas (along with the Centre-North regions), and have been receiving fewer funds from EU programs in per capita terms (Figure 1).

The information on ERDF expenditure in Italy comes from the OpenCoesione website.[4] It collects all the information relative to projects at least partially funded by EU Structural Funds starting from the 2007-2013 programming cycle. In this archive, expenditure data include not only the money coming from the EU funds, but also the national co-financing from the Italian Government (or local authorities). Importantly, the data provide geo-referenced information about the targeted places. Although the vast majority of projects (over 95 percent) take place at the level of municipalities, some target a higher administrative level (i.e., provinces or regions). In such cases the expenditure was distributed between the respective municipalities on the basis of their population in the initial year of our analysis (2007).

In the empirical analysis, we aggregate TFP and ERDF data to the level of LLMs, which are geographical areas designed by the National Statistical Institute (Istat) to be approximately a self-contained commuting zone (on the basis of the 2001 Census). All variables relative to payments are expressed in per capita terms (2007 population is used as a denominator). Table 1 shows the main descriptive statistics.

[3] In this paper, we do not consider the CF, which is intended for countries whose per capita GDP is below 90% of the Community average; the Italian per capita GDP lies above this threshold.

[4] www.opencoesione.gov.it

In our sample, average TFP stagnated between 2007 and 2015. The productivity decline experienced in the years 2008 and 2009 – when the economy was hit by the international financial crisis (its impact was less severe in the South than in the North of Italy, where firms are more open to international trade) – was followed by a period of slow recovery, hindered by the strong dependence of the southern economy from public demand. Our data show a significant degree of heterogeneity in local productivity dynamics, ranging between a drop of more than 1 per cent to a growth close to 1.8 per cent. Over the same period, also ERDF disbursements displayed substantial LLM variation, ranging between 100 euros and 4,700 euros per capita.

ERDF disbursements started in 2007 (in Southern LLMs only some 450 million euros were spent in that year, representing about 1.6 percent of the total expenditure over the entire period) and became significant from 2008 (Figure 2); their rate of growth progressively increased in the two following years. In 2011 there was a significant expansion, which followed the actions taken by the Italian government to speed-up the spending and re-focusing the programs, to try to mitigate the impact of the long recession. Finally, there was an acceleration at the end of the cycle 2007-2013, that extends to 2015 following the "N+2" rule.[5]

Figure 3 shows the distribution of TFP variation and spending across LLMs. Both maps display a substantial geographical variability, which we exploit for our investigation.

4 Empirical model and data

Our focus lies on the effect of ERDF programs on TFP growth ($\Delta\Phi_i$) measured at the local level. The unit of observation for the analysis is the LLM, to which subscript i refers. In this Section, local TFP is calculated as an unweighted average of firm-level data; in Section 5 we also experiment using firms' value added as a weight. Appendix I summarizes the model-based estimation of firm TFP from Ciani et al. (2019) on which we rely.

Model 1 is our baseline specification in which we estimate the impact of the overall amount of per capita ERDF expenditure (s_i) received by LLM i in the entire period of analysis on the growth of local TFP between 2007-2015. The estimated equation is:

$$\Delta\Phi_i = \delta \ln(s_i) + \beta_0 + f_i'\omega + \Delta\varepsilon_i \qquad (1),$$

[5] EU financing rules implied that, for each year N of the period 2007-2013, annual funding from the Cohesion policy had to be spent by the end of the second year after its allocation (N+2).

where $\Delta\Phi_i$ represents the growth of average TFP in LLM i expressed in terms of a log-difference, $\ln(s_i)$ is the natural logarithm of the overall ERDF expenditure, f_i' is a vector of LLM-specific variables which is included to predict local counterfactual trends in TFP, and $\Delta\varepsilon_i$ is the error term.

In order to predict local counterfactual trends in TFP, we included a vector of LLM-specific variables f_i'. The introduction of these covariates in our specification in first differences allows for linear time trends that depend on pre-determined differences in these variables. For OLS to consistently estimate the true effect of cumulate payments, we need expenditure to be orthogonal to shocks $\Delta\varepsilon_i$, given the LLM characteristics included in f_i'.

In estimating equation (1), a trade-off arises between two opposite concerns. On the one hand, our empirical strategy requires a very long set of covariates f_i' to gain credible estimates of parameter δ: we considered an extensive set of (82) local variables,[6] which regard geography and socio-economic characteristics of LLMs that could influence productivity at the local level. On the other hand, using a large set of covariates may hinder the precision of the estimators and create problems for standard inference because of the small sample size. One approach to solve this problem is to follow Belloni et al. (2014), and select a smaller set of variables using a "double selection method". Instead of assuming that one needs to control for the entire list of variables f_i', it may be assumed that there is a smaller set of covariates such that, once controlling for them, $\ln(s_i)$ can be considered exogenous. The problem is that this subset is a priori unknown. The standard procedure would be to consider only those variables that the researcher or the literature consider more relevant. Differently, Belloni et al. (2014) propose to select them by using a Least Absolute Shrinkage and Selection Operator (LASSO), which minimizes the sum of squared residuals and an additional penalty parameter that aims at reducing the overall size of the model. The selection must be conducted on the two reduced forms:

$$\Delta\Phi_i = \beta_0^{\Phi} + f_i'\beta_1^{\Phi} + \Delta v_i^{\Phi} \qquad (2a)$$

$$\ln(s_i) = \beta_0^{s} + f_i'\beta_1^{s} + \Delta v_i^{s} \qquad (2b)$$

[6] The list of variables, referred to 2001, includes: population and population density; geographical features (latitude, longitude, altitude, coastal location); presence of a provincial capital; employment, unemployment and activity rates; institutional quality (measured at provincial level with the index by Nifo and Vecchione, 2014); human capital (number of graduate people over adult population); social capital (number of non-profit organizations per capita); bankarization (number of bank offices per capita); presence of an industrial district; sector composition (share of workers in 57 Ateco 2-digit sectors); size of local manufacturing plants (share of manufacturing workers belonging to ten size classes: 1-2, 3-5, 6-9, 10-19, 20-59, 50-99, 100-199, 200-499, 500-999, 1,000 or more). Additional information and descriptive statistics on variables are reported in the Appendix II.

and the final set of variables should be the union of those selected in (2a) and (2b). The reason is that the selection aims at maximizing the predictive power of the covariates, which is captured by the reduced forms rather than by the equation of interest.

To exploit the panel dimension of our data, we have also estimated the effect of annual per capita expenditure s_{it} on annual growth:

$$\Delta\Phi_{it} = \delta\ln(s_{i\tau}) + \gamma_t + \Delta\varepsilon_{it} \qquad (3),$$

where $t = 2008, \dots, 2015$ and $\tau = t - l, l = 0,1,2$ to account for lagged effects.

By considering the year-to-year variability as in equation (3) we can experiment with a number of different strategies. First of all, we can control for LLM-specific linear time trends by adding LLM fixed effects g_i, which would capture a constant growth over the years for each LLM:

$$\Delta\Phi_{it} = \delta\ln(s_{i\tau}) + \gamma_t + g_i + \Delta\varepsilon_{it} \qquad (4a).$$

Shocks $\Delta\varepsilon_{it}$ must be, conditional on time effects γ_t and LLM effects g_i, uncorrelated with payments in all time periods. However, there may be non-linear trends that would require introducing additional interactions between the LLM fixed effects and higher order time trends in the regression, which is not feasible given the short length of our panel. So we also exploit a different strategy, based on our set of time-invariant covariates f_i' (see footnote 6). We introduce them in a year-to-year regression and we also interact them with a linear time trend t and its square. This allows for linear and quadratic trends that depend on these pre-determined variables:

$$\Delta\Phi_{it} = \delta\ln(s_{it}) + \gamma_t + f_i'\omega_1 + t \times f_i'\omega_2 + t^2 \times f_i'\omega_3 + \Delta\varepsilon_{it} \qquad (4b).$$

Due to the high-dimensionality of the model (4b), we have again adopted the LASSO "double selection" strategy of Belloni et al. (2014) to estimate its parameters.

5 Baseline results

Table 2 reports the estimates of coefficient δ in equation (1) for Southern LLMs, which represents the effect of the ERDF programs on local TFP. Our baseline specification in column 1 includes the subset of covariates selected using Belloni et al. (2014) "double selection" strategy among the set of variables described in Section 4. Appendix II illustrates the controls selected by the LASSO procedure for the specifications of Table 2. In column 2, we include initial (2007) productivity, to explicitly account for a convergence mechanism in TFP growth,[7] and in column 3 we also add a set of regional fixed effects.[8] In column 4, as a further check, we augment our set of LASSO potential covariates with their squared terms and pairwise interactions (for a total of about 6,500 variables). Our estimates of coefficient δ are not statistically different from zero in any specification considered; this suggests that the ERDF programs had no appreciable impact on local TFP.

To corroborate this evidence, we conduct an extensive list of robustness checks reported in Tables 3 and 4. To check whether the result is guided by our sample choice, we first repeat the analysis on the entire country (Table 3, panel A); we then restrict the attention only to "Convergence Objective" regions (panel B).[9] One additional concern is that our time window includes the very large 2008-2009 decline in both economic activity and TFP documented, among others, by Ciani et al. (2019); to account for this issue, we shorten our estimation window to the years 2010-2015 (panel C). Finally, since a large part of expenditure is concentrated between 2013-15 and its effect could materialize in the following years, we also extend the time horizon by considering TFP growth between 2007 and 2017 (panel D). In all these cases our results are confirmed.

In Table 4 we explore to what extent our results are robust to measuring local TFP in alternative ways. In panel A, we replicate our analysis weighing TFP with firms' value added rather than use unweighted means. We notice that this measure, although being more representative of the aggregate productivity dynamics, may suffer more severely from the absence of establishment-level data, compared to the unweighted average. In panel B, we use the TFP measure obtained when the number of employees is chosen as a measure for labor input; this measure presents some advantages over labor costs (it does not require special treatments, e.g. deflation, nor is it affected by the cost of living) but it may be less suitable to account for labor quality and intensity (see, e.g., Fox and Smeets, 2011, and Irarrazabal et al., 2013). In panel C, we use TFP data derived from distinguishing between blue-collar and white-collar workers in the labor input of the TFP equation. In panel D, we use TFP data derived from using as proxy for the capital input the estimates of total capital (both tangible and intangible) obtained by Lenzu and Manaresi (2017) using the perpetual inventory method, rather than the book value of tangible assets. Finally, in panel E, we replicate the analysis approximating firms'

[7] More specifically, we applied the LASSO estimator to the following growth equation: $\Delta\Phi_i = \delta \ln(s_i) + \Phi_{iT} + \beta_0 + f_i'\omega + \Delta\varepsilon_i$, where the change in outcome is taken to be related to the initial level of productivity (i.e. at time T=2007). The convergence term is not penalized in the LASSO procedure; as a result, it is always included among the predictors in our equation of interest.

[8] This specification allows us to capture the effect of unobservable local dynamics common to LLMs in a region.

[9] As mentioned in Section 3, "Convergence Objective" Southern regions are Apulia, Basilicata, Calabria, Campania and Sicily, whereas Abruzzo, Molise and Sardinia are classified as "Competitiveness Objective" regions, along with the Centre-North regions.

productivity with value added per employee rather than TFP. For all these sensitivity checks, our results always confirm that local productivity dynamics do not show any association with ERDF spending.

Finally, Table 5 shows our panel data results. More in details, Columns 1-3 and 4-6 report, respectively, the estimates obtained from models (4a) and (4b) using 0, 1 or 2 lags. Even in this case, our estimates fail to point to any significant effect of ERDF programs on the TFP of manufacturing firms, both when considering contemporaneous spending and when its lags are included in the model.[10]

6 Decomposing the impact of policy

6.1 Types of intervention

Until now, we have ignored the nature of expenditure promoted by ERDF programs. In particular, during the programming cycle 2007-2013, 54 per cent of expenditure was devoted to infrastructure spending, while 20 per cent was used to grant firm subsidies (the rest is mainly related to purchase of goods and services by the public administration). On a theoretical perspective, both of these types of expenditure could have positive effects on TFP: in the first case through increasing the stock of public capital, in the second case by stimulating research and innovation, or the investment in technology and other productive capital.

Table 6 shows the results obtained applying our empirical model separately to cumulate spending in public work and to firm subsidies separately. There is supportive evidence in favor of a positive effect of the infrastructure investment realized by ERDF programs on the change in TFP of manufacturing firms: our estimate suggest that a 10 percent increase in ERDF spending on infrastructure led to a 0.3 percentage average increase in TFP. To the contrary, money transferred to firms in the form of grants and subsidies seems to have had a negligible impact on productivity. Of course, we cannot exclude that the amount of money spent in subsidies had some significant effect for the pool of targeted firms. Nevertheless, the economic return of this expenditure is nil if estimated

[10] One may be concerned that the allocation of funds may be influenced by previous productivity levels. To address this concern, we have re-estimated our models including both lags and leads of ERDF expenditure. This allows us to rule out the possibility of reverse causality: a zero estimated coefficient in the OLS regression of model (1) could be compatible with $\delta > 0$ and $cov(\Delta\varepsilon_i, \Delta s_i) < 0$ (or vice versa), i.e. with the presence of some shock in TFP that generated a variation in the amount of ERDF funds disbursed to the municipalities in the LLM. The results (available upon request) show no significant inter-temporal relation between TFP and ERDF funds; in particular, we do not find any significant relationship between TFP dynamic in period t and funds in the following couple of years.

at the macro (LLMs) level. As further evidence, Table 6 (Columns 3-4) shows that there is no association between TFP dynamics and either the purchase of goods and services by the public administration or the expenditure for promoting employment and social inclusion by the ESF programs.

We have also estimated the policy effect at different points of the distributions of TFP across LLMs. In particular estimates reported in Table 7 show that infrastructure investment realized by ERDF promoted TFP growth along the entire distribution of productivity growth, which explains the positive overall effect described in the previous paragraph. On the contrary, public procurement and firm subsidies were effective in fostering TFP growth only among the LLMs displaying the most sluggish TFP dynamics, leading to an insignificant overall average effect.

6.2 Heterogeneity by area characteristics

Estimates in Section 5 focus on the average effect of ERDF programs in the overall sample of LLMs. Now we move to verify if there is some relevant heterogeneity due to differential trends for different groups of LLMs. In Table 8, we test for the presence of interactions between ERDF spending and a some socio-economic characteristics of LLMs.

A first feature is the quality of local institutions. As suggested by an increasing literature (see, for instance, Becker et al., 2013; Rodríguez-Pose and Garcilazo, 2015), institutional quality at the local level seems to be one of the main drivers of the effectiveness of cohesion policy in Europe and Italy. The measure of institutional quality that we adopt in this paper is the Institutional Quality Index (IQI) index proposed by Nifo and Vecchione (2014). The index is a synthetic indicator of institutional quality in Italian provinces for the period 2004-2012, based on a large set of elementary indexes grouped into five dimensions (voice and accountability, government effectiveness, regulatory quality, rule of law, corruption).[11] Our results confirm the evidence found in the previous literature: Column 1 suggests in fact that areas characterized by higher institutional quality experiences a more sustained TFP dynamic.

Secondly, the effect of ERDF programs on TFP could vary with the characteristics of the local productive system. In this regard, Di Giacinto et al. (2014) document for Italy different trends of local productivity between industrial districts and urban areas, with a gap in favor of the latter group. Similarly, Columns 2-4 show that ERDF expenditure in more urbanized areas, as measured by their

[11] For more technical details, see Nifo and Vecchione (2014)

population density, reap a significantly larger productivity gain than that devoted to less urbanized areas, while the association between ERDF intervention and TFP dynamics is nil for any degree of industrial specialization (measured by the share of manufacturing workers to total employment or by the presence of an industrial district).

More in detail, Table 9 expands this analysis, considering the three categories of ERDF expenditure in turn. In Columns 1-3 we show that the quality of local institutions matters especially for the effectiveness of spending for public works. In the Columns 4-6 we focus on the role played by the degree of urbanization and find that it is particularly conducive to productivity gains in the case of incentives.

7 Concluding remarks

The impact of place-based policies on local outcomes has been heavily investigated, but mainly with reference to the factors of production: labor and capital. Few studies have looked at the effect on TFP, which is however a key economic variable as it explains the bulk of the differences in income levels across areas and reflects all the local impediments to growth. Cohesion policy has the objective of tackling exactly these sorts of impediments. Moreover, estimating the impact of this policy on TFP provides useful complements to the existing estimates on labor and capital outcomes, which might underestimate the policy impact in case of labor- or capital-saving productivity improvements. The reason why TFP is not a standard outcome for (cohesion) program-evaluation exercises is that this unobserved variable must be estimated through model-based techniques on firm-level data. The availability of such data has allowed us to provide a first assessment, which refers to the lagging areas of the south of Italy.

Our results suggest that local TFP growth was on average rather unresponsive to the European financing. In an investigation of heterogeneous effects, we find that the ineffectiveness of the policy is related to composition issues, since we can detect a positive effect only for half of ERDF expenditure which is devoted to infrastructure investments. We also show that some characteristics of local context, such as institutional quality and the existing degree of urbanization, do matter.

Tables and figures

Figure 1: Map of "Competitiveness Objective" regions and "Convergence Objective" regions.

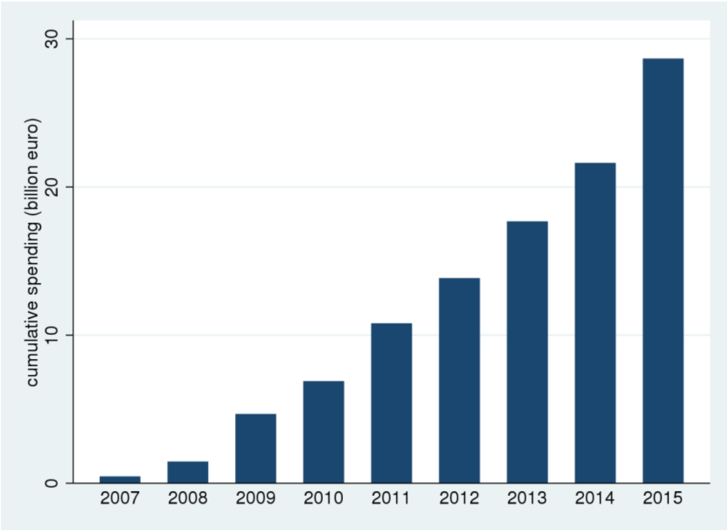
Notes: The figure also reports the names of bordering "Competitiveness Objective" regions and "Convergence Objective" regions.

Table 1. Descriptive statistics on ERDF programs and TFP, Southern Italy LLMs

	Mean	Std	Min	Max	Obs
TFP average 2007-15 growth	0.049	0.265	-1.067	1.783	286
Cumulate 2008-15 per-capita payments	1,271.3	724.2	100.9	4,726.8	286
Log Cumulate 2008-15 per-capita payments	6.95	0.72	4.61	8.46	286

Notes: The TFP average growth over 2007-15 is calculated as change in log-level.

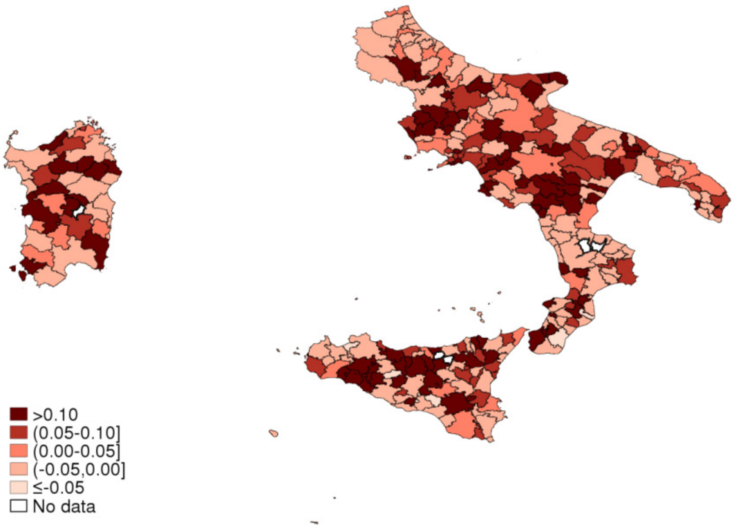
Figure 2: ERDF 2007-2013 programs, cumulative spending, Southern Italy



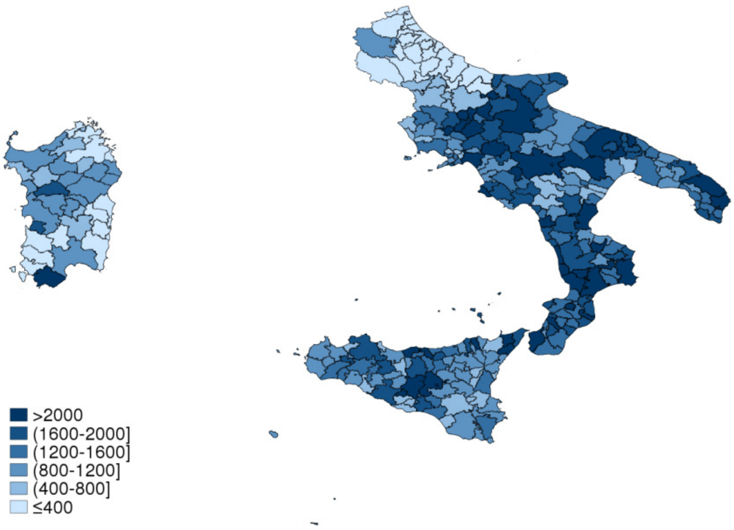
Notes: Expenditure by ERDF 2007-2013 programs in Southern Italy (EU funds plus national co-funding). Data are taken from Opencoesione website.

Figure 3: TFP change and spending, Southern Italy LLMs

Panel A: TFP Growth 2007-2015



Panel B: ERDF 2007-2013 programs



Notes: Panel A: 2007-2015 change in (log) TFP of manufacturing firms. Own elaborations on Cerved Group data. Panel B: cumulative expenditure per-capita by ERDF 2007-2013 programs (EU funds plus national co-funding), to total population in 2007. Population from Istat intercensus reconstruction, expenditure from Opencoesione website.

Table 2. The effect of ERDF programs, Southern Italy, 2007-2015

	(1)	(2)	(3)	(4)
ln(cumulate pc spending 08-15)	0.018	0.016	0.024	0.020
	(0.024)	(0.019)	(0.028)	(0.026)
Lasso Covariates	Basic	Basic	Basic	Augmented
Initial Log-Level TFP	N	Y	Y	Y
Regional FE	N	N	Y	Y
Number of observations	286	286	286	286

Notes: The unit of observation is the LLM. The dependent variable is the change 2007-2015 in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1; in Column 4, squared terms and pairwise interactions are included. Columns 2-4 include the (log) average TFP in 2007. Columns 3-4 include regional fixed effects. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 3. The effect of ERDF programs, robustness checks

	(1)	(2)	(3)	(4)
	Panel A: Italy			
ln(cumulate pc spending 08-15)	0.006	0.002	-0.001	-0.002
	(0.007)	(0.007)	(0.008)	(0.008)
Number of observations	673	673	673	673
	Panel B: "Convergence Obj." regions			
ln(cumulate pc spending 08-15)	-0.043	-0.037	0.006	0.006
	(0.039)	(0.035)	(0.033)	(0.033)
Number of observations	223	223	223	223
	Panel C: 2010-2015			
ln(cumulate pc spending 11-15)	0.024	0.020	-0.001	-0.001
	(0.019)	(0.017)	(0.024)	(0.024)
Number of observations	286	286	286	286
	Panel D: 2007-2017			
ln(cumulate pc spending 08-15)	0.012	0.010	0.013	0.017
	(0.021)	(0.015)	(0.022)	(0.020)
Number of observations	285	285	285	285
Lasso Covariates	Basic	Basic	Basic	Augmented
Initial Log-Level TFP	N	Y	Y	Y
Regional FE	N	N	Y	Y

Notes: The unit of observation is the LLM. The dependent variable is the change in the log average TFP of manufacturing firms (the reference period is: 2007-2015 in Panels A-B; 2010-2015 in Panel C; 2007-2017 in Panel D). Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1; in Column 4, squared terms and pairwise interactions are included. Columns 2-4 include: the (log) average TFP in 2007; Columns 3-4 include regional fixed effects. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 4. The effect of ERDF programs, alternative TFP measures

	(1)	(2)	(3)	(4)
	Panel A: TFP weighted by value added at firm level			
ln(cumulate pc spending 08-15)	0.007	0.012	0.015	0.003
	(0.031)	(0.026)	(0.045)	(0.043)
Number of observations	286	286	286	286
	Panel B: Labor input equal to the number of employees			
ln(cumulate pc spending 08-15)	0.023	0.013	0.038	0.039
	(0.027)	(0.025)	(0.038)	(0.035)
Number of observations	286	286	286	286
	Panel C: Distinction between blue-collar and white-collar workers			
ln(cumulate pc spending 08-15)	0.040	0.020	0.055	0.040
	(0.028)	(0.023)	(0.040)	(0.036)
Number of observations	286	286	286	286
	Panel D: Capital input based on the permanent inventory method			
ln(cumulate pc spending 08-14)	0.015	-0.001	0.023	0.005
	(0.019)	(0.018)	(0.033)	(0.027)
Number of observations	275	275	275	275
	Panel E: value added per worker			
ln(cumulate pc spending 08-15)	0.014	0.000	0.037	0.020
	(0.025)	(0.024)	(0.039)	(0.037)
Number of observations	286	286	286	286
Lasso Covariates	Basic	Basic	Basic	Augmented
Initial Log-Level TFP	N	Y	Y	Y
Regional FE	N	N	Y	Y

Notes: The unit of observation is the LLM. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. In Panel A the average (log) TFP is weighted by value added at firm level. In Panel B labor input in TFP estimates is the number of employees. In Panel C labor input in TFP estimates distinguishes between blue-collar and white-collar workers. In Panel D capital input in TFP estimates is based on the permanent inventory method (available until 2014 only). In Panel E the dependent variable is the log value added per worker of manufacturing firms. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1; in Column 4, squared terms and pairwise interactions are included. Columns 2-4 include: the (log) average TFP in 2007 in Panels A-D; the (log) average TFP in 2010 in Panel C; the (log) value added per worker in 2007 in Panel E. Columns 3-4 include regional fixed effects. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 5. The effect of ERDF programs, panel estimates

	(1)	(2)	(3)	(4)	(5)	(6)
ln(annual pc spending)$_t$	-0.012*	-0.014*	-0.010	-0.005	-0.010*	-0.008
	(0.007)	(0.007)	(0.008)	(0.003)	(0.006)	(0.006)
ln(annual pc spending)$_{t-1}$		0.005	-0.001		0.007	-0.002
		(0.006)	(0.008)		(0.005)	(0.008)
ln(annual pc spending)$_{t-2}$			0.009			0.009
			(0.007)			(0.007)
Estimation method	FE	FE	FE	LASSO	LASSO	LASSO
Number of observations	2289	2289	2005	2289	2005	2289

Notes: The unit of observation is the LLM. The dependent variable is the annual change in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Columns 1-3 include year fixed effects and LLM fixed effects. In Columns 4-6, estimates always include year fixed effects; additional controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1, and their pairwise interactions with linear and quadratic trends. Standard errors clustered for LLM in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 6. The effect of ERDF programs in Southern Italy by expenditure type

	(1)	(2)	(3)	(4)
ln(cumulate per capita spending 08-15)	0.005	0.028**	-0.028	-0.003
	(0.022)	(0.014)	(0.019)	(0.044)
Expenditure type	Firm subsidies	Infra-structures	Purchase of goods and services	ESF expenditure
Number of observations	286	286	286	286

Notes: The unit of observation is the LLM. The dependent variable is the change 2007-2015 in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per capita values are calculated using always population in 2007. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 7. The effect of ERDF programs, quantile regressions

	(1)	(2)	(3)	(4)
Q10	0.042*	0.042*	0.039***	0.051**
	(0.023)	(0.022)	(0.015)	(0.025)
Q25	0.049***	0.044**	0.029**	0.049**
	(0.014)	(0.017)	(0.012)	(0.022)
Q50	0.024	0.011	0.023**	-0.001
	(0.019)	(0.020)	(0.012)	(0.017)
Q75	0.039	-0.003	0.039**	-0.025
	(0.026)	(0.019)	(0.016)	(0.023)
Q90	-0.011	-0.042	0.066*	-0.093*
	(0.080)	(0.050)	(0.037)	(0.055)
Expenditure type	All	Firm subsidies	Infra-structures	Purchase of goods and services
Number of observations	286	286	286	286

Notes: Quantile regressions. The unit of observation is the LLM. The dependent variable is the change 2007-2015 in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Controls are those selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1. Bootstrapped standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 8. The effect of ERDF programs, heterogeneous effects

	(1)	(2)	(3)	(4)
ln(cumulate pc spending 08-15)	-0.002	0.010	0.012	0.022
	(0.026)	(0.028)	(0.030)	(0.023)
ln(cumulate pc spending 08-15) X Quality of Institutions	0.040**			
	(0.019)			
ln(cumulate pc spending 08-15) X Share of manufacturing		0.000		
		(0.000)		
ln(cumulate pc spending 08-15) X Industrial district			0.032	
			(0.036)	
ln(cumulate pc spending 08-15) X Urbanization (pop density)				0.009**
				(0.005)
Number of observations	286	286	286	286

Notes: The unit of observation is the LLM. The dependent variable is the change 2007-2015 in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Table 9. The effect of ERDF programs, heterogeneous effects by expenditure type

	(1)	(2)	(3)	(4)	(5)	(6)
ln(cumulate pc spending 08-15)	-0.006	-0.001	-0.039*	0.014	0.023	-0.016
	(0.020)	(0.019)	(0.021)	(0.021)	(0.014)	(0.019)
ln(cumulate pc spending 08-15) X Quality of Institutions	0.047*	0.055**	0.036			
	(0.024)	(0.024)	(0.024)			
ln(cumulate pc spending 08-15) X Urbanization (pop density)				0.012**	0.010*	0.094*
				(0.005)	(0.005)	(0.062)
Expenditure type	Firm subsidies	Infra-structures	Purchase of goods and services	Firm subsidies	Infra-structures	Purchase of goods and services
Number of observations	286	286	286	286	286	286

Notes: The unit of observation is the LLM. The dependent variable is the change 2007-2015 in the log average TFP of manufacturing firms. Data on spending come from OpenCoesione; the per-capita values are calculated using always population in 2007. Controls have been selected using the "double selection" of Belloni et al (2014) among the set of covariates in Table A1. Robust standard errors in parentheses. * p<.10 ** p<.05 *** p<.01.

Appendix I - Building TFP at LLM level

TFP at the LLM level (Φ_i) is obtained aggregating firm-level TFP, borrowed from the work of Ciani et al. (2019). They consider a Cobb-Douglas production function, which expresses the maximum quantity of a good produced by firm i at time t as a multiplicative function of productive inputs:

$$VA_{it} = \omega_{it} K_{it}^{\beta_K} L_{it}^{\beta_L} e^{\epsilon_{it}} \qquad (A1),$$

where production is approximated by value added (VA) and capital (K) and labor (L) inputs are approximated by tangible assets and labor costs respectively (Ciani et al., 2019, consider the use of alternative proxies. For a detailed discussion about the choice and the treatment of the variables used for the estimation, please refer to Ciani et al., 2019. Here we adhere to their favorite specification). All data are taken from the archives of Cerved Group and deflated with the sector-specific deflator of the value added. Parameters β_K, β_L are estimated from a log-specification of the production function:

$$\ln(VA_{it}) = \beta_K \ln(K_{it}) + \beta_L \ln(L_{it}) + \ln(\omega_{it}) + \epsilon_{it} \qquad (A2)$$

following the methodology proposed by Levinsohn and Petrin (2003), which allows to account for the simultaneity between productivity shocks and the choice of the amount of labor input. TFP is computed as the exponent of the residual:

$$\widehat{\omega_{it}} = e^{\ln(VA_{it}) - \widehat{\beta_K} \ln(K_{it}) - \widehat{\beta_L} \ln(L_{it})} \qquad (A3).$$

Appendix II - Lasso covariates

Table A1 Descriptive statistics of Lasso covariates (obs=286)

	Mean	Std	Min	Max
Population (thousands inh.)	71.5	169.9	4.7	2444.2
Pop density	220.3	373.9	14.0	3592.2
Participation rate	43.0	3.1	32.0	52.3
Unemployment rate	21.3	6.2	7.1	39.8
Employment rate	33.9	4.3	22.8	44.9
Latitude	39.8	1.6	36.7	42.9
Longitude	14.5	2.3	8.3	18.4
Altitude	374.1	238.9	6.0	1185.4
Coastal location	0.5	0.5	0.0	1.0
Provincial capital	0.2	0.4	0.0	1.0
N. noprofit orgs per capita	3.3	1.3	0.0	8.4
N. of graduate people over adult population	0.1	0.0	0.0	0.1
Institutional quality	0.4	0.2	0.0	0.7
N. of bank office per 1,000 inh	0.4	0.1	0.1	1.1
Industrial district	0.1	0.3	0.0	1.0
Share Nace 01	0.4	0.6	0.0	5.7
Share Nace 02	0.2	1.1	0.0	16.8
Share Nace 05	0.6	1.4	0.0	11.7
Share Nace 10	0.0	0.2	0.0	4.0
Share Nace 11	0.0	0.2	0.0	2.9
Share Nace 13	0.0	0.2	0.0	2.5
Share Nace 14	0.4	1.0	0.0	12.8
Share Nace 15	3.4	2.1	0.9	21.1
Share Nace 16	0.0	0.3	0.0	3.9
Share Nace 17	0.9	2.1	0.0	15.2
Share Nace 18	1.8	3.3	0.0	23.4
Share Nace 19	0.6	2.9	0.0	37.4
Share Nace 20	1.1	1.2	0.2	19.2
Share Nace 21	0.2	0.4	0.0	3.5
Share Nace 22	0.3	0.4	0.0	4.4
Share Nace 23	0.1	0.8	0.0	10.1
Share Nace 24	0.4	1.2	0.0	12.8
Share Nace 25	0.5	0.9	0.0	8.2
Share Nace 26	1.5	1.4	0.0	9.8
Share Nace 27	0.2	1.1	0.0	12.8
Share Nace 28	2.1	1.5	0.3	8.7
Share Nace 29	0.6	0.8	0.0	4.9
Share Nace 30	0.0	0.1	0.0	0.6
Share Nace 31	0.4	1.0	0.0	11.1
Share Nace 32	0.3	0.8	0.0	7.7
Share Nace 33	0.2	0.3	0.0	2.5
Share Nace 34	0.5	2.6	0.0	33.3

Table A1 (Continue)

	Mean	Std	Min	Max
Share Nace 35	0.2	0.7	0.0	8.0
Share Nace 36	0.7	1.3	0.0	11.6
Share Nace 37	0.0	0.1	0.0	0.5
Share Nace 40	0.6	1.2	0.0	17.7
Share Nace 41	0.2	0.9	0.0	12.3
Share Nace 45	10.5	3.7	3.6	26.8
Share Nace 50	3.0	0.9	0.7	8.2
Share Nace 51	3.3	1.9	0.5	14.8
Share Nace 52	12.3	2.5	5.5	21.1
Share Nace 55	5.4	5.0	1.5	37.8
Share Nace 60	2.5	1.4	0.5	12.8
Share Nace 61	0.0	0.2	0.0	2.3
Share Nace 62	0.0	0.3	0.0	4.8
Share Nace 63	0.9	1.3	0.0	12.6
Share Nace 64	1.3	0.5	0.5	4.0
Share Nace 65	1.2	0.4	0.4	2.6
Share Nace 66	0.0	0.0	0.0	0.5
Share Nace 67	0.5	0.2	0.0	1.1
Share Nace 70	0.3	0.4	0.0	3.4
Share Nace 71	0.1	0.2	0.0	1.7
Share Nace 72	0.6	0.4	0.0	3.3
Share Nace 73	0.2	0.6	0.0	9.4
Share Nace 74	5.6	2.1	1.7	20.9
Share Nace 75	6.7	3.0	1.2	21.1
Share Nace 80	15.1	5.0	5.1	38.6
Share Nace 85	8.1	4.4	1.0	32.5
Share Nace 90	0.6	0.6	0.0	4.1
Share Nace 91	0.4	0.4	0.0	2.8
Share Nace 92	0.9	0.7	0.0	7.0
Share Size 1-2	25.4	14.8	3.0	79.7
Share Size 3-5	16.4	7.8	2.6	43.1
Share Size 6-9	11.6	5.1	0.0	28.2
Share Size 10-19	14.3	6.9	0.0	47.7
Share Size 20-49	13.7	9.3	0.0	44.3
Share Size 50-99	6.5	7.7	0.0	42.3
Share Size 100-199	4.2	7.0	0.0	41.4
Share Size 200-499	4.6	10.2	0.0	65.0
Share Size 500-999	1.5	6.0	0.0	58.9
Share Size 1000+	1.9	7.8	0.0	56.5

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