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LABOR MARKET SPILLOVERS OF A LARGE PLANT OPENING. EVIDENCE FROM THE OIL INDUSTRY

by Matteo Alpino*, Irene Di Marzio**, Maurizio Lozzi** and Vincenzo Mariani**

Abstract

We study the labor market spillovers of the opening of a large oil extracting facility in a peripheral area of the South of Italy, focusing on the time when the physical investment was made, before production took off and royalties started flowing in. Using firm-level administrative data covering the universe of non-farm businesses in a difference-in-differences design, we find large positive effects on firm-level employment and positive, albeit smaller, effects on wages per employee. Within-firm employment gains are geographically localized and are concentrated in the upstream sector (not only in manufacturing) and among the largest firms; however the number of firms declines. Aggregate results obtained using census data show that the overall employment effect in the area is slightly positive.

JEL Classification: J21, L71, O13, R11.
Keywords: oil, local labor markets, plant opening, natural resource
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Contents

* Bank of Italy, Directorate General for Economics, Statistics and Research; **Bank of Italy, Economic Analysis and Research Unit, Bari Branch.

1 Introduction[1]

The opening of a large industrial plant often leads to an increase in local employment above and beyond the workers directly employed on the new site (Greenstone and Moretti, 2003; Monte et al., 2018); similar effects are found for the establishment of a large extraction facility (Aragón and Rud, 2013). In both cases employment gains are usually concentrated among incumbent firms that are geographically and economically close (i.e. in a buyer/supplier relationship or relying on similar technologies and workers) to the new entrant (Greenstone et al., 2010; Allcott and Keniston, 2018). Less is known on how local firms of different size and productivity are affected by the opening, although it seems reasonable that larger and more productive incumbents should be better equipped at accommodating the surge in demand prompted by the new entrant, pretty much in the same way as this type of firms is better equipped at accessing export markets and thus reap benefits from trade integration (Bernard et al., 2007; Melitz, 2003).

In this paper we provide new evidence on these issues. We focus on the opening of an oil extraction center in a remote area of the South of Italy (Val d'Agri, Basilicata) that hosts the largest oil reserves in Europe and we study its consequences on local firms in terms of employment and payroll. The richness of our administrative data, covering the universe of non-farm private businesses in the period since 1990, allows us to estimate heterogeneous effects in terms of sector, exposure to the oil industry, firm size, workforce composition and geographic location. Availability of data on construction and services is important, because most previous studies focused only on manufacturing, while a new industrial plant might generate demand also in other sectors. Notably, we study the time when the oil industry was first established in the area, before extraction and royalties took off; our estimates thus only refer to the initial physical capital investment (cumulatively 15 per cent of the annual regional GDP).

[1]For comments we are grateful to Antonio Accetturo, Giuseppe Albanese, Gaetano Basso, Luca Citino, Domenico Depalo, Andreas Kotsadam, Halvor Mehlum, Litterio Mirenda, Sauro Mocetti, Filippo Scoccianti, Luca Sessa and Wessel Vermeulen. We thank Roberto Iacono for sharing data on oil production for early years, Luca Citino and Andrea Linarello for their help with the INPS data and Mariangela Grosso and Vittoria Roppo for valuable research assistance. All errors are our own.

From an econometric standpoint, we rely on difference-in-differences and event-study designs that compare firms located close to the plant to those further away around the time of the establishment of the oil industry; a similar strategy is used by Aragón and Rud (2013) to study the impact of a large gold mine in Peru on households.

We find that the opening had positive effects on employment at the firm-level: on average 1 more employee per firm, corresponding to a 30 per cent increase. Interestingly, the effects are much larger both in absolute and relative terms the larger the initial size: firms with more than 50 employees increase employment by more than 50 per cent, firms with less than 5 employees by only 2 per cent. Moreover, the share of small firms (up to 5 employees) in the local economy declines. In line with previous evidence, the estimated effects are very localized, and dissipate for businesses located more than 30 minutes away from the oil fields. The increase in employment concerns all economic sectors, but it is particularly strong in industries that sell a large share of their output to oil & gas companies. Remarkably, these upstream firms are not only manufacturers, but also belong to services.

We also explore the aggregate employment effect of the opening. To do so, we use data at the municipal level from the population census, that contains also information on self-employed, public employees and farmers. Total employment rate increases by 1 percentage point more in the oil commuting zone than in the surrounding local labor markets, and the effect is entirely driven by female employment. Thus the large firm-level increase does not translate into a sizable aggregate effect, likely because the number of private firms (especially large ones) is small and declining.

Taken together, our two pieces of evidence suggest that the opening triggered a reallocation of labor towards companies that were able to accommodate the demand generated by the new plant thanks to their geographical position, integration in the oil & gas value chain, or initial size. The finding that *size* complementarities matter is probably our most innovative contribution to the existing literature and might have interesting implications. Since large firms are on average more productive (Berlingieri et al., 2018; Brandolini and Bugamelli, 2009; Calligaris et al., 2016; Bugamelli et al., 2018), our results might imply that the opening of a large industrial establishment will increase total productivity by favoring a reallocation of labor towards more productive companies. Unfortunately, we are unable to test directly this effect due to lack of firm-level balance sheet data for our sample period, which would allow an estimation of firms' productivity.

Our findings are informative for policymakers who must decide whether to favor or limit the extraction of natural resources or to subsidize or discourage the opening of large capital-intensive plants. From a policy perspective, it is important to know what are the likely winners and losers of these demand shocks, and to highlight that employment gains are not evenly distributed across firms and sectors. In fact, many placed-based policies favor the settlement of large firms in lagging-behind areas but, in light of our findings, these interventions might be scarcely effective if the incumbent local firms are too small or economically distant from the new entrant.[2]

An important caveat is that our study is limited to the labor market effects of the initial physical investment to set up the extractive industry, thus our evidence must be combined with estimates of the health (e.g. due to accidents), environmental (e.g. due to pollution) and fiscal (e.g. due to royalties) externalities in order to carry on a complete cost-benefit assessment of the presence of the oil industry, which is beyond the scope of this work.

The rest of the paper is organized as follows: section 2 illustrates how our work fits into different strands of the literature; section 3 provides background information about oil extraction and the economic structure of Val d'Agri; section 4 sketches a simple conceptual framework to guide the empirical analysis; section 5 describes the data; section 6 reports the analysis at the firm-level, and section 7 the analysis at the aggregate level; finally, section 8 concludes.

[2] Accetturo and de Blasio (2019) review the effect of these policies in Italy for the last 25 years, finding scarce support in favor of their effectiveness.

2 Literature review

In line with Greenstone et al. (2010) and Monte et al. (2018), we investigate the causal effects of the establishment of a large industrial plant on the surrounding firms. Greenstone et al. (2010) find that the total factor productivity of incumbent plants is considerably higher in U.S. counties that attracted a large manufacturing plant relative to counties that did not experience this shock. Using the same data, Greenstone and Moretti (2003) and Monte et al. (2018) find that the opening of a large manufacturing plant increases the local employment and the wage bill, especially in counties whose local labor market has a higher degree of openness in terms of commuting. Contrary to these papers, we do not study a manufacturing plant but an extractive facility, whose location does not depend on the attractiveness of the local economy, but rather on the presence of natural resources.

Given our focus on the extractive industry, we also contribute to the strand of the literature concerned with estimating the local impact of natural resource discovery and exploitation on labor market outcomes (Van Der Ploeg and Poelhekke (2017), Cust and Poelhekke (2015), Aragón et al. (2015) and Marchand and Weber (2018)). This literature, building on previous research at the country level (see Van der Ploeg (2011) for a review), has more recently taken advantage of novel disaggreggated data to model natural resource extraction as a source of local demand shocks. The empirical evidence overwhelmingly shows that resource extraction increases both employment and earnings at the regional level in advanced countries (Black et al., 2005; Michaels, 2010; Marchand, 2012; Aragón and Rud, 2013; Basso, 2017). Munasib and Rickman (2015) add that the intensity of positive spillovers to non-extractive industries depends positively on the degree of economic isolation of the extraction area. In particular, we share similarities with Pelzl and Poelhekke (2020), who analyze the local effect of natural resource extraction on a panel of manufacturing plants in Indonesia and find that labor-intensive booms induce crowding out of employment in the non-mining sectors, while capital-intensive mining booms do not affect local wages but increase employment. Finally, the focus on the investment period differentiates us from most other studies in the natural resource literature, that usually exploit for identification the temporal variation in resource prices (Basso, 2017) or in national employment in the extractive sector (Allcott and Keniston, 2018).[3]

As we study the establishment of a capital-intensive industry in a depressed area of the South of Italy, we also relate to the extensive literature on place-based policies, particularly to the strand focusing on the evaluation of industrial policies and physical capital investments[4]. The establishment of the oil industry in Basilicata was not a consequence of an explicit policy deployed to develop a lagging-behind area, even if, during most of the considered period, ENI was a State-owned company.

Since our analysis pays particular attention to treatment effect heterogeneity with respect to firm characteristics, we contribute to the debate on how demand shocks affect firm selection, labor reallocation and agglomeration spillovers. In analogy with the existing empirical evidence, we study how treatment effects vary with both spatial and economic distance from the extractive facilities. Regarding the former, we relate to the literature recently reviewed by Rosenthal and Strange (2020), which highlights that agglomeration economies are highly non-linear over space and decline with distance. As for the latter, we follow the approach in Allcott and Keniston (2018) and examine how the treatment effect varies with respect to the firms' degree of upstreamness to the oil industry. Our results that firms which are economically closer to the entrant plant are more impacted by the local shock is in line with both theoretical predictions and a growing body of empirical evidence studying how shocks propagate through networks of firms (Greenstone et al., 2010; Giroud and Mueller, 2019; Siegloch et al., 2021). Furthermore, we investigate heterogeneity in terms of firm size, finding that the treatment alters firms composition. This result speaks to the literature in international trade on the heterogeneous effects of economic integration and predicts that this shock leads to inter-firm reallocation towards more productive firms within the same industry

[3]One exception is Carrington (1996) who studies the labor market consequences of the construction of the trans-Alaska oil pipeline.

[4]See Kline and Moretti (2014), Neumark and Simpson (2015), Duranton and Venables (2018) for detailed reviews of the literature and Criscuolo et al. (2019); Siegloch et al. (2021) for particularly relevant recent contributions

(Melitz, 2003; Melitz and Ottaviano, 2008).

3 Background

Location The present work focuses on Val d'Agri (the valley of the Agri river), a small area that hosts the richest on-shore oil field in Europe. In the period 2004-18 the oil extractions from the area accounted for 99 per cent of the regional oil production and 70 per cent of the national oil production. The valley is surrounded by mountains (see Figure 1) and, according to the classification proposed by the Agenzia per la Coesione territoriale (2014), its municipalities are classified either as peripheral or ultra-peripheral internal zones, that is, areas far from the main centers of provision of public services (e.g. secondary and tertiary schools, hospitals, high-speed railways). The oil plant is located in the valley floor, in the municipality of Viggiano.

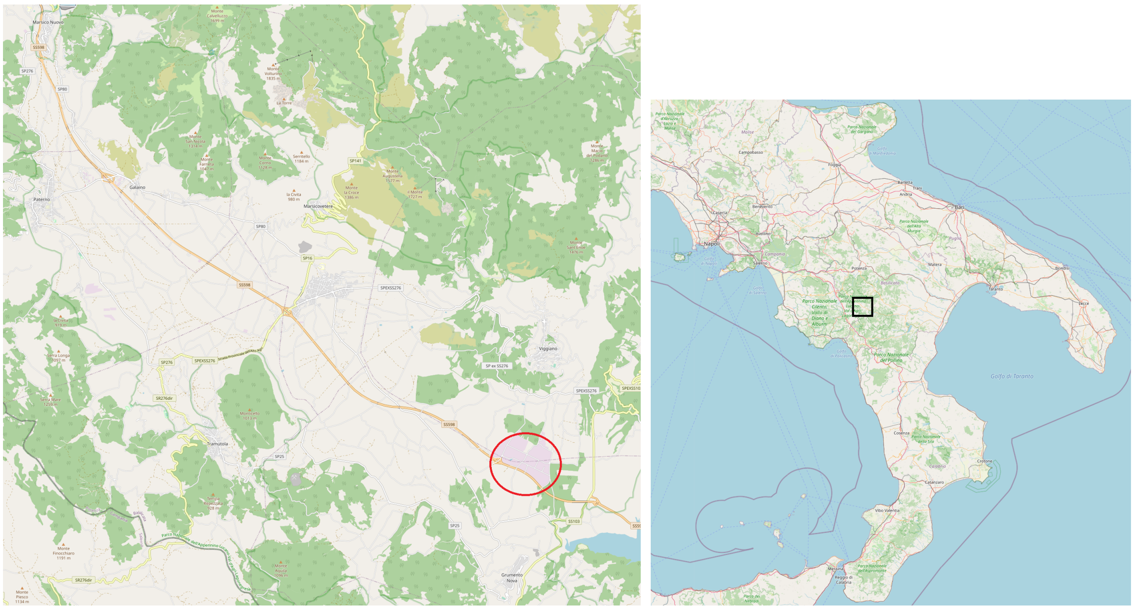
Val d'Agri is part of Basilicata, a small region (0.6 millions inhabitants) in the South of Italy.[5] Similarly to other regions in the South, Basilicata has a lower GDP per capita than the Italian average (approximately 12,000 euros per capita, or 70 per cent of the Italian average in 1995), and a lower employment rate (38 per cent versus 45 in Italy in 1995, as a share of population with 15 years or older).

History The discovery of oil in Val d'Agri dates back to 1926. However, at the time extraction was difficult due to the rugged terrain and the depth of the reservoirs, so the operations stopped after some drilling between 1936 and 1945. In the 1970s exploration resumed, driven by technological progress and by the rise in oil price. In 1990 the industrial development of the oil sector began: the Ministry of Industry granted to the oil company ENI three new mining concessions (later merged under the name "Val d'Agri"), covering approximately 660 squared kilometers.[6] At that time, ENI was a state-owned company, but was privatized in 1995, with the Italian treasury keeping control via a minority share. In 1996 ENI built the pilot treatment

[5] Basilicata is a NUTS 2 administrative region.

[6] The mining concession is a portion of land with well defined boundaries. It does not necessarily correspond to an administrative unit, and it can cut across administrative boundaries.

Figure 1: Geography of Val d'Agri (left) and its location in the South of Italy (right)



Source: Open Street Maps. Scale: 1:52,771 in the left panel; 1:1,678,047 in the right panel. Note: in the left panel, the red circle marks the location of the oil treatment center. Green areas are covered in forest. The grey regional border with Campania is visible in the south-west corner. In the right panel, the black square identifies Val d'Agri.

center in Val d'Agri, in the Viggiano municipality. The plant was operational since April and had a capacity of 7,500 barrels per day. Later that year, ENI requested the authorization to expand the plant, which was granted in 1999. At the end of 1998 ENI signed an exploitation agreement with the regional government, which included transfers and investments for 70 millions euro in 10 years. The new expanded plant was operational since 2001, with an additional treatment line added in 2002, and the final one in 2004. ENI also built a pipeline to carry the oil to the refinery in Taranto (150 kilometers away), operational since 2001. The new infrastructures increased the plant capacity by 14 times relative to the original pilot center. The overall investment by ENI amounted to roughly 1.5 billions euro (approximately 15 per cent of average regional annual GDP) according to Bank of Italy (2001). This magnitude roughly corresponds to the figures reported in the ENI balance sheet, where the attached documentation in the years between 1997 and 2000 reports the material immobilization in machinery and equipment specifically aimed at Val d'Agri; the scaling up of the investment over time is visible in Table 1.

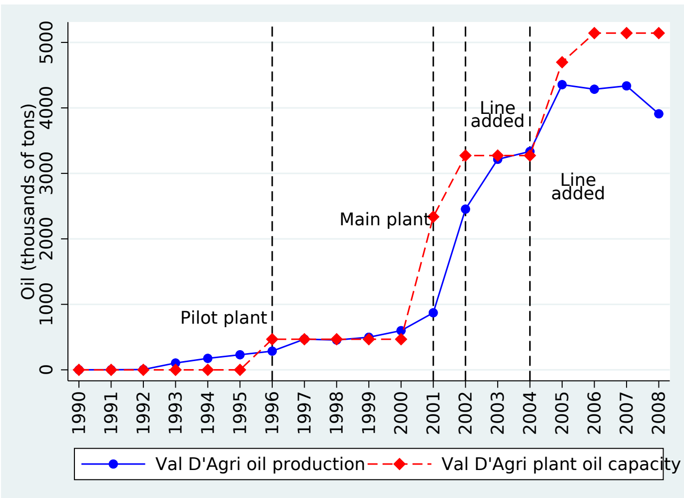
Table 1: Ongoing material immobilization in machinery and equipment by ENI in Val d'Agri

Year	Material investment (millions of euro)	Regional GDP (millions of euro)	Material investment (share of regional GDP)
1997	175.6	7,729.8	2.3
1998	300.6	8,088.5	3.7
1999	353	8,579.2	4.1
2000	475	8,825.4	5.4
Total	1,304.2		15.7

Source: ENI for data on material investments and Istat for data on regional (NUTS2) GDP. Note: the table reports only figures for the years between 1990 and 2001 where the note to the balance sheet reports explicitly the amount of material investments aimed at the oil infrastructures in Val d'Agri. Last line of the table reports the share of regional GDP calculated as the ratio of overall material investment to average regional GDP between years 1997-2000.

Oil production closely tracked the expansion of the treatment capacity of the plant in Viggiano (see figure 2). Through the 1990s production raised steadily, but remained at relatively low levels (0.5 millions tons in 1999). When the expanded plant started its operations, production took off (130 per cent annual growth in 2002). After some further increases in the following years, production stabilized at more than 4 millions annual tons in 2005.

Figure 2: Oil production and capacity in Val d'Agri



Source: Ministry of Development and ENI. Note: thousands of tons. Vertical lines correspond to major expansions of the production capacity: the construction of the pilot treatment center, its expansion, and the addiction of two new production lines.

Royalties and oil price Since 1997 oil production on-shore is subject to a 7 per cent tax rate calculated on its market value, and its revenues accrue mostly to the regional government[7]. Between 1990 and 2001, the oil price was fairly stable around 20 US dollars per barrel; the low price combined with the low production made the revenues from royalties very limited in this period[8]. Although the revenues are not earmarked, the regional government used its share to finance a development plan that targeted thirty municipalities; the first cycle of the program took place in the period 2003-2008, and had a budget of 350 millions euro. At the end of 2008, only 19 per cent had been effectively spent (Bank of Italy, 2009).

Previous research In spite of the fact that Val d'Agri holds the largest onshore oil field in Europe, the evidence on the effects of its exploitation on the local economy is scant. Percoco (2012) finds a small positive effect on the number of active firms in the area where the development plan was active, using a geographic RDD at the municipality level. Iacono (2016) uses the synthetic control method at the regional (NUTS2) level and finds no effect on real per capita GDP, employment and investment. Descriptive works by Bubbico (2016, 2019) argue that the impact on local employment is likely to be very small due to the capital-intensive nature of oil industry and to the weakness of local institutions. On the contrary, company reports argue that the local employment effects are significant (ENI, 2012).

4 Theoretical framework

Several recent contributions have adapted the spatial equilibrium framework by Moretti (2010) and Moretti (2011) to study the effects of local demand shocks on local labor

[7]The revenues from the royalties accrue for 30 per cent to the national level (which devoted it entirely to the regional administration since 1999), 55 per cent to the regional level, and 15 per cent to municipalities. The revenues generated by each specific mining concessions are distributed across the municipalities as follows: 20 per cent accrues to the municipalities where the main collection and treatment center is located (Viggiano in our case), and the rest to municipalities where oil fields are located (five in our cases), proportionally to the numbers of oil wells.

[8]In real terms the Brent price was equal to 28.6 2010 US dollars in 1990, to 31.9 in 2001 and to 91.4 in 2014, the last year in our sample.

markets (Greenstone et al., 2010; Aragón and Rud, 2013; Allcott and Keniston, 2018; Pelzl and Poelhekke, 2020). The same framework can be used to guide our analysis.

The main focus of our work is to study the employment effect of the establishment of an oil extraction facility, which can be interpreted as a local labor demand shock, and the heterogeneity of the effect in terms of firm characteristics. We study a capital intensive industry, so in principle the *direct* effect of the new plant on employment is expected to be small, because the oil company hires only few workers. The new establishment may increase demand for goods and services in the upstream sector, namely for those local firms selling goods and services to the oil company, thus increasing the demand for labor by the upstream sector (*first-order indirect* effect). This effect is likely sizable during the initial investment phase, that is the main focus of our analysis. To the extent that the *direct* and *first-order indirect* effects increased employment and that the average real wage does not decline (for example due to an increase in local prices such as housing), then the purchasing power of the local population increases, and thus spending as well. This would translate into a raise in local labor demand, as long as the propensity to consume locally-produced good is high enough. This *second-order indirect* effect would thus reinforce the *first-order indirect* one. Notably, the positive labor demand shock may well involve responses both at the extensive margin (employment) and at intensive margin (hours worked). The effect at the intensive margin is expected to be particularly relevant in the short run, because hours can be adjusted more quickly than employment (Rosen, 1968; Becker, 1962).

In this work, we also study the effect on wages. According to the model by Moretti (2011), a labor demand shock will increase salaries, because it reduces the monopsony power of firms (Manning, 2003): the upward pressure on wages is higher the more the labor supply is inelastic across areas, and the less workers are substitutable across sectors (due to migration from other locations and reallocation from other sectors). Those predictions are derived from full-employment models, that effectively assume away involuntary unemployment. However, the Italian context is characterized by high unemployment and high wage rigidity, with unions negotiating sector-specific wages that are very similar across regions and firms. Wages in national contracts are typically set close to the equilibrium level in Northern regions, where firms are more productive than in the South (Bodo and Sestito, 1994). Decentralized firm-level bargaining is allowed, but very rare in the South and more frequent in large firms in the North, which contributes to create a small wage gap across areas (Casadio, 2010). These features imply that in the South increases in labor demand do not translate into higher wages (which are not flexible, and are already above the market-clearing level (Accetturo et al., 2022)), but rather into higher employment, drawing from the reserve of unemployed workers (Boeri et al., 2021). Empirically, this results in a low sensitivity of wages to shocks in Italian labor markets, especially in the South (Ciani et al., 2019).

5 Data

Social security data The analysis at the firm level is based on administrative microdata from the National Social Insurance Institute (INPS), covering all private sector firms (except agriculture) with at least one employee in a month of the year.[9] The frequency is at annual level and the sample covers the period from 1990 to 2014. In the data, the observational unit corresponds to a social insurance position at INPS. In each year, a single social position (observation) is associated to a firm, but some firms have multiple social positions per year. This is due to administrative reasons, related for instance to the distinction of employees with different national contracts or to the presence of multiple local autonomous administrative units of the same firm. For each social insurance position, we have information on the number of employees for different job positions (blue collars, white collars, apprentices, managers, not classified), together with information on the total payroll. Dividing this by the number of employees we obtain a measure of gross wage per worker. Given that we observe average annual employment, the smallest social insurance position has employment equal to 1/12 (i.e. one employee in a single month of a given year). The data in-

[9]For an example of recent research using this data see Citino and Linarello (2022).

clude information on the industry (available as 2-digits ATECO code, corresponding to 2-digits NACE) and location at the municipal level.

First, we select social insurance positions located in four provinces (NUTS 3): Potenza (where the oil fields are) and the three neighboring provinces of Matera, Salerno and Cosenza.[10] Second, we aggregate variables at the firm level assuming that the location and the industry of each firm coincides with the observation with highest employment; in our sample, the share of multi-position firms is 4 per cent. Finally, we drop firms that change municipality within our time period (approximately 3 per cent). The final sample is thus an unbalanced panel of firms, because of entry and exit in the market and/or in the sample area. A final note is warranted: the oil plant under investigation belongs to ENI, a large oil company with headquarter outside our sample region; as such, our data does not consider the employees working for the oil company. Thus, all our estimates do not include the *direct* effect, which corresponds to approximately 300 employees (ENI, 2012).

Distances from the oil centre We use data from the National Statistical Institute (Istat) on travel distances by car between municipalities, measured in kilometers or hours (Matrici di pendolarismo). Distances are measured from the municipality of Viggiano, which is the one hosting the oil treatment center. In our sample, the two measures of distance (kilometers and hours) the oil center are very highly correlated (0.96) and such that it takes on average one hour to drive 100 km (60 km in the direct vicinity of the oil fields). For sake of brevity, we only present results using time distances, but they are almost identical to the one obtained using the other measure. Given that distances by car can be affected by the treatment if the latter leads to road construction, we also use for robustness measures of air distances.

Tradable and upstream sectors When studying the heterogeneity of the effect of the oil shock, we classify firms according to their industry. We split firms in tradable and untradable according to the standard and broad definition used in AMECO

[10]Potenza and Matera are the only two NUTS3 provinces of Basilicata, while Salerno is a province in Campania and Cosenza is in Calabria.

(2021). The AMECO database classifies the ATECO (NACE) sectors A to E and G to I (agriculture and fishing, mining and utilities, manufacturing, trade, hotels, communications) as tradable, while sectors F, J to P (construction, finance and business services, market services, other service activities) are considered as non-tradable. We also classify firms according to their degree of upstreamness with respect to the oil industry, following the approach in Allcott and Keniston (2018). For a given industry i, upstreamness is measured as the share of value added purchased by the oil industry from i out of total value added produced by industry i. The proxy is calculated from national input-output tables by Istat and it varies at the ATECO 2-digit level. According to this definition, the most upstream industries include water supply, rental and leasing activities, manufacture of chemicals, manufacture of non metallic minerals, waste management, oil production itself.[11]

Census data For the aggregate analysis at the municipal and local labor market level, we turn on data from the decennial population censuses by Istat. This source has comprehensive information at the municipal level on resident population and employment by gender and sector, and it is available for years 1951, 1961, 1971, 1981, 1991, 2001 and 2011.

6 Firm level analysis

Our empirical design for the firm level analysis is very close to what Aragón and Rud (2013) use to study the effects of a single large gold mine in Peru. We estimate by OLS several difference-in-differences specifications akin to model (1), where i is the index for firm, m for municipality, and t for year.

$$Y_{imt} = \alpha + \beta D_m \times Post_t + \gamma D_m + \delta Post_t + \theta X_{imt} + \varepsilon_{it}. \quad (1)$$

[11] Table 18 reports the degree of upstreamness to the oil production of each industry.

The vector X_{imt} includes control variables. The coefficient of interest β is attached to the interaction between a cross-sectional variable D_m that measures the vicinity to the oil fields (i.e. to the municipality of Viggiano), and a dummy variable $Post_t$ for the development of the extractive industry. In particular, $Post_t$ takes the value zero between 1990 and 1995, and one between 1996 and 2001. In lack of complete annual data on investment by the oil company, our binary definition allows to capture the effect of the initial material investment made to set up the oil industry in Val d'Agri. In fact, the years 1990-95 can be considered as an exploratory period, with little production and investment. The following six years mark instead a period of significant material investment: the construction of the pilot treatment center in 1996 and its expansion until reaching a capacity of more than 100,000 barrels per day in 2001 (1.5 billions euro; see section 3 for more details). Our baseline analysis is restricted to the period 1990-2001, a time in which production and the related royalties were low, so our specification identifies only the effect of the initial investment (and the expectations of the forthcoming windfall of resources). In subsequent analyses, we extend the sample to 2013, to investigate the persistence of the effects beyond 2001.

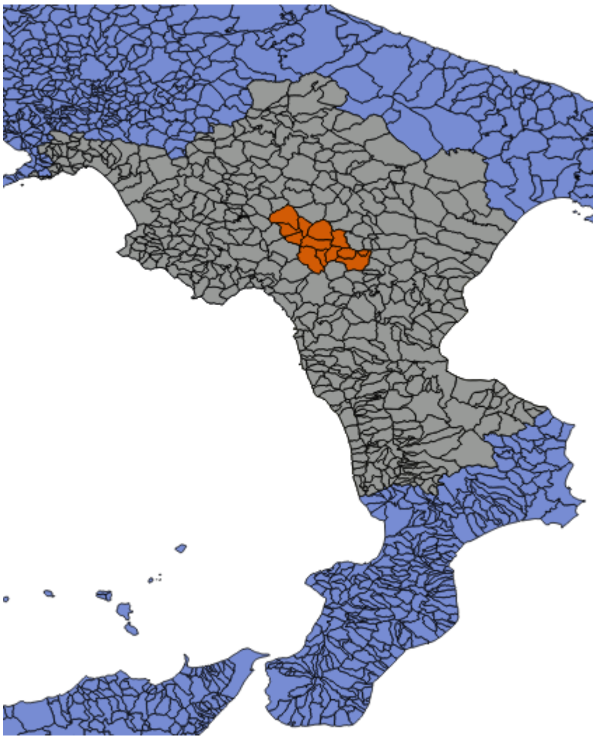
We experiment with several definitions of the variable D_m that measures vicinity to the oil fields. At first, we use a binary definition that considers as treated all firms located in municipalities in the same local labor market (LLM) as Viggiano, where the oil treatment center is located.[12]

Firms located in the treated area are somewhat different from those located outside, as from the summary statistics reported in Table 17 for the period before the construction of the first oil treatment center in Viggiano (1990-1995). Most notably firms are on average smaller, have lower wages and the sectoral composition is slightly different. However, the difference in firms size is due to few large firms that are only present in the control group: after trimming the right tail, this difference shrinks.

Looking at the histograms of the number of employees and of the average wage, the distributions are remarkably similar between the treated and control groups. Figure 4

[12] The municipalities are: Grumento Nova Marsicovetere, Marsico Nuovo, Moliterno, Montemurro, Paterno, San Chirico Raparo, San Martino d'Agri, Sarconi, Spinoso, Tramutola e Viggiano.

Figure 3: Map of the sample



Note: black borders are municipal boundaries; grey municipalities are those included in the sample; orange municipalities are those in the local labor market where the oil treatment center is located.

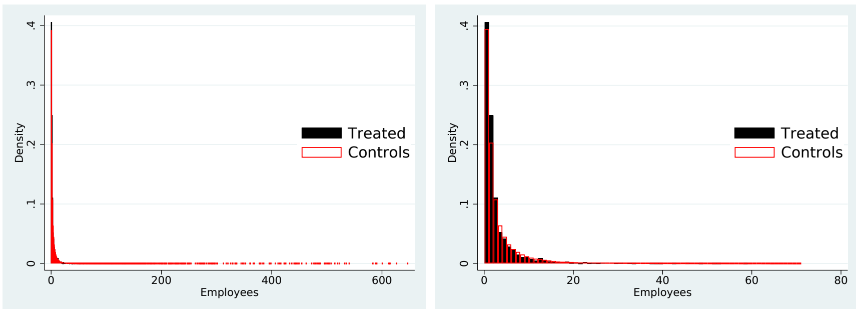
Table 2: Descriptive statistics. Sample: 1990-1995.

	Ctrl	Treat	Diff
Average wage (euro)	122822	120076	27.45**
Average wage (euro) - trim 99.9	122360	120076	22.84**
Average wage (euro) - trim 99	120568	119318	12.50
Employees	5.06	2.99	2.08*
Employees - right trim 99.9	4.51	2.99	1.53***
Employees - right trim 99	3.66	2.79	0.87***
Blue collars	3.43	2.42	1.01**
White collars	1.05	0.37	0.67*
Apprentices	0.22	0.15	0.07***
Manufacturing (0/1)	0.22	0.19	0.03***
Construction (0/1)	0.30	0.44	−0.14***
Trade (0/1)	0.24	0.20	0.04***
Tourism (0/1)	0.06	0.05	0.01**
Other services (0/1)	0.17	0.12	0.05***
Tradeble (0/1)	0.57	0.49	0.08***
Upstream (0/1)	0.23	0.22	0.01
No. observations	181592	3191	

Note: column $Treat$ refers to firms in the same local labor market (SLL) as the oil fields, and $Ctrl$ to those outside. Column $Diff$ reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

plots the distribution of firm size (in terms of employment) in the local labor market where Viggiano is located (in black) and in the rest of the sample (in red) in the period 1990-1995. In the left panel, the variable is trimmed at the 99.9th percentile, while on the right panel at the 99th percentile to visualize the distribution better. The distributions in the treatment and control groups are quite similar: approximately 40 per cent of the observations have at most one employee, 20 per cent between one and two, 10 per cent between two and three, 5 per cent between three and four, and so on with a long right tail. The control group has a longer tail, with few firms having more than 6,000 employees; on the contrary, the largest firm in the treated group has approximately 600 employees. Figure 5 plots the same for the average wage, trimmed at the 0.1 per cent and 99.9 per cent percentile on the left, and on the 1 per cent and 99 per cent percentiles on the right panel.

Figure 4: Firm distribution: number of employees



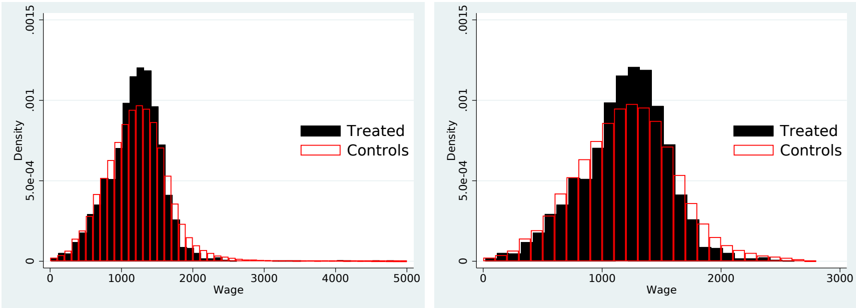
Note: treated refers to firms in the same local labor market (LLM) as Viggiano, and controls to those outside. In the left panel, the number of employees variable has been right trimmed at the 99.9th percentile; in the right panel, at the 99th percentile. The width of each bar is 1 employee.

As an alternative binary definition, we also consider as treated those municipalities within 30 minutes by car from Viggiano, but the set of included municipalities is very similar.[13]

Next, we use travel distance from Viggiano to the municipality where the firm is located as a continuous measure of treatment. As distance enters linearly in our specification, this definition assumes that the treatment effect decays linearly as firm locations move away from Viggiano.

[13]This definition also includes Missanello, Laurenzana and Armento but excludes San Chirico Raparo.

Figure 5: Firm distribution: average wage



Note: treated refers to firms in the same local labor market (SLL) as Viggiano, and controls to those outside. In the left panel, the average wage has been trimmed at the 99.9th percentile; in the right panel, at the 99th percentile.

Finally, we use a spline of travel distance. We divide firms in groups according to their distance from Viggiano. The first group includes firms located in municipalities within 30 minutes from Viggiano. We then group remaining firms in brackets of further 30 minute distances, with the last category containing all firms located between 120 and 166 minutes from Viggiano. We also experiment with finer categories: the first group include only Viggiano, the second municipalities within 16 minutes, and then we categorize remaining firms in brackets of further 16 minute distances, with the excluded category containing all firms located more than 64 minutes away.[14] These exercises are useful in order to provide evidence on the presence of geographical spillovers, namely on the possibility that an increase in the outcome variable for firms close to the plant is mirrored by a corresponding, or even larger, drop for those located further away, for example due to the reallocation of workers.

6.1 Identification

The coefficient β in (1) identifies the average treatment effect on the treated under the standard parallel trend assumption: in a counterfactual scenario without the birth and expansion of the oil industry, firms located close to Viggiano would have displayed the same dynamics in employment. The assumption is untestable, but it is possible to provide suggestive evidence in support of its validity, by showing that the outcome

[14] Defining categories over a 15-minute interval would imply the second category to include only very few firms in a single municipality.

variables display similar trends in the two groups in the pre-treatment period. If the outcome variables are also similar in terms of levels and distribution, this would further corroborate the validity of the identifying assumption.

Notably, in the DID setting the choice of the functional form of the outcome variables (e.g. employees in logs or in level) is crucial, because the parallel trend assumption can not hold simultaneously for all functional forms, except in some special cases (Angrist and Pischke, 2008).[15] In our case, the distributions of employment and wage are rather similar in the treated local labor market and elsewhere, but the control group has a much longer right tail, as discussed above. Thus it is not ex-ante clear if the parallel trend holds (or not) independently on the functional form of the outcome. We thus experiment with both outcomes in levels and logs.

To test for parallel trends in the pre-treatment period, we estimate the event-study model:

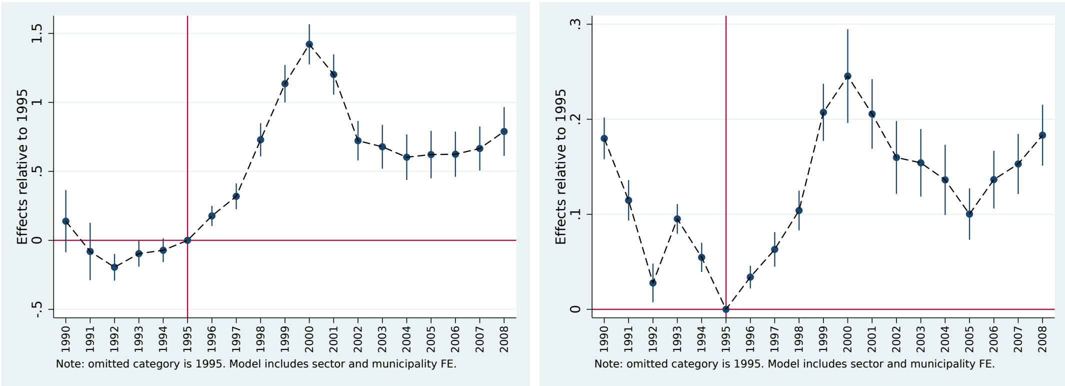
$$Y_{ismt} = \sum_{t=1990}^{2008} \beta_t D_m \times FE_t + FE_m + FE_s + FE_t + \varepsilon_{ismt}, \quad (2)$$

where i is the index for firm, m for municipality, s for sector and t for year. Here we code D_m as a binary variable corresponding to the local labor market where the oil fields are located. The excluded year is 1995. Starting with the number of employees as outcome variable, Figure 6 plots the coefficients β_t: on the left with the outcome in levels, and on the right with the outcome in logs. Figure 7 is the corresponding plot for the average wage.

For both outcome variables in levels, the event-study specification suggests a parallel trend in the pre-treatment period (before 1996), and positive effects afterwards. Thus in our baseline estimates we use the outcome in levels, a case for which we are able to make causal statements on solid grounds (this is the approach suggested by Cunningham (2021)). In the case of the logged outcomes, the coefficients display a somewhat different pre-treatment trend: firms in the treated LLM are on a slightly

[15] The classical view is that the parallel trend assumption can hold for different functional forms if the distribution of the outcome variable in the pre-treatment period is the same in the treatment and in the control group. However, this view has been recently challenged by Rothy and Sant'Anna (2021), who show that having identical baseline distributions is not necessary (nor sufficient) for the parallel trends assumption to be invariant to transformations.

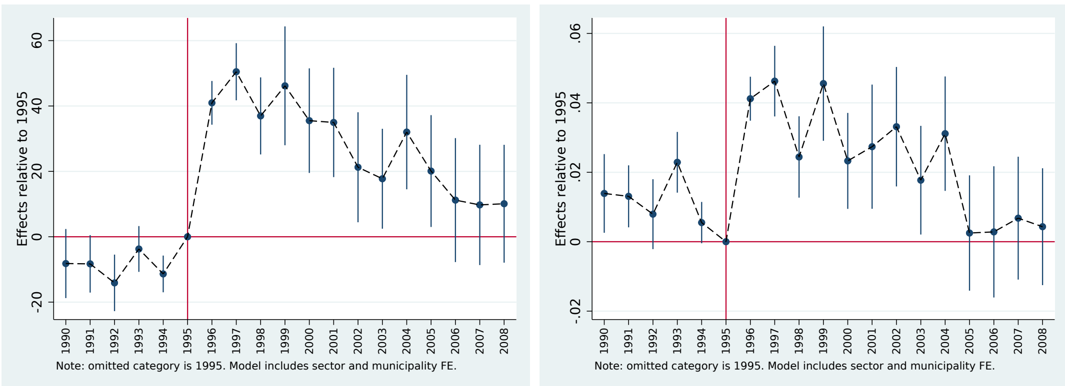
Figure 6: Event study specification, firm-level. Effects on the number of employees.



Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees in the left panel, and its log in the right panel.

downward trajectory relative to the control group; we believe that this pattern is not worrisome because it would result in an underestimation of any positive effects, but we anyway relegate the log-model to the robustness section.

Figure 7: Event study specification, firm-level. Effects on the average wage.



Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the average wage in the left panel, and its log in the right panel.

6.2 Estimated effects on the firm-level number of employees

We start by estimating equation (1) by OLS using firm-level data over the period 1990-2001, and using a dummy D_m equal to one for firms in the LLM where the oil fields are located. Results are reported in table 3. Column (1) shows the results for the specification without any control variables; in column (2) we add municipality fixed effects. In the following columns, we add different sets of dummies to account for pre-existing differences in the distribution of firms by sector and to account for differential trends across sectors. In particular, the model in column (3) includes, together with municipality fixed effects, also (broadly defined) sector fixed effects (manufacturing, construction, trade, tourism, other services). Column (4) includes, as an alternative, more disaggregated industry fixed effects (two digits economic activity ATECO code); finally column (5) includes, in addition, the interactions of these fixed effects with the *Post* dummy. Standard errors are clustered at the LLM level (56 groups).[16]

Table 3: Effect of oil industry on firm size (number of employees)

	Number of employees				
	(1)	(2)	(3)	(4)	(5)
Post * Treat	0.86***	0.97***	0.97***	0.91***	0.83***
	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)
Baseline outcome	3.0	3.0	3.0	3.0	3.0
Relative effect	0.29	0.32	0.33	0.31	0.28
FE municipality		X	X	X	X
FE sector			X		
FE NACE-2-digit				X	
FE NACE-2-digit X Post					X
N firms	82020	82020	82020	82020	82020
N observations	393646	393646	393646	393646	393646

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001, and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. The specification always include also the two terms of the interaction separately, so it amounts to a difference-in-differences specification, and thus the coefficient of the interaction corresponds to the average treatment effect on the treated. The outcome variable is the number of employees (right trimmed at the 99.9th percentile), whose average in 1990-95 period for the treatment group is reported as baseline outcome. The table also reports the relative effects that is the ratio between the coefficient and the baseline outcome. Different columns correspond to the inclusion of different sets of fixed effects. The sample covers the years 1990-2001. Standard errors in parenthesis are clustered at the local labor market level.

The coefficient of interest, representing the average effect of the treatment on the

[16]We also experiment with standard errors that account for arbitrary spatial correlation with a spatial cut-off of up to 200 kilometers (Colella et al., 2019). Standard errors are of similar magnitude, and become smaller as the spatial cut-off increases. Since calculating these standard errors is computationally very demanding, we always report standard errors clustered at the LLM level.

treated firms, is estimated in the range 0.83-0.97, depending on the exact model, and it is always statistically significant at the 99 per cent level. In our preferred specification (column 3), the effect equals 0.97.[17] Hence, our estimates imply that, on average, treated firms increase employment by roughly one unit as a consequence of the treatment. The effect is quite large, considering that average employment in the 1990-95 period for the treated firms (what we call "baseline employment" in the tables) is 3 units: it means that treated firms increase their employment by 33 per cent (reported as "relative effect" in the table).[18]

Next, we turn to results obtained with treatment status defined using travel distance by car from the municipality that hosts the oil treatment center. When firms are defined as treated if they are within 30 minutes from Viggiano, the coefficient of interest is very similar, around 0.9; this is not surprising, because this definition approximately corresponds to the local labor market, as noted above.[19] When distance enters linearly as a continuous variable, the coefficient is very small and not significantly different from zero.[20] This null result is due to the fact that the effect of the treatment is highly non-linear over space and very concentrated close to the oil fields. This emerges quite clearly when we group firms in bins of travel distance from the oil treatment center. Figure 8 provides a graphical illustration of these estimates. In the left panel, we consider a set of 30-minutes bins of travel time, and the excluded category is made by firms located more than two hours away from Viggiano. We only

[17]Estimates in columns (3) and (4) are very similar. In column (5) including the interactions of ATECO fixed effect with the treatment dummy implies that the effect of the treatment does not capture changes of employment due to the reallocation of firms across ATECO codes, which is an important component of the effect of interest.

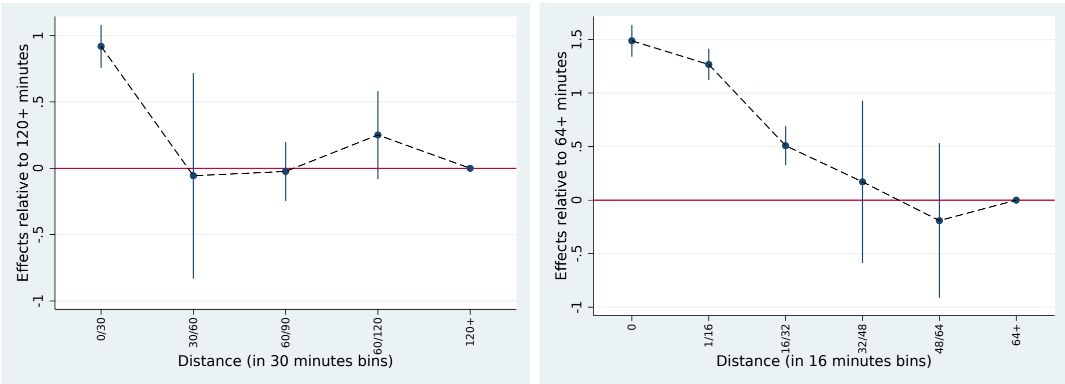
[18]We do not report results from models with firms fixed effects. The OLS and fixed effects estimators of the DID parameter are numerically identical if the panel is balanced; if the panel is unbalanced, as in our case, the fixed effect estimator exploits only variation from the firms that are observed in both periods and hence produce an estimate which does not consider firms entering or exiting the sample (Lechner et al., 2016). As we are also interested in these firms, we prefer the model without firm fixed effects. For completeness, the DID coefficient estimated including firm fixed effects in model (1) is 0.43 and is statistically significant at the 99 per cent level. We interpret this result as suggesting that the increase of employment is due partly to already existing firms and partly to net natality of firms.

[19]Also the event-study graph looks very similar; see appendix A.

[20]The point estimate implies that an additional hour of distance from Viggiano *increases* employment by 0.03 units.

find a positive effect for firms in the first bin, while it is exactly zero at higher distances. This pattern suggests the absence of negative spillovers beyond 30 minutes, namely that the increase in firm size estimated in Val D'Agri is not mirrored by a corresponding drop in the surrounding areas. In the right panel, we consider a finer set of distance bins (16 minutes), and the excluded category is made by firms located more than 64 minutes away. It is possible to see that the effect is not only localized in the municipality where the oil center is located (first bin), but it decays linearly until it becomes zero beyond 32 minutes. Event-study graphs, reported in appendix A, are consistent with the presence of parallel trends in the pre-treatment period in all 30-minutes (Figure 12) and 16-minutes bins (Figure 13).

Figure 8: Effect on firm size (number of employees) at different distances



Note: the table reports graphically as dots the coefficient of the interaction between a dummy equal to one for the years 1996-2001, and variables capturing the presence of the oil industry: in the left panel a set of dummies for firms located in different 30-min bins of distance from Viggiano, where the excluded category is made by firms located more than two hours away; in the right panel a set of dummies for firms located in different 16-min bins of distance from Viggiano, where the excluded category is made by firms located more than 64 minutes away. The specifications always include municipality and sector fixed effects, so they amount to difference-in-differences. The outcome variable is the number of employees (right trimmed at the 99.9th percentile). The sample covers the years 1990-2001. The bars correspond to 95 per cent confidence intervals constructed using standard errors clustered at the LLM level.

Heterogeneity In this section we assess if the average treatment effect estimated above is constant across firms which are observationally different, focusing in particular on two attributes: firm size and sector. Moreover, we explore how the effect varies for different categories of employees. For each heterogeneity test presented in this section, we report in Appendix A the corresponding event-study graphs aimed at assessing the presence of parallel trends before 1996.

We start by estimating the baseline model (1) on different sub samples made of firms of different size. The upper panel of table 4 shows that the treatment effect is positive and significant for all size groups, and it is increasing in size: smaller firms (0-5 employees) increase the number of employees by 0.04, while the effect for the largest firms (at least 50 employees) is 58.9. Scaling the effect using the pre-treatment employment yields a relative effect of 1 or 2 per cent for firms below 50 employees and of 57 per cent for the larger firms.[21] As a second exercise, we estimate the baseline

Table 4: Heterogeneity by size

	N of employees. Subsamples: employees in:			
	(1) 0-5	(2) 5-10	(3) 10-50	(4) 50+
Post X LLM Oil	0.032*** (0.008)	0.073*** (0.019)	0.276** (0.119)	57.696*** (2.966)
Baseline outcome	1.54	6.94	17.14	100.38
Relative effect	0.02	0.01	0.02	0.57
N firms	78180	12945	6933	809
N observations	323305	38278	28839	3224
	Pr(number of employees in interval)			
	(1) 0-5	(2) 5-10	(3) 10-50	(4) 50+
Post X LLM Oil	-0.024*** (0.002)	0.012*** (0.001)	0.007*** (0.002)	0.005*** (0.000)
Baseline outcome	0.866	0.083	0.048	0.003
Relative effect	-0.03	0.15	0.15	1.83
N firms	82020	82020	82020	82020
N observations	393646	393646	393646	393646

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001 (Post), and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. In the upper panel, each column refers to a regression on the subsample of firms of the size reported above each column, and the outcome variable is the number of employees. In the lower panel, the sample is always full and the outcome variable is a dummy equal to one if a firm belongs to size category reported above each column. Both panels report the average of the outcome variable in the 1990-95 period for the treated observations, and the relative effects equal to the ratio between the coefficient and the baseline outcome. The sample always covers the period 1990-2001, and municipal and sector dummies are always included. Standard errors in parenthesis are clustered at the local labor market level.

[21] The event-study specification does not support a causal interpretation for the group of largest firms (see Figure 15 in Appendix A).

model (1) four times on the full sample, using as outcome variable a dummy equal to one if the firm belongs to each one of the four size categories. The results, reported in the lower panel of table 4, show that the the treatment has reduced the probability of a firm being small (0-5 employees) by 2.4 percentage points (from a baseline of 87 per cent). On the contrary, the treatment effect is positive for all other groups: the share of firms between 10 and 50 employees has increased by 0.7 percentage points (from 5 per cent), and the share of larger firms (50 employees or more) has almost doubled as a consequence of the treatment (from 0.3 per cent). Results from the event-study specifications are rather noisy but, especially for the 0-4 and 50+ categories, are broadly consistent with a causal interpretation of the results (see Figure 16 in Appendix A).

We have conducted a similar analysis to study heterogeneity across sectors. The effect of the treatment is positive in all sector sub-samples, as shown in the upper panel of table 5. However, as for size categories, some differences emerge. The effect is particularly strong in manufacturing (50 per cent, column 1). A positive effect in manufacturing is in line with previous evidence (Allcott and Keniston, 2018; Pelzl and Poelhekke, 2020). The second most affected industry is the tertiary sector, where the effect is approximately 30 per cent (columns 3, 4 and 5). While some of these effects might be due to demand by the oil company, the magnitude and pervasiveness of the increase suggests that second-order indirect effects are at least partly at work. Interestingly, the effect is positive also for touristic activities (column 4), where one might expect that environmental externalities would scare off tourists; however, the development of the new industry has likely generated a profitable local market for business travels, which fulfills the demand from those workers who stay on site on a temporary basis. Finally, we also find a positive effect in the construction sector (12 percent, column 2); this is not completely surprising because the period under consideration is characterized by significant investment in physical capital, which also entails some buildings.[22] Notice that across the columns of Table 5, the effect is

[22]Event-study specifications support a causal interpretation in all sectors (see Figure 18 in Appendix A)

stronger for the so-called tradable sectors: manufacturing and trade; this result is confirmed when we create a dummy for tradable sector according to the AMECO (2021) definition (manufacturing, trade and some specific other services) and interact it with $Post \times LLMoil$. At first, this finding might appear puzzling as the local labor market framework predicts smaller effects for the tradable sectors, because they are subject to competition from firms in other regions (Moretti, 2011); however, our result is consistent with the previous empirical literature, that has pointed that this crude binary partition does not capture whether a firm produces locally tradable goods or not, that is what matters in spatial models. For example, Allcott and Keniston (2018) show that even within manufacturing, some sub-sectors are much more tradable than others, and that this matters for consequences of local oil shocks. Unfortunately, we do not have the granular data that would allow us to replicate this type of analysis.

Next, we turn to the specifications where we use dummies for different sectors as left-hand side variables in equation (1). This approach estimates the change in the probability of belonging to a given sector, thus it can be thought as a test of sectoral reallocation. We do not find any changes in the share of manufacturing and trade firms (columns 1 and 3). On the contrary, the share of construction businesses declines by 3.4 percentage points, and there is a corresponding increase in the tertiary sector (1.6 percentage points in tourism, and 1.9 in other services).[23] These results suggest that if the "Dutch disease" is at play, it does not crowd out manufacturing, but rather the construction sector.[24]

The theoretical framework predicts that the rise of the oil industry should affect first and foremost those firms that sell goods and services to the extractive sector. To test this prediction, we construct a continuous proxy for how much each firm is upstream to the oil industry using national input-output tables (see section 5). We

[23] Note that the results from the event-study specifications are very noisy and do not always support a causal interpretation (see Figure 18 in Appendix A).

[24] This finding might appear puzzling given that construction is usually considered a non-traded sector; however, at this geographical level, it is not obvious that for construction works it is necessary to rely on firms located in the same commuting zone, rather than in other surrounding labor markets. Manufacturing is usually considered as a tradable sector, but recent research has shown that within manufacturing there is considerable industry heterogeneity in tradability at the local level (Holmes and Stevens, 2014).

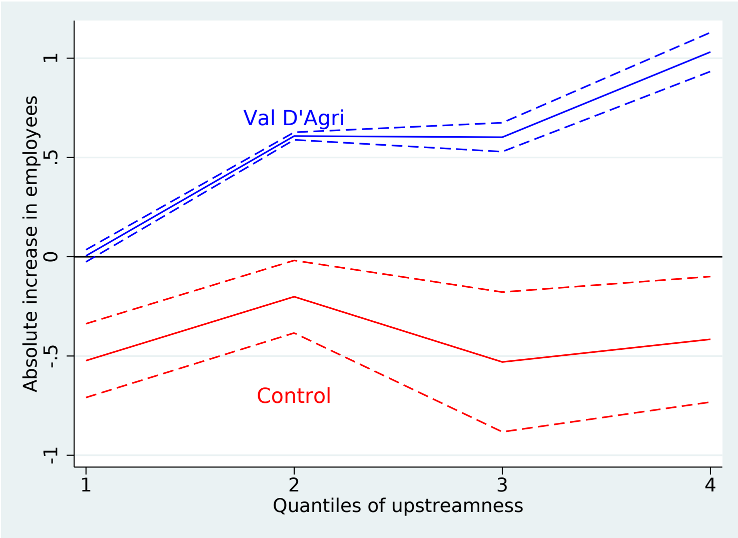
Table 5: Heterogeneity by sector

	Number of employees				
	(1) Manuf.	(2) Constr.	(3) Trade	(4) Tour.	(5) Oth. serv.
Post X LLM Oil	2.788***	0.327***	0.446***	0.480***	0.747***
	(0.235)	(0.091)	(0.040)	(0.111)	(0.145)
Baseline outcome	5.32	2.80	1.50	3.27	2.32
Relative effect	0.52	0.12	0.30	0.15	0.32
N firms	15902	23228	20337	6695	18272
N observations	84108	105909	99219	28761	75649
	Pr(firm in sector)				
	(1) Manuf.	(2) Constr.	(3) Trade	(4) Tour.	(5) Oth. serv.
Post X LLM Oil	0.000	-0.034***	-0.001	0.016***	0.019***
	(0.004)	(0.006)	(0.005)	(0.001)	(0.003)
Baseline outcome	0.19	0.44	0.20	0.05	0.12
Relative effect	0.00	-0.08	-0.00	0.30	0.16
N firms	82027	82027	82027	82027	82027
N observations	393814	393814	393814	393814	393814

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001 (Post), and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. In the upper panel, each column refers to a regression on the sub-sample of firms of the sector reported above each column, and the outcome variable is the number of employees. In the lower panel, the sample is always full and the outcome variable is a dummy equal to one if a firm belongs to the sector reported above each column. Both panels report the average of the outcome variable in the 1990-95 period for the treated observations, and the relative effects equal to the ratio between the coefficient and the baseline outcome. The sample always covers the period 1990-2001, and municipal and sector dummies are always included. Standard errors in parenthesis are clustered at the local labor market level.

split firms in four quartiles based on their upstreamness, and interact a set of dummies for these quartiles with $Post_t \times D_m$ in our baseline regression. We report the results graphically in figure 9, that shows how the time trends (i.e. difference in the number of employees between the two periods) for treated (blue) and untreated (red) firms vary at different quartiles of upstreamness. The vertical difference between the two lines is the difference-in-differences estimate at the corresponding quartile. The time trend is always negative for firms in the control group, independently on the degree of upstreamness of the firm. On the contrary, the time trend is approximately zero for treated firms whose goods and services are not heavily purchased by the oil industry

Figure 9: Effect of oil industry presence on firm size in the upstream sector



Note: the figure reports graphically the effects estimated in a specification whith a triple interaction between a dummy equal to one for the years 1996-2001 (Post), a dummy equal to one for the firms in the local labor market where the oil extraction takes place, and a set of dummies for the quartiles of upstreamness. The blue line is the increase in firm size (number of employees) in the local labor market where the oil extraction takes place, while the red line refers to the rest of the sample. The vertical distance between the two lines is the difference-in-differences estimate for different levels of upstreamness. Dashed line are the 95 per cent confidence intervals. The specification also include the Post dummy, and sector, municipality and quartiles of upstreamness fixed effects.

(first quartile), and then it gradually increases with upstreamness, reaching the highest level for the fourth quartile. Thus the treated effect (that is the vertical distance) is increasing in upstreamness. The causal interpretation is supported by the event-study specifications (see Figure 18 in Appendix A). The finding that upstream firms are more affected by the establishment of the oil industry is confirmed by various robustness checks (not reported). In particular, we model upstreamness as a continuous variable, or as a dummy tagging firms whose upstreamness is above the median or in the highest quartile.

Finally, given that our data allows us to distinguish, to some extent, the employees according to their skill group, we estimate the baseline equation 1 using as dependent variable the employees in each skill group, instead of total employment. The total effect, reported in column (1) of table 6, is the sum of the effect over the skill groups. It emerges that firms have increased both blue (column 2) and white collars (column 3) as a consequence of the treatment (the parallel trend assumption seems to hold; see

Figure 18 in Appendix A). In absolute terms, the effect is larger for blue collars, but given that these represent a much larger share of the work-force, in relative terms the effect is larger for white collars. On the contrary, the effect is negative for apprentices, which might be consistent with treated firms switching to more stable work contracts for their employees. However, our data does not allow to test this conjecture.

Table 6: Effect of oil industry on employees of different types

	Number of employees				
	(1) Tot.	(2) Blue	(3) White	(4) Appr.	(5) Other
Post X LLM Oil	0.97***	0.53***	0.09***	-0.03***	0.38***
	(0.09)	(0.18)	(0.03)	(0.01)	(0.10)
Baseline outcome	2.99	2.42	0.37	0.15	0.04
Relative effect	0.33	0.22	0.24	-0.18	10.11
N firms	82020	82027	82027	82027	82027
N observations	393646	393814	393814	393814	393814

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001 (Post), and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. In each model the outcome variable is the number of employees of the category reported above each column: total, blue collars, white collars, apprentices and others. The average of the outcome variable in the 1990-95 period for the treated group is reported as baseline outcome. The table also reports the relative effects that is the ratio between the coefficient and the baseline outcome. Standard errors in parenthesis are clustered at the local labor market level.

Robustness tests We assess the robustness of the results in several directions: we validate them with respect to an alternative control group of firms located in municipalities that are more similar to those in Val d'Agri; we present results from model where the outcome takes the logarithmic form; we estimate the effect of oil extraction using the changes-in-changes estimator (Athey and Imbens, 2006), whose identifying assumption does not depend on the functional form of the outcome variable.

The first robustness test is motivated by the pre-1996 differences in firm size, average wage, and other characteristics between the firms in Val d'Agri and those in the control group (see 17). Although a perfect balancing is not required for identification in the DID setting, a more similar control group would make the results less sensitive to the functional form of the outcome variable. So far, we compared treated firms to all those located outside the local labor market where the oil fields are (in the four surrounding provinces; see figure 3). The idea was to choose, as a control, firms that are, as far as possible, exposed to similar context factors and local shocks, with the exception of the development of the extractive industry. Here we consider instead a more restrictive control group, excluding firms that are located in municipalities that we consider very different from those in Val d'Agri. Table 7 shows the results: column (1) report the average effect from the baseline model for comparison; in column (2) we only consider firms located in municipalities with less than 6,000 residents (which is approximately the number of residents in the most populous municipality in the treated LLM); in column (3) we only include firms located in peripheral or semi-peripheral municipalities (according to the definition by Agenzia per la Coesione territoriale (2014)); in column (4) we only include firms located in mountainous municipalities (defined as the ones with altitude higher than 600 metres, which is the altitude of the lowest municipality in the oil LLM); in column (5) we exclude firms located in the LLM of Melfi, that hosts a very large car plant; finally in column (6) we consider only firms at the intersection of all these sub-samples. The last sub-sample includes roughly 5,400 firms, as opposed to 83,000 in the full sample. All sub-samples are more balanced in terms of the level of the outcome variables and of several covariates (as observed before 1996) compared to our main sample (see Appendix B). The effect of the treatment is still positive and statistically significant throughout the columns of table 7, but its size is sometimes smaller, and halves in column (6) compared to the baseline estimate; however, the relative effects is still economically sizable (18 per cent). Figure 14 in the Appendix shows that the assumption of parallel trend in the pre-treatment period is likely to hold also in these restricted samples, perhaps with the exception of the sample used for the regression in column (4).

As an additional robustness test, we estimate the baseline models using the outcome variable in logarithmic form. In this case the treatment induces a 7 per cent increase in the number of employees (standard error 1 per cent), approximately 1/4 of the relative effect estimated with the model in levels. There are two reasons why the log-model estimates a smaller effect than the level-model. First, as reported in Section 6.1, the

Table 7: Difference-in-differences estimates in sub-samples restricted by firm location

	Different samples					
	(1) Full	(2) Small towns	(3) Periphery	(4) Mountain	(5) No Melfi	(6) All above
Post X LLM Oil	0.97***	0.64***	0.75***	1.04***	1.01***	0.55***
	(0.09)	(0.08)	(0.12)	(0.31)	(0.08)	(0.10)
Baseline outcome	3.0	3.0	3.0	3.0	3.0	3.0
Relative effect	0.33	0.22	0.25	0.35	0.34	0.18
N firms	82020	23436	26383	16743	80019	5357
N observations	393646	108109	124020	79778	384078	24374

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001, and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. The specification always includes also the two terms of the interaction separately, so it amounts to a difference-in-differences specification, and thus the coefficient of the interaction corresponds to the average treatment effect on the treated. The outcome variable is the number of employees (right trimmed at the 99.9th percentile), whose average in 1990-95 period for the treatment group is reported as baseline outcome. The table also reports the relative effects that is the ratio between the coefficient and the baseline outcome. The sample covers the years 1990-2001. Different columns correspond to regression using subsamples with different geographical coverage: (1) full; (2) municipalities with less than 6,000 inhabitans; (3) municipalities categorized as peripheral area; (4) municipalities with altitude higher than 600 meters; (5) exclusion of the local labor market of Melfi; (6) all the previous restrictions together. Standard errors in parenthesis are clustered at the local labor market level.

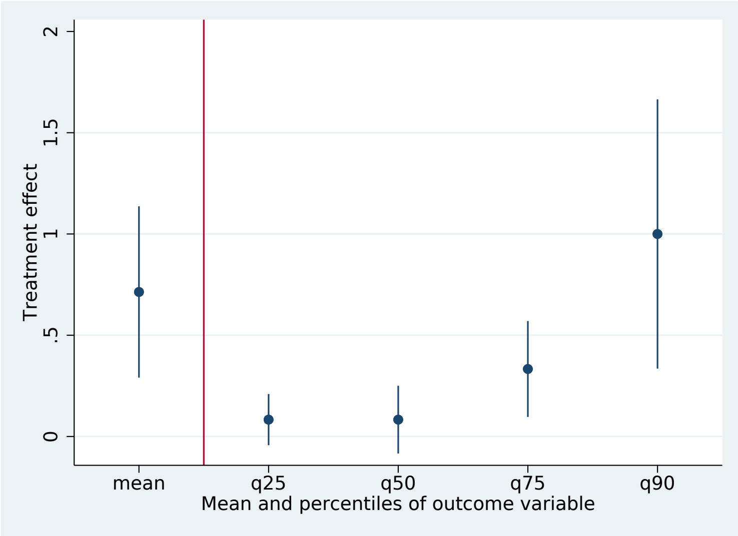
log-models display a declining trend in the pre-treatment period (see Figure 7), and thus their estimates can be interpreted as a lower bound of the true effect. Second, the log-model implicitly gives less weight to the right tail of the outcome distribution; as discussed before, the distribution of the number of employees has a long right tail, and the effect is larger in large firms (see the upper panel of Table 4). Note that these two reasons are interconnected: as discussed above, the parallel trend assumption should hold independently of the functional form if the distribution of the outcome is similar between treatment and control groups. In our case the control group has a much longer right tail, so the parallel trend graphs are different if we use the outcome in level or in logs.

As a final robustness test, we estimate our treatment effect using the non-parametric estimator changes-in-changes (CIC) proposed by Athey and Imbens (2006). The CIC is a generalization of the standard DID and aims at identifying the treatment effects for each quantile of the outcome distribution, rather than only the average treatment effect.[25] For this reason, the parallel trend assumption must hold for each quantile of

[25] Both models identify only the effects on the treated. The CIC works only for the standard two group - two period case, that is suitable for our application.

the outcome distribution, and the estimates do not depend on the functional form of the outcome variable. Figure 10 reports the treatment effects estimated with the CIC

Figure 10: Changes-in-changes model



Note: the plots shows as dots the average treatment effect (mean) and the treatment effects at different quantiles of the outcome variable, that is the number of employees. The bars are 95 per cent confidence intervals obtained using bootstrapped standard errors. The estimator is the changes-in-changes proposed by Athey and Imbens (2006) implemented using the Stata package `cic` by Kranker (2016).

for the 25th, 50th, 75th and 90th percentiles, and for the mean (that corresponds to the average effect). The results are consistent with our previous analyses: the effect increases with firm size, ranging from 0.08 employees for the 25th percentile (10 per cent in relative terms) to 1 employee for the 90th percentile (15 per cent in relative terms). The average effect is equal to 0.7 employees (23 per cent in relative terms), that is one third smaller than the average effect estimated with the standard DID, but still sizable.

6.3 Estimated effects on the firm-level average wage

As discussed in section 3, the development of the oil industry may affect positively both employment and wage, via an increase in labor demand. After having estimated the effect on employment in the previous section, here we estimate equation (1) using the average monthly wage in the firm as the outcome variable. An important caveat is that in our data we only observe the average wage per worker at the firm level, which is calculated as the ratio between total firm payroll and the number of workers. This measure corresponds to the product of the average hourly wage times the average number of hours worked in the firm. Hence we are not able to disentangle the impact on the hours worked from the impact on the hourly wage.

Table 8 shows the results: in our baseline specification (column 3) the effect is roughly 46 euros (in monthly terms) during the period 1996-2001; this amounts to a 4 per cent increase in relative terms. The effect becomes smaller in column (4) and also not statistically significant in column (5), where we add respectively ATECO 2-digit fixed effects, and their interaction with the *Post* dummy. The effect on the average wage is thus smaller than the effect on employment.

Table 8: Effect on firm-level average wage

	Average wage				
	(1)	(2)	(3)	(4)	(5)
Post X LLM Oil	46.11***	44.07***	45.43***	27.55***	7.69
	(8.03)	(7.42)	(7.56)	(7.83)	(7.99)
Baseline outcome	1200.8	1200.8	1200.8	1200.8	1200.8
Relative effect	0.04	0.04	0.04	0.02	0.01
FE municipality		X	X	X	X
FE sector			X		
FE NACE-2-digit				X	
FE NACE-2-digit X Post					X
N firms	81998	81998	81998	81998	81998
N observations	393440	393440	393440	393440	393440

Note: the table reports the coefficient of the interaction between a dummy equal to one for the years 1996-2001, and a dummy equal to one for the firms in the local labor market where the oil extraction takes place. The specification always include also the two terms of the interaction separately, so it amounts to a difference-in-differences specification, and thus the coefficient of the interaction corresponds to the average treatment effect on the treated. The outcome variable is the average wage calculated as total payroll divided by the number of employees (trimmed at the 99.9th percentile), whose average in 1990-95 period for the treatment group is reported as baseline outcome. The table also reports the relative effects that is the ratio between the coefficient and the baseline outcome. The sample covers the years 1990-2001. Different columns correspond to regression using different combinations of fixed effects. Standard errors in parenthesis are clustered at the local labor market level.

As said, our outcome variable captures variation in both hours and hourly wage. However, previous studies have found low sensitivity of wages to local labor demand shocks in Italy, because of high wage rigidity and high structural unemployment (Boeri et al., 2021; Ciani et al., 2019). Hence, we suppose that the effect estimated in this section mostly captures the response in hours worked, but we cannot assess this directly.

An additional interesting note relates to the dynamic of the effect, captured by the event-study model in equation (2). Contrasting figure 6 and figure 7, we can see that the increase in employment is rather gradual, but quite persistent over time; on the contrary, the average wage increases immediately at the beginning of the investment period, and then slowly reverts back to the pre-treatment level. The differences in timing may reflect that in the short-run it is easier for firms to adjust hours, rather than hire new employees (Rosen, 1968).

6.4 The persistence of the effects

The findings from the event-study specification (equation (2)) suggests that the estimated effects on employment are rather persistent over time, while less so in the case of the average wage. In this section we test more formally for the persistence of the effects: we extend the sample until 2013, and interact the indicator for presence of the oil industry with three dummies for the periods 1996-2001, 2002-07, and 2008-13 (the excluded period is again 1995-2000; for the sake of symmetry each period is six-year long). As mentioned before, the 1996-2001 period is marked by high investment but low production; in the following period 2002-07, production and royalties increase substantially, while material investment declines; finally the last period 2008-13 corresponds to a maturity stage, but crucially overlaps with the financial and sovereign crises. Table 9 shows findings for both the number of employees (first three columns), and the average wage (last three columns); columns (1), (3), (4) and (6) have sector fixed effects, columns (2) and (5) have ateco times post fixed effects; columns (3) and (6) restrict the sample to firms located in municipalities with similar characteristics (see section 6.2). The baseline results suggest that the effects on employment seem to persist for a long period, while the average wage returns to its pre-treatment level after six years. However, results from the restricted sample suggests that also the

Table 9: Persistence of the effect

	Number of employees			Average wage		
	(1) Full sample	(2) Full sample	(3) Selected sample	(4) Full sample	(5) Full sample	(6) Selected sample
1996-2001 X LLM Oil	0.90***	0.77***	0.49***	49.00***	6.07	-15.17
	(0.09)	(0.08)	(0.10)	(7.86)	(8.28)	(15.97)
2002-2007 X LLM Oil	0.63***	0.37***	-0.09	29.27***	-13.32	-38.20*
	(0.10)	(0.10)	(0.14)	(10.19)	(10.13)	(20.97)
2008-2013 X LLM Oil	1.15***	0.88***	0.28*	6.58	-37.46***	-75.84***
	(0.12)	(0.12)	(0.15)	(11.80)	(11.47)	(19.73)
FE municipality	X	X	X	X	X	X
FE sector	X		X	X		X
FE NACE-2-digit X Post		X			X	
N firms	156568	156567	9522	156529	156528	9521
N observations	1012879	1012876	60114	1012570	1012567	60080

Note: the table reports the coefficients of the interactions a dummy equal to one for the firms in the local labor market where the oil extraction takes place, and three dummies for the periods 1996-2001, 2002-2007 and 2008-2013 (the excluded category is 1990-1995). The specification always include also the terms of the interactions separately, so it amounts to a difference-in-differences specification. The sample period is 1990-2013. The outcome variable is the number of employees in the first three columns and the average wage in the last three columns. The average of the outcomes in 1990-95 period for the treatment group is reported as baseline outcome. The table also reports the relative effects that is the ratio between the coefficient and the baseline outcome. Different columns correspond to regression using different combinations of fixed effects. Standard errors in parenthesis are clustered at the local labor market level

effect on employment does not persist beyond 2001. All in all, we believe that these results must be interpreted with caution because, as more time passes from the initial establishment of the oil industry, more factors come into play, most notably the royalties windfall and the regional investment plan starting in the early 2000s (see section 3). Note that our reduced-form estimator can only capture the net effects of all these factors, and is not well suited for estimating effects far away in time.

7 Aggregate analysis

In the previous sections, we have focused on the micro effects and on the mechanisms, but we did not investigate much the consequences on the local labor market as a whole. However, estimating the effect on aggregate employment is interesting and important in its own sake, for example from the perspective of a policymaker.

The firm-level analysis suggests that the birth of the extractive industry increased firm size (in terms of number of employees) in all sectors; the average treatment effect is approximately 1 employee in our baseline firm-level specification (0.55 in our most conservative model). Since in our administrative data the treated LLM hosts approximately 400 firms in 1996, our estimates imply an increase in employment of roughly 400 units (220 in our most conservative model). To put this into perspective, this increase is approximately the same as the direct employment in the extractive facility. Since our data do not include workers employed by ENI (see section 5), our firm-level estimates suggest that each job in the oil company is coupled with approximately one additional job in other private firms.

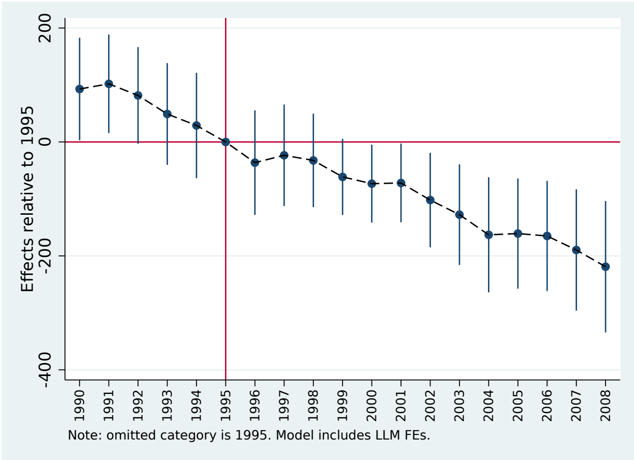
A limitation of the back-of-the-envelope calculation above is that it assumes that the number of firms stays constant. This is not necessarily the case, as the number of active businesses can change as a consequence of the treatment or for other exogenous reasons. In this section, we address this issue by estimating directly the effect of our treatment on the number of firms (section 7.1).

A second and even more important feature of our firm-level social security data is that it only covers approximately 12 per cent of total employment in Val d'Agri. In fact, this dataset records approximately 1,200 firm employees, while the census records approximately 10,000 people with an occupation in the area. The difference is explained by the fact that the social security dataset does not include sizable categories such as self-employed workers, public employees, farmers, employees of firms with headquarter outside the sample (e.g. the oil company), and irregular workers. To estimate aggregate effects, we thus turn at data from the decennial population censuses (section 7.2).

7.1 Firm demographics

To estimate the effects of the establishment of the oil industry on the number of firms, we collapse the social security data at the level of LLM. We estimate an event-study specification similar to model (2); the unit of observation is the LLM, the outcome variable is the number of firms, and the coefficients of interest are those associated with the interactions between the dummy for the Val d'Agri labor market and the year dummies. We present the results graphically in Figure 11: the number of firms drops by approximately 100 units in the period 1996-2001, relative to the previous period and to the other local labor markets. The decline is sizable, but the figure clearly shows that the negative trend begins much earlier than 1996, and continues at

Figure 11: Event-study graph: number of firms



Note: the plot reports the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place. The excluded year is 1995. The model also includes year dummies and municipal dummies. The outcome variable is the number of firms. Confidence bars are based on robust standard errors.

a similar pace until 2008. As such, we do not consider this estimate as a causal effect induced by the oil industry. Nevertheless, this decline must be taken into account when quantifying the aggregate effects of the firm-level estimates, which must then be adjusted downwards.

7.2 Aggregate labor market effects

In order to estimate the aggregate labor market effects, we turn at data from the decennial population censuses that cover the entire economy. This source has comprehensive information at the municipal level on population and employment based on the residence of the workers. Census data covers all sectors, including self-employment, the public sector and agriculture, and even oil company workers who reside in the area. The data is available for all years ending with 1, starting in 1951. The timing is particularly convenient for our aim, as the 1991 edition collects information about the situation before the rise of the oil industry, and the 2001 edition covers the end of the period of massive investment by ENI.

First, it is useful to have a look at the economic structure in Val D'Agri from a descriptive point of view. Table 10 reports figures for the aggregate local labor

Table 10: Dynamics in the oil local labor market

Year	Pop.	Empl.	Employment rate			Employment incidence			
			Tot.	Mal.	Fem.	Agr.	Ind.	Tra.	Oth.
1981	26957	10037	37.2	52.4	22.6				
1991	28794	9758	33.9	47.9	20.6	19.3	33.0	31.9	15.8
2001	28509	10264	36.0	47.9	24.9	14.5	29.8	38.1	17.6
2011	27441	10604	38.6	50.1	28.0	12.5	27.5	42.3	17.7

Source: different censuses, Istat. Note: the figures refer to the aggregate amount for the local labor market where the oil fields are located. Population refers to those aged 15 or older. Employment refers to all persons with an occupation. The employment rate is the ratio between the two. Employment incidence in different sectors is calculated as a share of employment.

market on population, employment, employment rate (also by gender), and incidence of different sectors. Between 1991 and 2001, active population[26] decreased by 280 people (-1 per cent), while the number of people with an occupation increased by 500 units (5 per cent); as a consequence, the employment rate increased from 33.9 to 36 per cent. Interestingly, the latter increase is driven by female, while the employment rate for male is constant in this time period. In terms of sectors, the employment shares in agriculture and manufacturing decline by, respectively, 5 and 3.3 percentage points; at the same time, the commercial sector grows from 31.9 to 38 per cent, and the remaining part of the service sector from 15.7 to 17.7 per cent. Of course these dynamics can not be attributed to the rise of the oil industry, at least not completely. For example, behind these numbers, we probably see an ongoing structural transformation away from agriculture, and the secular rise in female labor force participation (Del Boca, 2002). However, we can already see that the establishment of the extractive industry does not result in a large increase in aggregate employment, unless we think that in a counterfactual scenario without oil, employment would have declined dramatically.

In order to compare these numbers to a sensible counterfactual, we implement a difference-in-differences analysis at the municipal m level, similar to what already implemented at the firm level (equation 3). The main outcome variable is the employment rate[27], while the treatment dummy equals one for the 12 municipalities in

[26]Defined as aged 15 or more.

[27]Calculated with the population older than 15 years old at the denominator.

the Val D'Agri local labor market, and it is interacted with census year dummies. As before, we restrict our sample to municipalities in the four provinces Potenza, Matera, Salerno and Cosenza, making a total of 444 municipalities in 56 local labor markets (level at which we cluster the standard errors). We include years between 1971 and 2011, leaving 1991 as the omitted category. Importantly, we estimate our equation by weighted least squares, using population in 1991 as weight, in order to capture the employment effect in the local labor market as a whole. We fix population weights in the latest pre-treatment year in order to avoid endogenous weighting.

$$Y_{mt} = \sum_{t \in 1971,1981,2001,2011} \beta_t ValAgri_m \times FE_t + FE_t + ValAgri_m + \varepsilon_{mt}, \tag{3}$$

We are particularly interested in the coefficient on the interaction between the Val d'Agri dummy and the 2001 dummy, that identifies the change in the employment rate relative to the control group over the period of massive investment to set up the oil industry. Under a standard common trend assumption, this change can have a causal interpretation and be attributed to the raise of the extractive sector. The frequency of the census data does not allow to assess the pre-trend as convincingly as in the firm-level analysis, but we can still test whether the outcome variable was on a differential trend in 1981 and 1971. We also try to restrict the comparison to a control group of municipalities most similar to Val d'Agri; to do so, in one specification we also include the following controls interacted with year dummies: coastal dummy, mountain dummy, population class dummies, and a Basilicata dummy.

The results are reported in table 11: in the first two columns the outcome variable is the total employment rate, in the next two the male rate, and in the last two the female rate; even columns include controls. The analysis suggests that between 1991 and 2001 the total employment rate increased by approximately 1 percentage point, while it was not statistically different from 1991 in 1981 and in 1971. The effect in 2001 is statistically significant, but economically small, corresponding to approximately two hundreds more people.[28] When looking at the employment rate by gender, we see

[28]In particular the effect on the employment rate is driven for roughly two-thirds by an increase

Table 11: Effect on the employment rate in Val d'Agri

	Total		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)
1971 X LLM Oil	0.23	-1.15	-2.14*	-0.01	1.74	-2.91**
	(0.98)	(0.82)	(1.11)	(1.26)	(1.12)	(1.15)
1981 X LLM Oil	-0.15	0.26	-1.15**	0.88	0.65	-0.53
	(0.34)	(0.65)	(0.49)	(0.59)	(0.45)	(1.04)
2001 X LLM Oil	0.82***	1.11*	-0.31	0.27	1.98***	1.97***
	(0.24)	(0.60)	(0.37)	(0.70)	(0.28)	(0.54)
2011 X LLM Oil	0.32	1.61***	0.52	1.76**	0.31	1.64***
	(0.34)	(0.53)	(0.50)	(0.76)	(0.43)	(0.47)
Controls	No	Yes	No	Yes	No	Yes
N obs.	2216	2216	2216	2216	2216	2216

Note: the table reports the coefficient of the interaction between a dummy equal to one for municipalities in the local labor market where the oil extraction takes place, and year dummies (the excluded year is 1991). The specification always include year dummies and municipalities fixed effects, so it amounts to a difference-in-differences specification. The outcome variable is the employment rate. Even columns include controls interacted with year dummies: coastal dummy, mountain dummy, population class dummies, and a Basilicata dummy. Standard errors in parenthesis are robust to heteroskedasticity.

that the increase is entirely driven by females (2 percentage point increase in the employment rate, strongly significant), while the rate among males does not change (the coefficient is small, not significant, and changes sign when controls are added). These effects seem to persist, at least in part, until 2011, but in this respect the evidence is more mixed and depends on the control set, so we caution against over-interpreting these results.

Table 12: Effects on the employment by sector in Val d'Agri

	Agriculture		Industry		Trade		Other services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2001 X LLM Oil	-0.01	1.30***	-0.72***	-1.07**	1.36***	1.08***	0.19*	-0.20
	(0.23)	(0.25)	(0.19)	(0.52)	(0.12)	(0.18)	(0.10)	(0.12)
2011 X LLM Oil	-1.24***	0.93**	0.38*	0.13	1.12***	1.14***	0.06	-0.59***
	(0.35)	(0.44)	(0.19)	(0.46)	(0.14)	(0.22)	(0.16)	(0.13)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N obs.	1332	1332	1332	1332	1332	1332	1332	1332

Note: the table reports the coefficient of the interaction between a dummy equal to one for municipalities in the local labor market where the oil extraction takes place, and year dummies (the excluded year is 1991). The specification always include year dummies and municipalities fixed effects, so it amounts to a difference-in-differences specification. The outcome variable is the employment incidence of any given sector. Even columns include controls interacted with year dummies: coastal dummy, mountain dummy, population class dummies, and a Basilicata dummy. Standard errors in parenthesis are robust to heteroskedasticity.

in the numerator (employment), and for the rest by a drop in the denominator (population). To see this we re-estimate the model by using as outcome the employment rate where the denominator is always fixed at 1991 (coefficient not reported).

To have a sense of the contribution of different sectors to the increase in employment, we compute the ratios of workers in each sector over active population (older than 15 years old), and use these as outcome variables. The results, reported in Table 12, suggest that the oil labor market experienced a decrease in industrial employment (which include both manufacturing and construction), and a corresponding and long-lasting increase in the commercial sector, relative to the control group. These findings are consistent with the dynamics by gender emerged in the previous table. A possible explanation for the drop in the industrial sector relates to the relevant weight of construction, that employs only 25 per cent less workers than manufacturing in Val d'Agri (in the social security data), and that shrinks in relative terms (see table 5). Interestingly, there is also a positive effects on agriculture, although in that period the sector contracted in absolute terms (see 10).

8 Conclusion

What are the causal effects of opening a new large capital-intensive extraction facility on the local labor market? We answer this question in the context of a small peripheral area in the South of Italy, using firm-level and census data. Firms located close to the oil fields grow bigger in terms of employment compared to those further away. On average, employment increases by slightly less than 1 unit per firm, which corresponds to a 30 per cent increase in our sample. The effect is stronger for upstream industries and for large firms both in absolute and relative terms. We also find evidence of positive effects on average wages per worker, amounting to a 4 per cent increase in relative terms. The firm-level results do not imply a strong increase in employment at the aggregate level because the number of firms in the area is small and declining. This finding is confirmed by the census data that covers all sectors and worker types: the effect on the employment rate is approximately one percentage point. Our evidence implies that the plant opening triggered a reallocation of labor towards firms that are larger, and economically and geographically close to the entrant firm.

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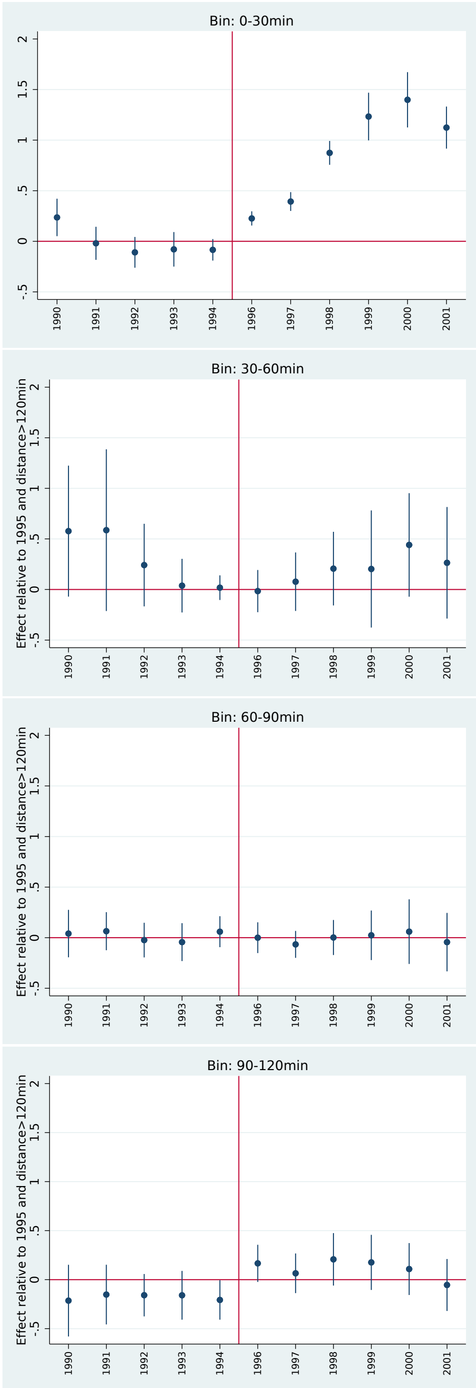
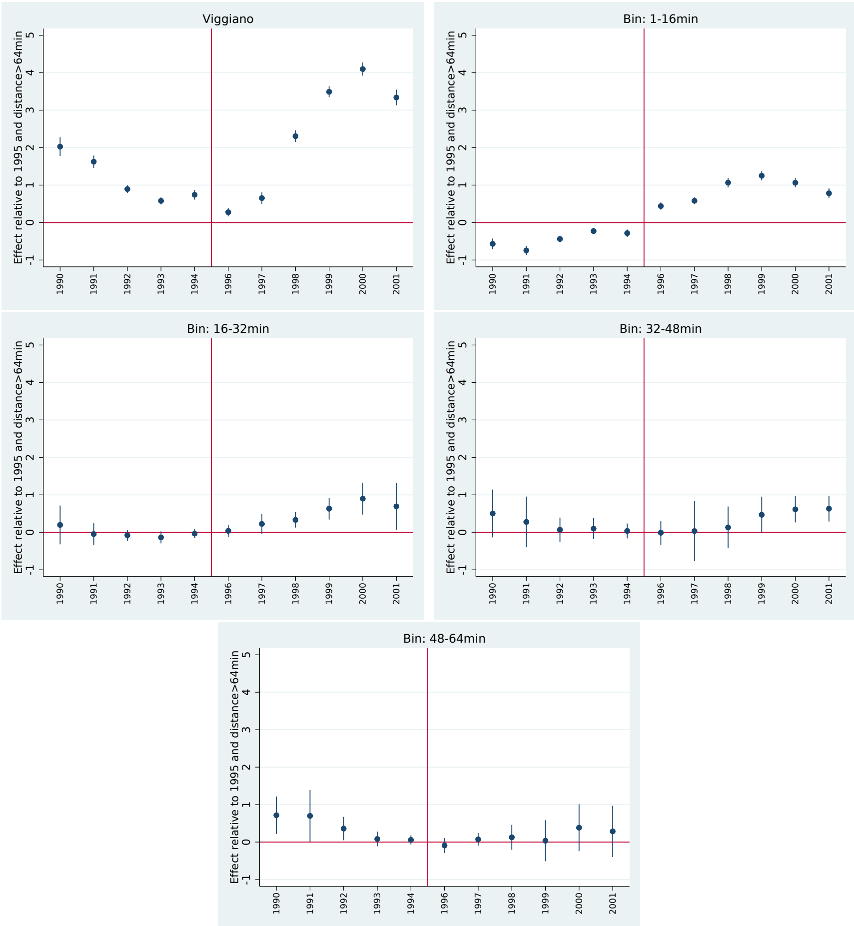
Appendix A Additional event-study graphs

Figure 12: Event-study graph for the 30-min bins



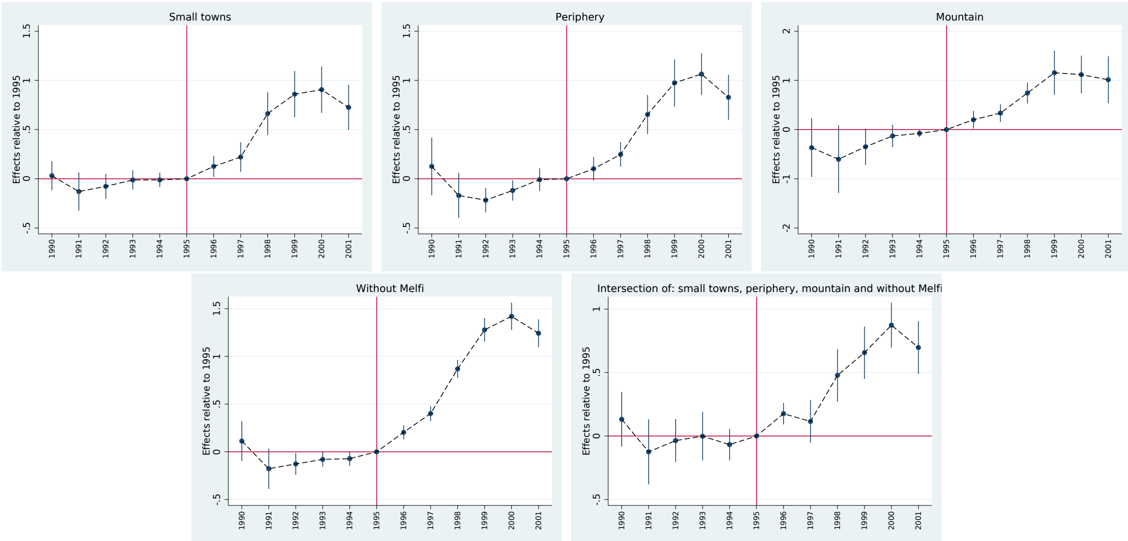
Note: the plots report the coefficients on the interaction between year dummies and a dummy for municipalities at different distances from Viggiano estimated in the same regression. The excluded year is 1995 and the excluded distance bin is made of municipalities further than 120 minutes from Viggiano. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Figure 13: Event-study graph for the 16-min bins



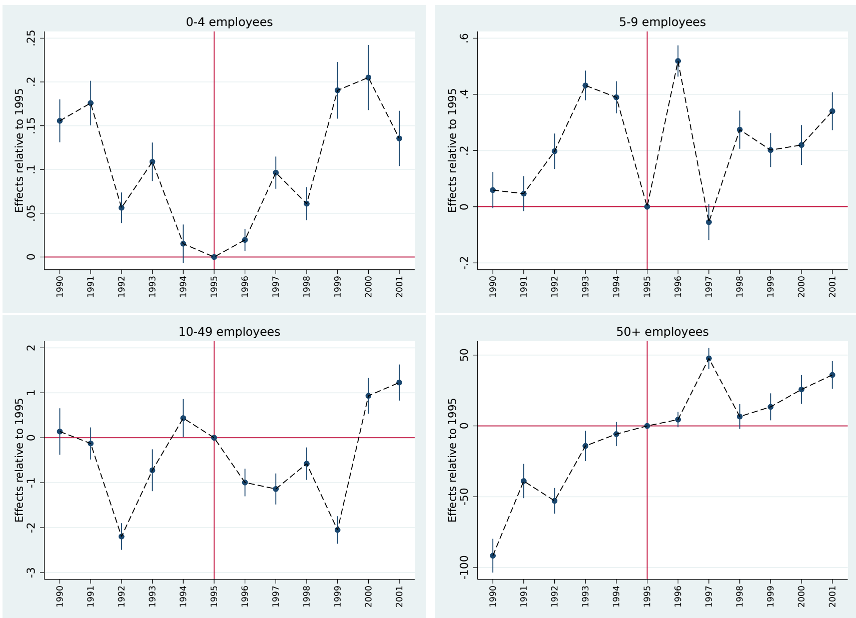
Note: the plots report the coefficients on the interaction between year dummies and a dummy for municipalities at different distances from Viggiano estimated in the same regression. The excluded year is 1995 and the excluded distance bin is made of municipalities further than 64 minutes from Viggiano. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Figure 14: Event-study graph for the restricted geographical sub-samples



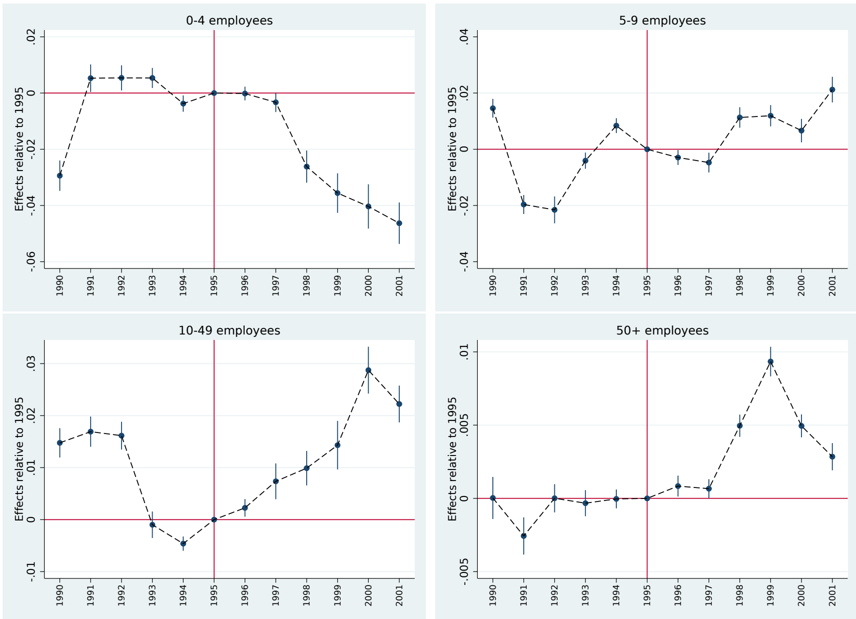
Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees. The samples are as follows: "Small town" is restricted to firms in municipalities with less than 6,000 inhabitants; "Periphery" in peripheral municipalities; "Mountain" in municipalities above 600 meters; "Without Melfi" excludes the commuting zone of Melfi.

Figure 15: Event-study graph for heterogeneity by size (n. of employees - "intensive margin")



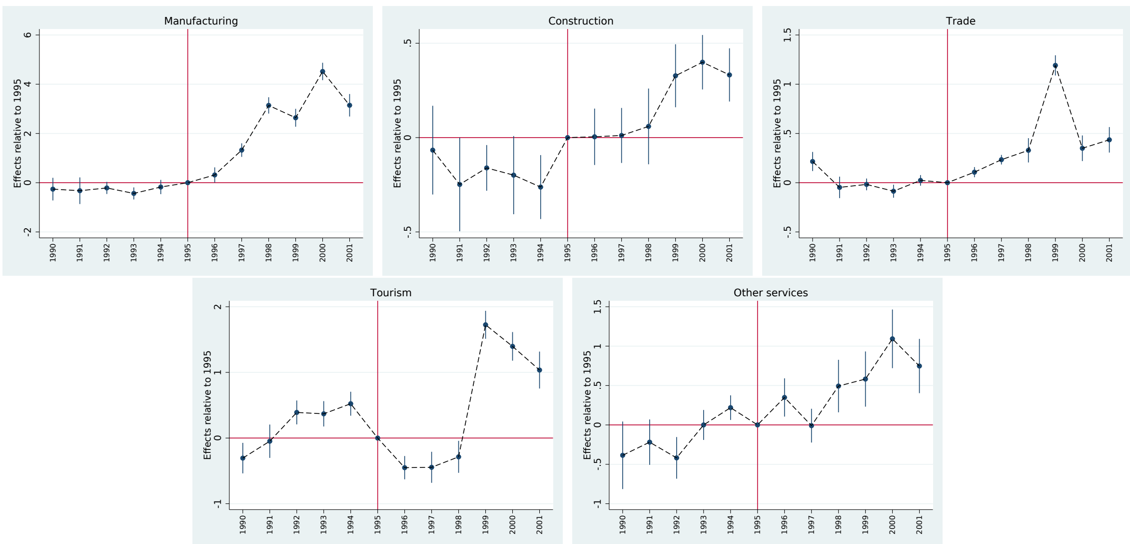
Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place estimated in four separate regressions. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Figure 16: Event-study graph for heterogeneity by size (Pr(n. of employees) - "extensive margin")



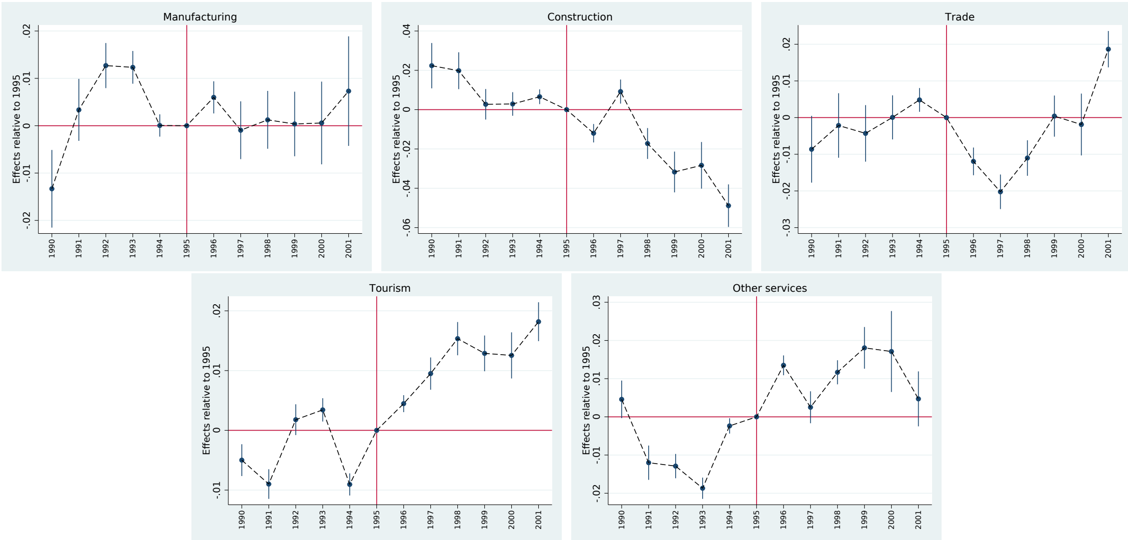
Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place estimated in four separate regressions. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Figure 17: Event-study graph for heterogeneity by sector (n. of employees - "intensive margin")



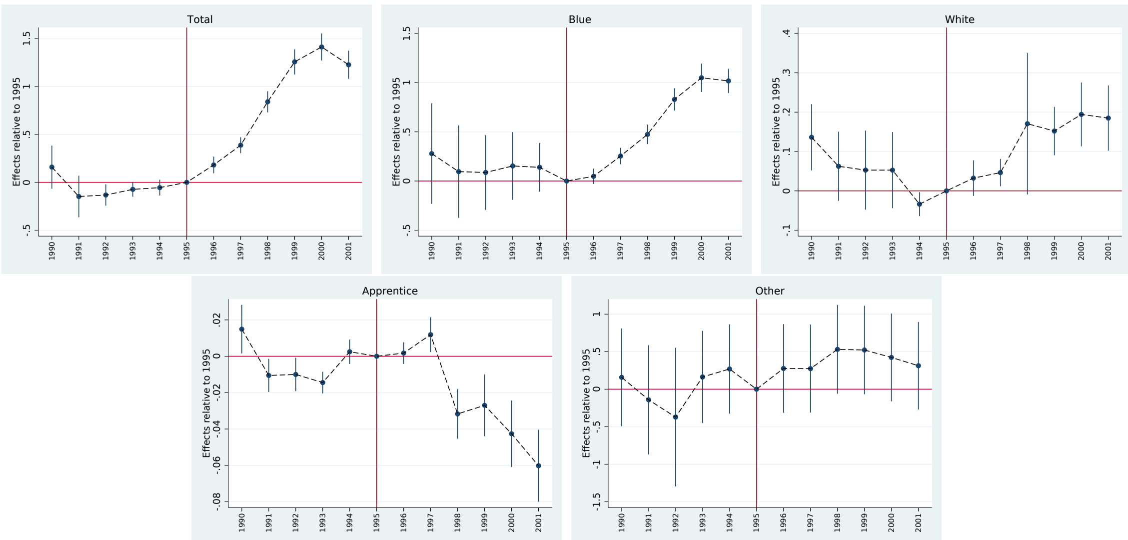
Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place estimated in four separate regressions. The excluded year is 1995. The model also includes year dummies and municipal dummies. The outcome variable is the number of employees.

Figure 18: Event-study graph for heterogeneity by sector (Pr(n. of employees) - "extensive margin")



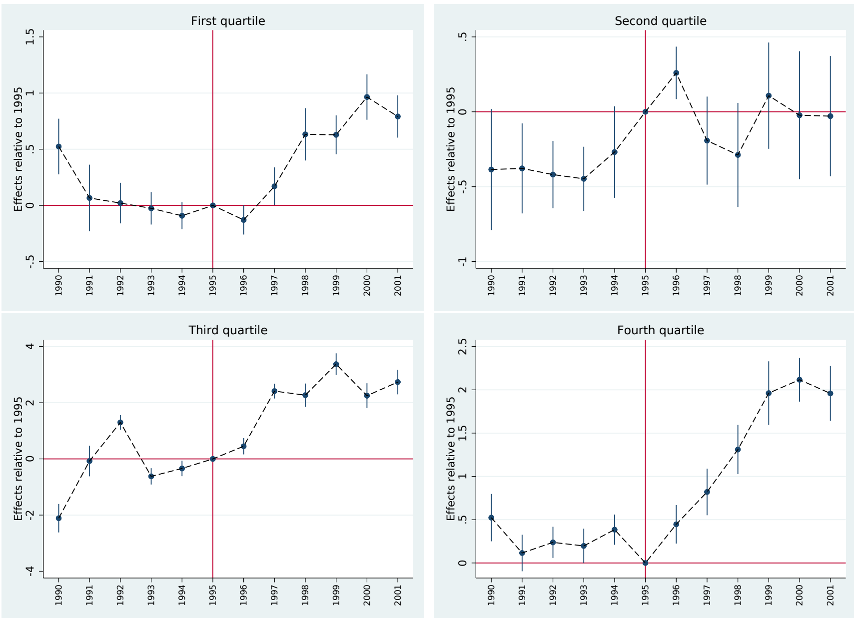
Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place estimated in four separate regressions. The excluded year is 1995. The model also includes year dummies and municipal dummies. The outcome variable is the number of employees.

Figure 19: Event-study graph for heterogeneity by type of employee



Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place estimated in four separate regressions. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Figure 20: Event-study graph for heterogeneity by quartile of upstreamness



Note: the plots report the coefficients on the interaction between year dummies and a dummy for the local labor market where oil extraction takes place. The excluded year is 1995. The model also includes year dummies, sector dummies and municipal dummies. The outcome variable is the number of employees.

Appendix B Additional tables

Table 13: Descriptive statistics. Sample: small towns, 1990-1995

	Ctrl	Treat	Diff
Average wage (euro)	114085	120076	−59.92***
Average wage (euro) - trim 99.9	113594	120076	−64.82***
Average wage (euro) - trim 99	111606	119318	−77.12***
Employees	3.88	2.99	0.89
Employees - right trim 99.9	3.40	2.99	0.41*
Employees - right trim 99	3.03	2.79	0.24**
Blue collars	2.67	2.42	0.24
White collars	0.44	0.37	0.06
Apprentices	0.20	0.15	0.05***
Manufacturing (0/1)	0.22	0.19	0.03***
Construction (0/1)	0.43	0.44	−0.01
Trade (0/1)	0.17	0.20	−0.03***
Tourism (0/1)	0.09	0.05	0.04***
Other services (0/1)	0.09	0.12	−0.03***
Tradeble (0/1)	0.51	0.49	0.02*
Upstream (0/1)	0.17	0.22	−0.04***
No. observations	49126	3191	

Note: column *Treat* refers to firms in the same local labor market (SLL) as the oil fields, and *Ctrl* to those outside. Column *Diff* reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

Table 14: Descriptive statistics. Sample: periphery, 1990-1995.

	Ctrl	Treat	Diff
Average wage (euro)	113294	120076	−67.82***
Average wage (euro) - trim 99.9	113020	120076	−70.56***
Average wage (euro) - trim 99	111712	119318	−76.06***
Employees	4.06	2.99	1.07
Employees - right trim 99.9	3.55	2.99	0.56**
Employees - right trim 99	3.02	2.79	0.23*
Blue collars	2.90	2.42	0.48
White collars	0.51	0.37	0.14
Apprentices	0.22	0.15	0.07***
Manufacturing (0/1)	0.21	0.19	0.02**
Construction (0/1)	0.40	0.44	−0.04***
Trade (0/1)	0.19	0.20	−0.01
Tourism (0/1)	0.09	0.05	0.04***
Other services (0/1)	0.11	0.12	−0.01
Tradeble (0/1)	0.52	0.49	0.03***
Upstream (0/1)	0.18	0.22	−0.03***
No. observations	56777	3191	

Note: column *Treat* refers to firms in the same local labor market (SLL) as the oil fields, and *Ctrl* to those outside. Column *Diff* reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

Table 15: Descriptive statistics. Sample: mountain, 1990-1995.

	Ctrl	Treat	Diff
Average wage (euro)	121579	120076	15.03
Average wage (euro) - trim 99.9	121111	120076	10.35
Average wage (euro) - trim 99	119272	119318	−0.46
Employees	4.50	2.99	1.51*
Employees - right trim 99.9	4.14	2.99	1.16***
Employees - right trim 99	3.28	2.79	0.49***
Blue collars	3.09	2.42	0.66**
White collars	0.93	0.37	0.56*
Apprentices	0.20	0.15	0.05***
Manufacturing (0/1)	0.20	0.19	0.01
Construction (0/1)	0.40	0.44	−0.04***
Trade (0/1)	0.21	0.20	0.00
Tourism (0/1)	0.05	0.05	−0.00
Other services (0/1)	0.14	0.12	0.03***
Tradeble (0/1)	0.49	0.49	−0.00
Upstream (0/1)	0.21	0.22	−0.01
No. observations	35426	3191	

Note: column *Treat* refers to firms in the same local labor market (SLL) as the oil fields, and *Ctrl* to those outside. Column *Diff* reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

Table 16: Descriptive statistics. Sample: no Melfi, 1990-1995.

	Ctrl	Treat	Diff
Average wage (euro)	122909	120076	28.33**
Average wage (euro) - trim 99.9	122443	120076	23.67**
Average wage (euro) - trim 99	120642	119318	13.24
Employees	5.00	2.99	2.01*
Employees - right trim 99.9	4.49	2.99	1.50***
Employees - right trim 99	3.65	2.79	0.86***
Blue collars	3.37	2.42	0.94***
White collars	1.04	0.37	0.67*
Apprentices	0.22	0.15	0.07***
Manufacturing (0/1)	0.22	0.19	0.03***
Construction (0/1)	0.30	0.44	−0.14***
Trade (0/1)	0.25	0.20	0.04***
Tourism (0/1)	0.07	0.05	0.01**
Other services (0/1)	0.17	0.12	0.05***
Tradeble (0/1)	0.57	0.49	0.08***
Upstream (0/1)	0.23	0.22	0.01
No. observations	176882	3191	

Note: column *Treat* refers to firms in the same local labor market (SLL) as the oil fields, and *Ctrl* to those outside. Column *Diff* reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

Table 17: Descriptive statistics. Sample: all above, 1990-1995.

	Ctrl	Treat	Diff
Average wage (euro)	112326	120076	−77.50***
Average wage (euro) - trim 99.9	111820	120076	−82.56***
Average wage (euro) - trim 99	110275	119318	−90.43***
Employees	2.64	2.99	−0.34***
Employees - right trim 99.9	2.64	2.99	−0.34***
Employees - right trim 99	2.62	2.79	−0.17*
Blue collars	2.13	2.42	−0.29***
White collars	0.26	0.37	−0.11***
Apprentices	0.20	0.15	0.05***
Manufacturing (0/1)	0.21	0.19	0.02
Construction (0/1)	0.51	0.44	0.08***
Trade (0/1)	0.15	0.20	−0.05***
Tourism (0/1)	0.06	0.05	0.00
Other services (0/1)	0.08	0.12	−0.04***
Tradeble (0/1)	0.44	0.49	−0.05***
Upstream (0/1)	0.16	0.22	−0.06***
No. observations	8951	3191	

Note: column $Treat$ refers to firms in the same local labor market (SLL) as the oil fields, and $Ctrl$ to those outside. Column $Diff$ reports the difference between the means in the other two columns. Sectoral dummies are created by aggregating 2-digit ATECO codes.

Table 18: Industries by quartile of upstreamness.

Industry	Quartile
05 Mining of coal and lignite	4
06 Extraction of crude petroleum and natural gas	4
08 Other mining and quarrying	4
09 Mining support service activities	4
10 Manufacture of food products	1
11 Manufacture of beverages	1
12 Manufacture of tobacco products	1
13 Manufacture of textiles	1
14 Manufacture of wearing apparel	1
15 Manufacture of leather and related products	1
16 Manufacture of wood [. . .]	1
17 Manufacture of paper and paper products	2
18 Printing and reproduction of recorded media	1
19 Manufacture of coke and refined petroleum products	4
20 Manufacture of chemicals and chemical products	4
21 Manufacture of basic pharmaceutical products [. . .]	3
22 Manufacture of rubber and plastic products	3
23 Manufacture of other non-metallic mineral products	4
24 Manufacture of basic metals	2
25 Manufacture of fabricated metal products [. . .]	1
26 Manufacture of computer, eletronic and optical products	2
27 Manufacture of electrical equipment	3
28 Manufacture of machinery and equipment n.e.c	4
29 Manufacture of motor vehicles, trailers and semi-trailers	4
30 Manufacture of other transport equipment	4
31 Manufactire of furniture	1
32 Other manufacture	1
33 Repair and installation of machinery and equipment	4
35 Electricity, gas, steam and air conditioning supply	4
36 Water collection, treatment and disposal activities [. . .]	4
37 Sewerage	4
38 Waste collection, treatment and disposal activities [. . .]	4
39 Remediation activities and other waste management [. . .]	4
41 Construction of buildings	1
42 Civil engineering	1
43 Specialised construction activities	1
45 Wholesale and retail traind and repair of motor vehicles [...]	4
46 Wholesale trade, except of motor vehicles [...]	4
47 Retail trade, except of motor vehicles and motorcycles	2
49 Land transport and transport via pipelines	4
50 Water transport	4
51 Air transport	4
52 Warehousing and support activities for transportation	3
53 Postal and courier activities	4
55 Accomodation	3
56 Food and beverage service activities	3
58 Publishing activities	3
59 Motion picture, video and television programme [. . .]	3
60 Programming and broadcasting activities	3
61 Telecommunications	3
62 Computer programming, consultancy and related [. . .]	4
63 Information service activities	4
64 Financial service activities, except insurance [. . .]	3
65 Insurance, reinsurance and pension funding [. . .]	3
66 Activities auxiliary to financial services [. . .]	1
68 Real estate activities	1
69 Legal and accounting activities	3
70 Activities of head offices; management consulatancy [. . .]	3
71 Architectural and engineering activities [. . .]	4
72 Scientific research and development	4
73 Advertising and market research	3
74 Other professional, scientific and technical activities	4
75 Veterinary activities	4

Continued on next page

Table 18 – continued from previous page

Industry	Quartile
77 Rental and leasing activities	4
78 Employment activities	1
79 Travel agency, tour operator reservation service [...]	3
80 Security and investigation activities	3
81 Services to buildings and landscape activities	3
82 Office administrative, office support and other [...]	3
90 Creative, arts and entertainment activities	3
91 Libraries, archives, museums and other [...]	3
92 Gambling and betting activities	3
93 Sports activities and amusement and recreation [...]	4
94 Activities of membership organisations	4
95 Repair of computers [...]	3
96 Other personal service activities	2

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