Judicial Administration and Business Spillovers: The Spatial Impact of Anti-Mafia Measures in Southern Italy

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Draft paper

Abstract: This analysis examines the indirect effects of a mafia firm's entry into receivership on neighboring firms (within a 10-km radius) operating in the same macro sector. Judicial administration is an intervention aimed at disrupting links between the mafia and the legal economy without altering market competition. Through an event study and dynamic diff-in-diff applied to a panel of 46,254 firms in Southern Italy, observed from 2006 to 2023, we find a decline in revenues (-2.24 percent per unit of treatment) and employment (-2.05 percent per unit of treatment) in the first three years after the measure. These results highlight how criminal organizations not only infiltrate the legal economy but also become an integral part of it, profoundly affecting the stability and functioning of the local market.

Keywords: organized crime, diff-in-diff, event study analysis, spatial spillovers.

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1 Introduction

In the past, the Mafia was not regarded as a threat in the societies where it operated (Sciarrone, 2002b). The relationship between the Mafia and the state was characterized by a symbiotic coexistence, with the logics of extralegal order intertwined with those of public order (Pizzorno, 1987).

The Italian state's struggle against the Mafia has often been marked by a chronic delay in intervention, with responses coming only after serious escalations of violence. Consequently, state measures against mafia expansion have historically been reactive, aimed more at responding to events than preventing them. This delay has allowed mafia organizations to become deeply embedded in the social and economic fabric, transforming themselves into essential actors within markets. As a result, genuine "gray areas" have emerged within the legal economy—areas in which the legal and illegal spheres collude to such an extent that the boundary between them becomes indistinguishable (Sciarrone and Storti, 2024). To date, the markets where the Mafia operates as an economic actor represent the most sensitive targets for intervention in the fight against organized crime. Anti-mafia efforts in these gray areas must therefore focus on unraveling the intricate connections between the Mafia and the economy, distinguishing the various degrees of compromise and complicity between legal and illegal actors. One of the intervention models developed by the Italian legislative system to curb mafia economic activity is judicial administration (JA), which forms the basis of the empirical analysis in this paper.

Judicial administration, governed by Article 34 of the Italian Anti-Mafia Code and fully reformulated by Article 10 of Law No. 161/2017, stipulates that if an enterprise's economic activity is directly or indirectly influenced by mafia dynamics, a new administrator (the judicial administrator) is appointed to work alongside the enterprise's legal administrator, thereby curtailing opportunities for collusion or cooperation with the mafia. Unlike seizure or confiscation, which remove the involved enterprise from the market, judicial administration was designed to safeguard business activity and inhibit mafia infiltration without undermining the pre-existing competition among enterprises.

Empirically, evaluating the indirect effects of confiscation or seizure might reveal an ostensibly positive effect—arising from a contraction in competition and concentration of demand among the surviving firms. In contrast, judicial administration curbs mafia economic activity without distorting the competitive landscape, making it particularly well suited for a pre/post analysis that can capture both positive and negative indirect effects.

The objective of this analysis is to investigate the local indirect effects of the entry of mafia-linked firms into judicial administration on the performance of neighboring firms operating in the same macrosector.

The analysis was conducted using data from Italian firms observed for ten years, spanning from 2006 to 2023. The data, collected from the Italian Aida database, consist of an unbalanced panel that is exploited for a pre-post analysis.

Within the economic literature, the institution of receivership has been examined from different perspectives. For example, Calamunci, Di Benedetto, and Silipo (2021) tested the effects of receivership on the financial indicators of firms that entered into receivership, while Calamunci and Drago (2020) focused on the indirect effects of entering receivership on the profitability, performance, and investments of legal firms operating in the same industry and province as those in judicial administration (JA).

Consistent with Calamunci and Drago (2020), the analysis presented in this paper examines the spillover effect on legal firms (i.e., those that have never entered receivership) resulting from a neighboring firm's entry into receivership. Unlike the aforementioned work—which considered firms as neighbors if they belonged to the same province and macrosector—this analysis defines neighbors as firms that not only operate in the same macrosector but are also located within a maximum distance of 10 km. By incorporating a spatial component through the calculation of distances using Vincenty's formula (Hijmans, 2020), we can more accurately identify spillover effects among truly neighboring firms, thereby reducing distortions that would inevitably arise from using a static territorial criterion such as province membership.

Furthermore, the analysis employs both a traditional event study approach (Clarke and Tapia Schythe, 2021) and a dynamic diff in diff model (de Chaisemartin and d'Haultfoeuille, 2024). In the latter, a non binary, continuous variable—representing the number of neighboring firms in the same macrosector that enter receivership each year—is used as the event variable, allowing us to capture varying intensities of the legislative intervention.

This paper is divided into several sections. The first section sets out the institutional framework, illustrating the operational role of JA in the fight against organized crime. The second section offers a review of the main contributions in the economic literature on the topic. The third section describes

the composition of the dataset and the criteria adopted for the selection of treated and control firms. The fourth section outlines the empirical strategy, including robustness analyses, while the final section presents and discusses the results obtained.

2 The role of judicial administration in the fight against the Mafia

The origins of the Italian Mafia, understood as "mafia acting," date back to the end of Sicilian feudalism (Gambetta, 1992; Bandiera, 2003), when landowners, in an effort to defend their property rights, hired bandits for protection (Dixit, 2009).

During the early postwar period, the Mafia continued to manifest itself as banditry, focusing primarily on matters related to land management. It was not until the late 1950s that Mafia interests began to shift toward the construction contracting business. Nevertheless, at that time, the Mafia was not yet perceived as a threat by the state.

The true extent of *Cosa Nostra*'s danger became apparent with the numerous Mafia murders in Palermo in 1962. Confronted with a growing awareness of *Cosa Nostra*'s economic ambitions, the Parliamentary Anti Mafia Commission was established. However, the work of the first Commission culminated in three final reports in 1968, including a majority report that reduced the Mafia to a criminal organization devoid of political entanglements, attributing its existence largely to regional customs.

Legislatively, the state ceased to ignore the Mafia phenomenon only after the tragic events of 1982, which culminated in the murders of the regional secretary of the Communist Party, Pio La Torre, and Palermo's prefect, Carlo Alberto Dalla Chiesa. On September 13, 1982, Law No. 646 was enacted, introducing Article 416 bis into the Italian Penal Code and, for the first time, defining "Association of Mafia-type."

From that point forward, the balance of power between the state and the Mafia changed radically. The Palermo anti Mafia pool, composed of Giovanni Falcone, Paolo Borsellino, Leonardo Guarnotta, and Giuseppe Di Lello, launched an unprecedented offensive against *Cosa Nostra*. Through bank investigations and arrests, this team implemented the insights of Boris Giuliano and Cesare Terranova, who were among the first to examine the links between the Mafia and the economy. Law 416 bis also provided the legal basis for the indictment of 475 defendants in the *Maxiprocesso*, which was conducted in the bunker room of Palermo's Ucciardone prison between February 10, 1986, and December 16, 1987. However, in the subsequent years, a decline in state and media attention allowed *Cosa Nostra* to reorganize. In 1992, the Mafia embarked on a spree of massacres, with bombings that claimed the lives of, among others, Giovanni Falcone and Paolo Borsellino. In response to these atrocities, the state launched a new wave of legislative interventions. Legislative Decree No. 306 of 1992 introduced the institution of judicial administration (JA). However, this measure initially remained unused, partly due to ambiguity regarding its objectives and implementation procedures.

Currently, judicial administration is regulated by Article 34 of the Italian Anti Mafia Code, as reformulated by Article 10 of Law No. 161/2017. This measure is applied when asset investigations by the Guardia di Finanza or the Judicial Police reveal that an enterprise's economic activity is, directly or indirectly, subject to intimidation or forms of subjugation attributable to the mafia dynamics described in Article 416 bis of the Criminal Code. JA may also be imposed when an economic activity—including business operations—risks facilitating individuals subject to personal or asset prevention measures, or those under investigation for crimes such as mafia association, extortion, usury, money laundering, and the use of goods of illicit origin.

In such cases, the management of companies and assets that could, even indirectly, be exploited for economic activities linked to organized crime is entrusted to a judicial administrator, who is appointed by the competent court together with a delegated judge. The judicial administrator assumes all the powers held by the legal owners of the properties and companies subject to the measure.

This measure may be adopted for a period not exceeding one year. Upon the expiration of the JA period, several options are available: (a) if the judicial administrator's report indicates the need for an extension, the measure may be renewed for a period not exceeding two years; (b) judicial administration may be revoked; (c) the measure may be replaced by judicial control; or (d) the assets involved may be permanently confiscated if the attempt at rehabilitation through JA proves ineffective.

By implementing this preventive measure—which removes from the involved parties the management and availability of assets and economic activities that serve criminal interests—the aim is to counter the expansion of the mafia phenomenon by limiting its influence on the legal economy while preserving the

operational continuity of the business. In this way, the institution seeks to shield healthy enterprises from mafia contamination, emphasizing prevention rather than mere repression (Sciarrone and Storti, 2024).

From a sociological perspective, judicial administration emerges as a critical tool for countering mafia activity within what Sciarrone and Storti (2021) refer to as the "gray areas" of the economy—that is, markets where mafiosi operate as economic actors and forge relationships with legitimate businesses. These markets predominantly consist of traditional sectors characterized by stringent public regulation and limited competition (Lavezzi, 2008; Sciarrone, 2002a, 2021; Transcrime, 2013). In these contexts, mafiosi are not distinguished by exceptional entrepreneurial, managerial, or financial skills; rather, their strength lies in their ability to establish strategic relationships, leveraging the expertise of entrepreneurs, professionals, and public officials. In exchange, they provide significant economic resources and exert violence for personal protection or to resolve private disputes (Sciarrone and Storti, 2024).

These dynamics yield mixed outcomes: while the removal of mafia influence may enhance competitive quality, it can simultaneously harm businesses that have, either intentionally or inadvertently, relied on the services provided by organized crime. This duality raises important questions about the indirect effects of anti mafia measures on the local economy. Although judicial administration is designed to rehabilitate infiltrated enterprises, it also carries the risk of destabilizing the market by disrupting established networks of relationships and economic mechanisms that have long benefited many participants.

Ultimately, the impact of judicial administration—whether positive or negative—hinges critically on the timeliness of intervention. Delayed action may allow the Mafia to become deeply entrenched in the market, build robust relational networks, and ultimately transform into an indispensable component of the local economic system.

3 Literature review

Mafia influence within the legal economy has been analyzed from various perspectives in the economic literature. The study conducted by Transcrime (2013) was the first to identify the distinctive traits of criminal enterprises — that is, those firms found by judicial investigations to be linked to mafia organizations. Transcrime (2013) found that these firms are primarily concentrated in sectors characterized by low openness to foreign markets, limited technological innovation, high labor intensity, and a predominance of small and medium-sized enterprises. In addition, these sectors are marked by high deregulation, strong territorial specificity, and significant involvement of public and government resources.

The report also indicates that the profitability of these firms is similar to, or even lower than, that of their legal competitors, owing to inefficient management. This occurs despite their employment of typical mafia practices, such as the intimidation of workers, competitors, and suppliers, as well as the manipulation of public contracts. In fact, the economic and financial management of such enterprises appears to be oriented more toward money laundering and the concealment of illegal activities than toward profit maximization.

Parbonetti (2021) later reconfirmed the "identikit" of the mafia enterprise by analyzing data on mafia-linked firms, identified based on judicial police operations and related convictions. He demonstrates that the distinctive traits of these criminal enterprises have remained largely unchanged from those highlighted by Transcrime (2013), despite the passage of time. Additionally, Parbonetti (2021) emphasizes that events related to the SARS CoV 2 pandemic have provided an opportunity for the Mafia to further develop and become entrenched.

Several authors have examined the impact of policies and measures against organized crime on local economies. Most studies focus on so called criminal enterprises — those operating in the gray area of the economy (Sciarrone and Storti, 2024; Transcrime, 2013; Parbonetti, 2021) — but have produced mixed results. Among these, Operti (2018) investigates the effects of confiscating assets linked to criminal organizations on the rate of new business formation at the provincial level in Italy between 2009 and 2013. The study identifies two opposing dynamics. On the one hand, the removal of economic assets associated with organized crime reduces irregular competition and stimulates entrepreneurial innovation, thereby fostering new business creation; on the other hand, the confiscation of operational assets of the Mafia can create an institutional vacuum, weaken territorial control, and generate uncertainty, which negatively impacts the emergence of new businesses.

Daniele and Dipoppa (2019) examine the effectiveness of a screening mechanism introduced by the Italian government in 2013 to exclude businesses potentially linked to the Mafia from applying for subsidies exceeding 150,000 euros. Their findings indicate that approximately 3.8 percent of firms strate-

gically reduced the subsidy amounts requested in order to avoid audits, thereby highlighting the capacity of mafia-linked firms to circumvent anti corruption measures.

Donato, Saporito, and Scognamiglio (2013) analyze the credit and management profile of mafia-related firms following confiscation. The authors highlight that the reduction in credit by banking institutions begins as early as four years before confiscation, likely coinciding with the onset of judicial investigations.

Calamunci, De Benedetto, and Silipo (2021), using a difference-in-differences approach, assess how the placement of firms linked to organized crime under judicial administration affects their access to credit. The results indicate that, prior to the court order, the financing terms granted to mafia-affiliated firms do not differ significantly from those of legal firms. However, once firms enter judicial administration, banks significantly reduce lending to confiscated firms, suggesting that the measure mitigates information asymmetry between lenders and firms. Fabrizi and Parbonetti (2021), analyzing data on Italian firms through a difference-in-differences procedure, observe that the removal of a mafia firm from the market leads to improved performance among legal firms operating in the same industry and municipality. This improvement is quantified as a 20.4% increase in normalized EBITDA relative to total assets. However, assessing the indirect effects of removing a mafia firm from the market presents a methodological challenge: the observed improvement in the performance of neighboring legal firms could stem from a reduction in competition rather than the cessation of mafia influence.

Calamunci and Drago (2020) address this issue by examining the indirect effects of judicial administration, a measure that severs a firm's mafia ties without disrupting its operations. Their study is methodologically closest to the approach adopted in this paper. Using financial data from corporations in Southern Italy, they assess the impact of a mafia firm's entry into judicial administration on legal firms in the same sector and province through an event study analysis. Their results indicate a 2.2% increase in performance and a 0.7% rise in turnover in the first four years following the judicial administration of a firm operating in the same province and sector.

This study differs from Calamunci and Drago (2020) and the broader econometric literature on this topic in several key aspects:

- *Definition of the local market*: While Calamunci and Drago define neighboring firms based on provincial boundaries, our study leverages latitude and longitude data to define firms as operating within the same market only if they are located within a 10-km radius.
- *Selection of control firms*: Calamunci and Drago identify control firms as those operating in the same city but in different industries. In contrast, our control group consists of firms that have never had competitors entering judicial administration within a 50-km radius. Additionally, to ensure greater comparability among firms, we employ propensity score matching.
- *Methodology of analysis*: In addition to event study analysis, we use a dynamic difference-in-differences estimator (de Chaisemartin and d'Haultfoeuille, 2024), which is robust to heterogeneity and applicable to unbalanced panels. Unlike traditional difference-in-differences models, this method accommodates nonbinary treatments, represented by discrete or continuous variables that can fluctuate over time. In our case, the treatment variable is the number of neighboring firms (within a 10-km radius) in the same industry that enter judicial administration each year.

4 Definition of hypotheses

Studying the indirect effects of a mafia firm's entry into receivership on legal firms operating in the same macrosectors opens up the possibility of identifying three distinct scenarios. The first scenario involves the absence of any effects: in this case, the judicial administration of mafia enterprises would not significantly alter the performance of legal firms, suggesting that the mafia's influence did not play a decisive role in the sector's functioning. However, numerous theoretical, sociological, and empirical contributions (including North, 1990; Gambetta, 1992; Sciarrone, 2002a, 2002b, 2021; Dickie, 2004; Dixit, 2009; Sciarrone and Storti, 2024; Bonaccorsi di Patti, 2009; Varese, 2011; Pinotti, 2015; Caglayan et al., 2019; Calamunci and Drago, 2020; Calamunci, De Benedetto, and Silipo, 2021) demonstrate that the mafia plays a fundamental role in shaping local economic dynamics. The mafia not only distorts competition but also establishes networks of structural relationships, rendering it an indispensable actor in the market. Therefore, the no-effects hypothesis appears implausible, as it would imply that legal enterprises can fully and immediately replace the economic functions performed by mafia actors—contradicting what has been observed in the literature.

The second scenario posits that curbing mafia infiltration through interventions such as judicial administration boosts the performance of legal firms, thereby increasing their market share and improving competitive conditions (Calamunci and Drago, 2020). This hypothesis is based on the notion that the violent pressures exerted by mafia organizations foster a climate of distrust that hinders the natural development of competition.

In contrast, the third scenario predicts a negative effect: the removal of mafia enterprises could weaken the local economic fabric, reducing opportunities for exchange and leading to a decline in the performance of legal firms. The theoretical framework presented earlier in this paper supports the assumption that the prevailing effect is negative. This hypothesis is grounded in the unique structure of markets in the so-called gray areas—those areas where legal and extralegal actors collude, generating mutual benefits and collaborative opportunities. Indeed, the literature on the subject highlights that mafia enterprises do not solely operate through violence and intimidation; they often fulfill a functional role in these gray areas (Sciarrone, 2002a, 2002b, 2021; Sciarrone and Storti, 2024) by providing essential services such as informal debt collection, security management, and facilitating access to specific resources, thereby creating a network of mutual dependencies.

Law enforcement interventions—though preventive in nature, like judicial administration—have historically been characterized by chronic delays. This lag allows mafia organizations to consolidate their role as key players within competitive dynamics. Consequently, closing the mafia's preferential channels through direct legal intervention can create an economic vacuum that legal firms find difficult to fill, leading to reduced productivity and, in some cases, increased uncertainty and operational difficulties.

This negative effect is most pronounced in sectors where the mafia is deeply entrenched and in local economies marked by strong interdependence between legal and illegal actors. In such contexts, the mafia is not merely a market distortion but a structural component, so that its removal can have destabilizing consequences for legal firms. Therefore, rather than improving business performance, the reduction of mafia presence through judicial administration may, at least in the short run, generate adverse effects on firms operating in the same sector.

5 Data

The empirical analysis is based on an annual unbalanced panel dataset of Italian firms operating in the southern regions of Italy (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, and Sicily), observed over a ten-year period from 2006 to 2023. The data are sourced from Aida, Bureau Van Dijk's Italian database, which provides detailed company information, including firm identifiers, financial data from annual financial statements, and geographic coordinates (address, latitude, and longitude). The database also includes information on legal proceedings involving the companies, specifying the years in which these proceedings began and concluded. By cross-referencing Aida with the Italian Court of Cassation's judgments portal, 440 enterprises were identified as having been subject to judicial administration in at least one of the years considered. For each of these enterprises, data were available on their sector of activity (six-digit Ateco codes), geographic location (latitude and longitude), and the year of entry into receivership. The following criteria were used to identify treated enterprises:

1. *Definition of geographic proximity*: A legal enterprise is considered "close" to a firm placed under receivership if the distance between them is less than or equal to 10 km. The shortest distance between two firms (i.e., the 'great-circle distance' or 'as-the-crow-flies' distance) is calculated using the Vincenty (sphere) method (Hijmans, 2020)[1].

2. *Industry classification*: Proximity is considered only among firms operating within the same macrosector[2].

If a legal firm has at least one firm entering in JA within a 10-km radius and operating in the same macrosector, it is classified as treated.

This procedure results in the definition of two variables:

[1]The distVincentySphere function, available on the statistical software R, via the geosphere package, was used to calculate the distance between legal firms and those in JA.

[2]The Aida database contains information on the activity code (six digits) of enterprises. Official ISTAT linking tables, available at the link, were used to move from activity to macro sector: https://www.istat.it/it/files/2022/03/Struttura-ATECO-2007-aggiornamento-2022.xlsx

- - a binary variable JAt_i that takes values:

$$JAt_i = \begin{cases} 1, & \text{in the year when firm } i \text{ has at least one nearby firm placed under JA} \\ 0, & \text{in years when this does not occur} \end{cases} \quad (1)$$

- a continuous variable that counts year by year for each treated firm i the number of firms nearby (within a 10-km radius) and active in the same macrosector that are placed in receivership.

Using this procedure, 2,256 treated firms are identified.

Using a method similar to the previous one, the control enterprises are defined and selected based on the following criteria:

1. *Absence of proximity to enterprises in receivership*: The control enterprise must not have any mafia-related enterprises in receivership within a 50 km radius.
2. *No judicial history*: Control firms must not have been involved in judicial proceedings, as verified through information in the Aida database.
3. *Belonging to the same macrosector, period, and geographic area*: Control firms must be active in Southern Italy, operate in the same macrosectors as the treated firms, and be active in the same years.

At the end of this procedure, 77,241 control enterprises were identified.

Following the approach of Calamunci, De Benedetto, and Silipo (2021), propensity score matching[3] was applied to refine the control group and enhance comparability with treated firms. For this purpose, a probit regression was estimated, where the dependent variable equals 1 if the firm is located near a firm placed under judicial administration (JA) and 0 otherwise. Province dummies, sector dummies, and firm size dummies (classified according to EU standards as micro, small, medium, or large enterprises) were used as independent variables.

To determine the appropriate caliper for matching, Stuart and Rubin's (2008) rule of thumb was followed, setting it equal to one-fourth of the standard deviation of the propensity score. This procedure significantly reduced the number of firms in the control group but optimized their similarity to the treated firms. The final panel dataset consists of 46,254 firms, of which 2,256 are treated and the remaining 43,998 are controls.

Table 1 presents the standardized bias for the dummies related to firm size, provinces, and manufacturing sectors. The difference between the sample means in the treatment and control subsamples is expressed as a percentage of the square root of the mean of the sample variances of the two groups (Rosenbaum and Rubin, 1985). According to Caliendo and Kopeinig (2008), standardized biases below the 5% tolerability threshold, as observed in our case, are considered sufficient to confirm the effectiveness of the matching procedure. Additionally, Table 1 displays the standardized differences (t-test) between the treatment and control groups for all examined variables. The absence of statistically significant differences further confirms the reliability of the propensity score matching.

6 Empirical strategy

The empirical strategy relies on a panel of financial data that distinguishes between two groups of enterprises: treated and control. Treatment of a legal enterprise (i) is defined as proximity (within a radius of 10 km) to a mafia enterprise active in the same macrosector that is placed under judicial administration. In other words, treatment occurs in years when a law enforcement action against organized crime disrupts or weakens mafia ties in the market surrounding enterprise i. Here, the market is defined as the set of firms operating in the same macrosector and located within a 10-km radius.

The objective is to analyze the spillover effects generated by the judicial administration of a mafia enterprise and the subsequent disruption of its criminal ties on neighboring enterprises. To this end, two different models are estimated: an event study analysis (Clarke and Tapia Schythe, 2021)[4] and a dynamic difference-in-differences (de Chaisemartin and d'Haultfoeuille, 2024)[5].

[3] The psmatch2 command in Stata proposed by Leuven and Sianesi (2018) was used.

[4] The event study analysis model was estimated by Stata, using the eventdd function created by Clarke and Tapia Schythe (2021).

[5] The Chaisemartin and d'Haultfoeuille, 2024 estimator is included in the Stata did_multiplegt package (de Chaisemartin and d'Haultfoeuille, 2024).

Table 1: Comparison between treated and control group

Variable	Treated	Control	%Bias	t-test (p-value)
Self employed	0.23435	0.23435	0.0	1.000
Micro	0.6051	0.60197	0.6	0.831
Small	0.07424	0.07648	-0.8	0.777
Medium	0.00313	0.00447	-1.7	0.466
Big	0.00313	0.00268	0.6	0.781
Manufacturing	0.02862	0.02952	-0.5	0.859
Energy	0.00134	0.00134	0.0	1.000
Water & Waste	0.00089	0.00134	-0.5	0.655
Construction	0.42755	0.42934	-0.4	0.904
Wholesale & Retail	0.36628	0.37030	-0.8	0.780
Transport	0.02862	0.02594	1.3	0.582
Accommodation	0.00850	0.00716	0.6	0.611
Finance	0.00045	0.00045	0.0	1.000
Real Estate	0.12165	0.11896	0.8	0.783
Healthcare	0.01565	0.01521	0.3	0.903
Arts	0.00045	0.00045	0.0	1.000
Agrigento	0.00045	0.00045	0.0	1.000
Avellino	0.02415	0.02370	0.3	0.922
Bari	0.00850	0.00805	0.2	0.869
Barletta-Andria-Trani	0.00224	0.00224	0.0	1.000
Catania	0.81082	0.81038	0.1	0.970
Catanzaro	0.00179	0.00224	-0.4	0.739
Enna	0.00045	0.00045	0.0	1.000
L'Aquila	0.00179	0.00268	-0.7	0.527
Messina	0.02191	0.02057	0.9	0.756
Napoli	0.00045	0.00045	0.0	1.000
Palermo	0.00089	0.00089	0.0	1.000
Ragusa	0.02236	0.02057	1.1	0.680
Reggio di Calabria	0.05590	0.05635	-0.3	0.948
Salerno	0.02191	0.02370	-0.7	0.689
Taranto	0.00045	0.00045	0.0	1.000
Trapani	0.02147	0.02191	-0.3	0.918
Vibo Valentia	0.00447	0.00492	-0.7	0.827

The firms under observation are predominantly small or medium-sized, active in traditional industries, and characterized by limited involvement in extraordinary financial transactions (Transcrime, 2013; Parbonetti, 2021).

Given the profile of the analyzed firms — which includes many sole proprietorships — the focus is placed on variables related to ordinary operations, as these best represent their core activities. Therefore, the selected variables of interest include revenue from the sale of goods and services, net income and number of employees. This approach avoids incorporating extraordinary financial activities, which, given the nature of the firms under consideration, would not be representative.

We define $JAevent_g$ as the variable that identifies year t, in which a legal firm, in the treatment group g, is exposed to proximity with a mafia firm under judicial administration. We assume that the entry into JA is not randomly assigned, but is influenced by environmental, political, and judicial factors beyond our control. The causal interpretation is based on the fact that, conditional on fixed effects for unit, year, province, and industry, the timing of a firm's entry into JA related to organized crime is exogenous to the performance of its competitors. This conditional independence hypothesis is supported by several circumstances, including the long duration of criminal investigations and the high variability in the timing of judicial disposition among districts, which suggests that the timing of judicial administration is driven largely by uncontrollable exogenous factors rather than by the economic performance of neighboring firms. Additionally, we assume that, in the absence of such an event, the treated and control units would have followed parallel trends (Clarke and Tapia Schythe, 2021).

Table 2: Descriptive statistics

Treatment group	Media	Std. Dev.	Min	Max	Obs
Sales revenue	1,287.107	8,601.234	-0.003	475,763.700	22,053
Net Income	25.038	345.621	-18,030.570	15,098.390	22,053
Employees	5.097	12.452	0.000	530.000	22,053
Total assets	1,811.802	4,663.247	0.244	148,479.900	22,053
Control Group	Media	Std. Dev.	Min	Max	Obs
Sales revenue	1,986.525	14,989.590	-135.500	2,605,703.000	422,121
Net income	55.166	1,045.128	-419,311.000	114,084.100	422,093
Employees	8.361	45.872	0.000	6,244.000	422,121
Total assets	3,042.048	91,268.630	0.001	53,800,000.000	422,121

The event study specification can be written as:

$$y_{gt} = \alpha + \sum_{j=2}^{J} \beta_j \, (\text{Lead}j)_{gt} + \sum_{k=1}^{K} \gamma_k \, (\text{Lag}k)_{gt} + \mu_g + \lambda_t + \delta_{\text{sector}\times\text{year}} + \eta_{\text{prov}\times\text{year}} + \varepsilon_{gt}. \tag{2}$$

Where y_{gt} is the outcome of interest (the equation was estimated for the following outcome variables: Sales revenue, Net income and Number of Employees); α is the intercept; μ_g and λ_t are the firm and year fixed effects, respectively; $\delta_{\text{sector}\times\text{year}}$ and $\eta_{\text{prov}\times\text{year}}$ are the fixed effects from the interaction between year and sector and year and province; finally ε_{gt} is the unobserved error term. In the estimated model, lags and event leads are defined as:

$$(\text{Lag } J)_{gt} = \mathbf{1}[t \leq JAevent_g - J], \tag{3}$$
$$(\text{Lag } j)_{gt} = \mathbf{1}[t = JAevent_g - j] \quad \text{for } j \in \{1, \ldots, J-1\}, \tag{4}$$
$$(\text{Lead } k)_{gt} = \mathbf{1}[t = JAevent_g + k] \quad \text{for } k \in \{1, \ldots, K-1\}, \tag{5}$$
$$(\text{Lead } K)_{gt} = \mathbf{1}[t \geq JAevent_g + K]. \tag{6}$$

In the event study model, lag and lead variables are defined as binary indicators that indicate whether a given unit (in our case the enterprises i belonging to group g) is within a certain number of periods of the event of interest in the period under consideration. In other words, each lag or lead variable takes the value of 1 if the unit is exactly that number of periods away from the event and 0 otherwise.

In our model, we include $J = 3$ lag variables and $K = 3$ lead variables.

Firms i for which the event never occurred serve as pure controls. These units always take the value of 0 in all lag and lead variables and constitute the counterfactual upon which the impact estimation is based. Differences between treated and control firms are set to 0 in the omitted base period (Clarke and Tapia Schythe, 2021). Accordingly, lag and lead variables capture the difference between treated and control units relative to the difference observed in the base period.

An unbiased estimation of post-event effects relies on the assumption of parallel trends: in the absence of treatment, treated and control units are assumed to follow similar trends. To reinforce this assumption, the control group underwent propensity score matching, which helped balance observable characteristics between the control and treatment groups (Caliendo and Kopeinig, 2008).

The event study analysis model was estimated using the High-Dimensional Fixed Effects (HDFE) estimator developed by Correia (2023). This estimator efficiently controls for a large number of fixed effects, improving the precision and efficiency of the estimates given the high dimensionality of the panel data. The confidence level, following Calamunci and Drago (2020), was set at 90 percent.

Following the event study analysis, we estimate the dynamic Difference-in-Differences (DiD) model developed by de Chaisemartin and d'Haultfoeuille (2024), which offers a more flexible generalization of the traditional DiD approach. This model allows for the estimation of treatment effects in a panel data

context, addressing the limitations of standard Two-Way Fixed Effects (TWFE) models and classical DiD estimates (de Chaisemartin and d'Haultfoeuille, 2024).

In TWFE models, the outcome $Y_{g,t}$ is typically estimated as a function of the treatment $D_{g,t}$ while controlling for fixed effects by group and period. However, it has been shown that if treatment effects vary across groups and/or over time, TWFE estimates may be biased (Goodman-Bacon, 2021). Additionally, in classical DiD models, treatment is often assumed to be binary (0 or 1) and absorbing (once treated, a unit remains treated indefinitely), which is not always realistic. Many studies estimate dynamic effects using Distributed Lag Models or Local Projections (Jordà, 2005), but these approaches may introduce contamination into the estimated coefficients, making it difficult to isolate the true treatment effects.

To address these issues, de Chaisemartin and d'Haultfoeuille (2024) propose a DiD estimator robust to heterogeneity, which allows researchers to:

- Work with nonbinary, nonabsorbing treatments, meaning treatments that can increase or decrease over time.
- Account for dynamic effects, recognizing that outcomes may be influenced not only by the current treatment but also by past treatments (lag effects).
- Ensure compliance with the "no sign reversal" property, meaning that the estimated effect does not change sign in a way inconsistent with the treatment's direction.

The key dynamic Difference-in-Differences equation proposed by de Chaisemartin and d'Haultfoeuille (2024) is as follows:

$$\delta_{g,\ell} = \mathbb{E}\left[Y_{g,F_g-1+\ell} - Y_{g,F_g-1+\ell}(D_{g,1},\ldots,D_{g,1})\right] \tag{7}$$

where, $\delta_{g,\ell}$ that quantifies the treatment effect after ℓ periods, comparing it to the hypothetical scenario where the treatment remained unchanged; $Y_{g,t}$ represents the potential outcome observed for group g at time t. The treatment applied to group g at time t is denoted as $D_{g,t}$, which can vary continuously and does not necessarily follow a staggered implementation. The variable F_g identifies the first period in which group g experiences a change in treatment, marking the switch point. The parameter ℓ indicates the number of periods elapsed since the treatment change first occurred. The observed outcome after ℓ periods from the initial treatment shift is represented by $Y_{g,F_g-1+\ell}$. Conversely, $Y_{g,F_g-1+\ell}(D_{g,1},\ldots,D_{g,1})$ denotes the counterfactual outcome, that is, the value the group would have exhibited if the treatment had remained constant at its initial level, $D_{g,1}$.

This formula calculates the expected difference between the actual outcome of a group that experienced a change in treatment during period F_g and the counterfactual outcome the group would have had if the treatment had remained constant.

Unlike the previous model by Clarke and Tapia Schythe (2021), which uses a binary 0/1 variable to identify treatment years, the estimator proposed by de Chaisemartin and d'Haultfoeuille (2024) allows for the use of a continuous variable that quantifies the number of neighboring firms that entered receivership. This approach enables the measurement of the event's effect by assigning different intensities to each observation based on the number of judicial interventions recorded each year.

6.1 Robustness checks

To enhance the reliability of the results, two analytical approaches were used: an event study analysis (Clarke and Tapia Schythe, 2021) and a dynamic difference-in-differences model (de Chaisemartin and d'Haultfoeuille, 2024).

A key assumption in difference-in-differences and event study models is the parallel trends assumption, alongside the no-anticipation assumption. To mitigate potential violations of parallel trends, propensity score matching was applied to balance observable characteristics between treated and control groups, ensuring that post-treatment differences are attributable solely to the intervention. Ensuring the no-anticipation assumption is particularly challenging in this context. The treatment is defined as the year in which a neighboring firm enters receivership (JA), but this intervention often follows an extended investigative period. As a result, treatment effects may emerge before the intervention is officially implemented. To test for anticipation effects, the did_multiplegt routine was used to conduct placebo tests. The lack of significant results in placebo tests and a p-value above 0.05 in the Test of Joint Nullity of the Placebos support the validity of the no-anticipation and parallel trends assumptions (De Chaisemartin and d'Haultfoeuille, 2022). Moreover, the absence of a clear pre-treatment pattern in the

Table 3: Event Study Results

	Sales Revenue (ln)			Employees (ln)			Net Income (ln)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
lag3	-0.0190	-0.0131	-0.0436**	-0.0253	-0.0291	-0.0435*	-0.0000558**	-0.0000260	-0.0000442*
	(0.0174)	(0.0193)	(0.0179)	(0.0225)	(0.0249)	(0.0235)	(0.0000250)	(0.0000333)	(0.0000261)
lag2	-0.0458***	-0.0385**	-0.00464	-0.0345*	-0.0356*	-0.00326	-0.0000562***	-0.0000387	-0.0000125
	(0.0149)	(0.0162)	(0.0154)	(0.0181)	(0.0201)	(0.0189)	(0.0000176)	(0.0000243)	(0.0000193)
lag1	-0.0448***	-0.0505***	0.000657	-0.0482***	-0.0606***	-0.0240	-0.0000784***	-0.0000864***	-0.0000569**
	(0.0114)	(0.0126)	(0.0118)	(0.0142)	(0.0160)	(0.0147)	(0.0000270)	(0.0000294)	(0.0000289)
lag0	-0.0392***	-0.0461***	-0.0135	-0.0256**	-0.0415***	-0.00570	-0.0000360**	-0.0000491**	-0.0000345**
	(0.00941)	(0.0102)	(0.00988)	(0.0112)	(0.0130)	(0.0118)	(0.0000153)	(0.0000232)	(0.0000164)
lead3	0.0128	0.00764	0.0317**	0.0608***	0.0574***	0.0582***	-0.0000116	-0.0000407*	-0.00000127
	(0.0139)	(0.0160)	(0.0142)	(0.0178)	(0.0206)	(0.0183)	(0.0000170)	(0.0000218)	(0.0000175)
lead2	-0.00383	-0.000919	0.0170	0.0178	0.0193	0.0168	-0.0000284**	-0.0000208	-0.0000120
	(0.0101)	(0.0107)	(0.0104)	(0.0117)	(0.0131)	(0.0122)	(0.0000134)	(0.0000240)	(0.0000131)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector-by-year	NO	NO	YES	NO	NO	YES	NO	NO	YES
Province-by-year	NO	YES	NO	NO	YES	NO	NO	YES	NO
Observations	443798	443796	442283	308340	308335	306944	443769	443767	442254
R-squared	0.905	0.905	0.910	0.875	0.875	0.879	0.412	0.412	0.431

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

event study analysis further reinforces the hypothesis of no anticipatory effects (Calamunci and Drago, 2020).

Another concern is that the treatment analysis might obscure unobserved trends at the sector or provincial level. To address this, estimates include interactive fixed effects for both year-sector and year-province combinations. Running the models with different fixed-effects specifications also allows for robustness checks, ensuring the stability of the results.

7 Results

The first estimated model is the event study analysis (Clarke and Tapia Schythe, 2021), tested under different fixed effects specifications to enhance the robustness of the results.

The findings (Table 3) indicate that judicial administration intervention, aimed at disrupting mafia ties, is associated with negative effects on the performance of neighboring legal firms. Specifically, the estimated coefficients for lag variables related to sales revenue are negative and statistically significant in the specifications controlling for year and firm. This pattern remains unchanged even when additional fixed effects are introduced at the provincial or sectoral level, although it loses significance in the latter case.

A similar trend emerges for the number of employees, showing a significant decline in certain post-treatment periods, particularly when additional fixed effects are included. Likewise, net income exhibits a contraction in the post-intervention periods, though with a smaller magnitude.

The coefficients associated with the leads do not follow a systematic pattern. However, some significant results raise concerns about the possible violation of the non-anticipation assumption.

To further investigate this issue, a dynamic difference-in-differences (diff-in-diff) model was estimated using the de Chaisemartin and d'Haultfoeuille (2024) estimator, which, unlike other estimators, allows for a non-binary, non-absorbing treatment variable that can increase or decrease over time. In this context, a continuous treatment variable was used to measure the number of neighboring firms entering receivership each year.

The results of this model (Table 4) confirm the post-intervention decline in operating performance, aligning with the findings from the event study analysis. For sales revenue, the estimated coefficients for the first three post-treatment years are -0.042, -0.050, and -0.047, respectively. This implies an average revenue decrease, with a cumulative effect of -0.0224, equivalent to a 2.24% reduction per unit

Table 4: Results of dynamic diff-in-diff

	Sales revenue	Net income	Employees
Effect 1	-0.0422***	-0.0000402***	-0.0323***
	(0.0092)	(0.000015)	(0.0105)
Effect 2	-0.0498***	-0.0000833***	-0.0545***
	(0.0113)	(0.000028)	(0.0136)
Effect 3	-0.0474***	-0.0000516***	-0.0302
	(0.0160)	(0.000016)	(0.0196)
Average tot. effect	-0.0224***	-0.0000284***	-0.0205***
	(0.0047)	(0.000007)	(0.0059)
Placebos			
Placebo 1	-0.0044	-0.0000343**	0.0126
	(0.0100)	(0.000014)	(0.0115)
Placebo 2	0.0184	-0.0000360*	0.0218
	(0.0132)	(0.000021)	(0.0176)
Placebo 3	-0.0134	-0.0000445	0.0835**
	(0.0239)	(0.000035)	(0.0357)
Joint nullity test			
Effects Test	0.000005	0.00053	0.00035
Placebos Test	0.1918	0.0856	0.1132
Observations	365483	365463	248547

of treatment. For net income, the estimated coefficients are small but negative (-0.00004, -0.000083, and -0.000052), with a cumulative effect of -0.0000284. Although the absolute impact is minor, the result is statistically significant (joint test p-value = 0.00053), indicating a slight deterioration in post-intervention profitability. For the number of employees, the estimated coefficients are -0.032, -0.054, and -0.030, with a cumulative effect of -0.0205, highlighting a negative employment impact.

To assess the robustness of the results and examine the non-anticipation and parallel trends assumptions, three placebo tests were conducted for each outcome variable. The placebo test estimates predominantly return non-significant coefficients (Table 4). Moreover, joint placebo tests, designed to verify the absence of anticipatory effects, yield p-values above the conventional significance threshold (typically >0.05) in all three cases. This reinforces the validity of the parallel trends assumption and confirms the absence of anticipatory effects (De Chaisemartin and d'Haultfoeuille, 2022).

8 Conclusions

The analyses in this paper aim to examine the economic dynamics that unfold in what Sciarrone and Storti (2024) define as the gray areas of the legal economy, meaning those segments of the market where mafiosi and entrepreneurs collaborate in mutually beneficial relationships, each gaining something.

Over time, these patterns of cooperation have evolved into stable and advantageous organizational fields, shaping a business model that has gained legitimacy and acceptance not only in southern Italy but also in the wealthier and more developed regions of the North (Sciarrone and Storti, 2024).

The extralegal power of mafias derives legitimacy not only from the cultural traditions and value systems of the surrounding society but also from the institutional structures that regulate it. This power is highly territorial in nature, as control over the territory is a defining characteristic of mafia organizations entrenched in traditional strongholds (Sciarrone, 2002b).

Given this context, this study investigates the economic impact of anti-mafia interventions on the local economy, focusing specifically on a market segment as closely linked as possible to mafia enterprises.

The analysis examines the spillover effects triggered when a mafia-affiliated firm is placed under judicial administration, specifically observing the impact on neighboring firms operating in the same macro-sector within a 10-kilometer radius. The underlying hypothesis is that public intervention aimed at regulating the market and curbing mafia infiltration generates operational spillovers affecting all firms in the impacted area. To test this hypothesis, data on 46,254 Italian firms from the Aida database were analyzed, constructing an unbalanced panel dataset covering the period 2006–2023. A total of 2,256 treated firms were identified as located within 10 km of a firm placed under judicial administration and active in the same macro-sector, while the remaining 43,998 firms served as the control group, selected through propensity score matching to ensure comparability.

In this framework, the treatment variable takes the value 1 for years in which a treated firm is within 10 km of a firm under judicial administration and operating in the same macro-sector. Two estimation strategies were employed: an event study analysis (Clarke and Tapia Schythe, 2021), tested across various fixed effects specifications (firm, year, sector, and province), and a dynamic difference-in-differences (diff-in-diff) approach using the estimator developed by de Chaisemartin and D'Haultfoeuille (2024), which allows for a continuous treatment variable quantifying the number of neighboring firms under judicial administration to be incorporated into the analysis.

The results of the de Chaisemartin and D'Haultfoeuille (2024) estimator show that removing a firm from mafia control through judicial administration leads to a 2.24% reduction in sales revenue per unit of treatment within the first three years post-intervention, a 2.05% decline in the number of employees, and a small but significant reduction in net income, with an average cumulative effect of -0.0000284. Although the absolute impact on net income is minor, the effect remains statistically significant.

These results, obtained using a different methodology from that of Calamunci and Drago (2020), reveal spillover effects that contrast with those reported by the latter. Specifically, while Calamunci and Drago find a positive spillover effect of judicial administration on firms in the same macro-sector and province — measured through normalized EBITDA-to-total-assets — the analysis presented here, by restricting the observation to a 10-km radius around firms under judicial administration, shows a negative impact on the operating performance of firms in close proximity. Importantly, this geographic restriction does not rule out the possibility that positive effects may emerge in broader spatial contexts (such as the entire province, region, or sector); rather, our approach focuses specifically on market dynamics in areas immediately adjacent to firms under judicial administration, quantifying the effect of government intervention within a narrower and thus distinct scope of analysis.

This study presents several complexities and identification challenges that lead to certain limitations and suggest potential future improvements. First, the identification of mafia firms is based on legal proceedings, which may exclude firms linked to organized crime that have not yet been formally discovered, potentially contaminating the control group. Additionally, judicial administration does not occur at a uniform time of the year but at different points, complicating the precise interpretation of the timing of the intervention. It should also be considered that judicial administration is often preceded by investigations and inquiries that may begin to disrupt mafia ties before the formal measure is implemented; this anticipation effect risks violating key assumptions of models such as event study analysis and difference-in-differences, potentially biasing estimates and complicating the quantification of the true effect.

Recent advancements in quasi-experimental estimation methods may, in the future, provide estimators that are less sensitive to these issues, improving the accuracy of analyses in similar contexts.

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A Appendix

Figure 1: Geographic distribution of firms in JA

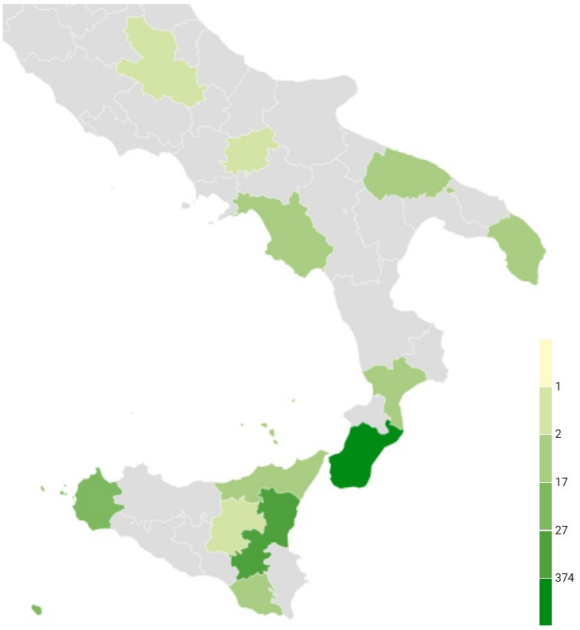
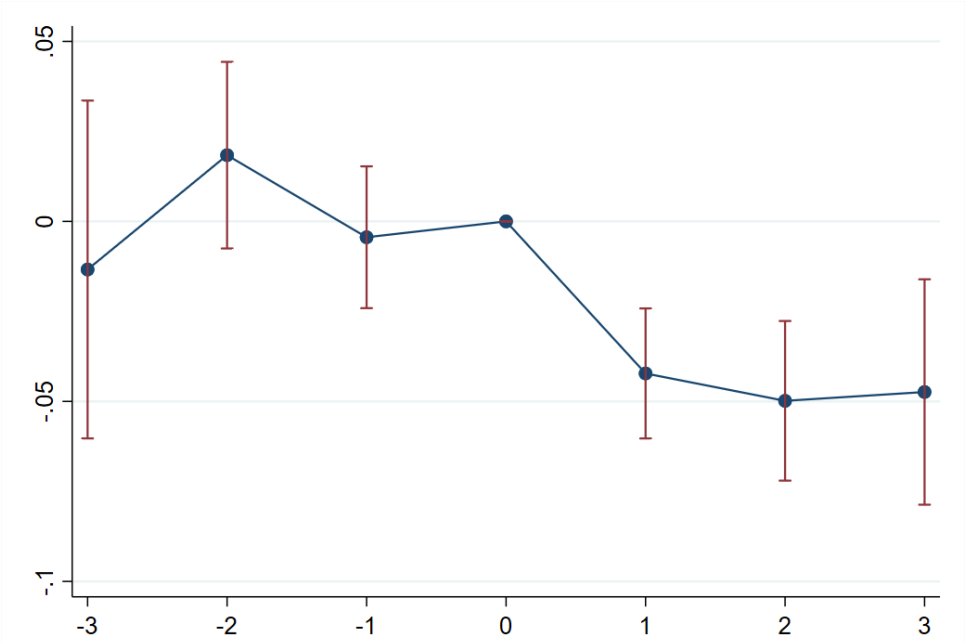


Table B5: Macrosectors of enterprises in JA

Sector	Frequency	Percentage
Manufacturing	24	5.45%
Energy	2	0.45%
Water & Waste	12	2.73%
Construction	148	33.64%
Wholesale & Retail	119	27.05%
Transport	46	10.45%
Accommodation	23	5.23%
Finance	2	0.45%
Real Estate	33	7.50%
Public Services	7	1.59%
Healthcare	11	2.50%
Arts	13	2.95%
Total	440	100.00%

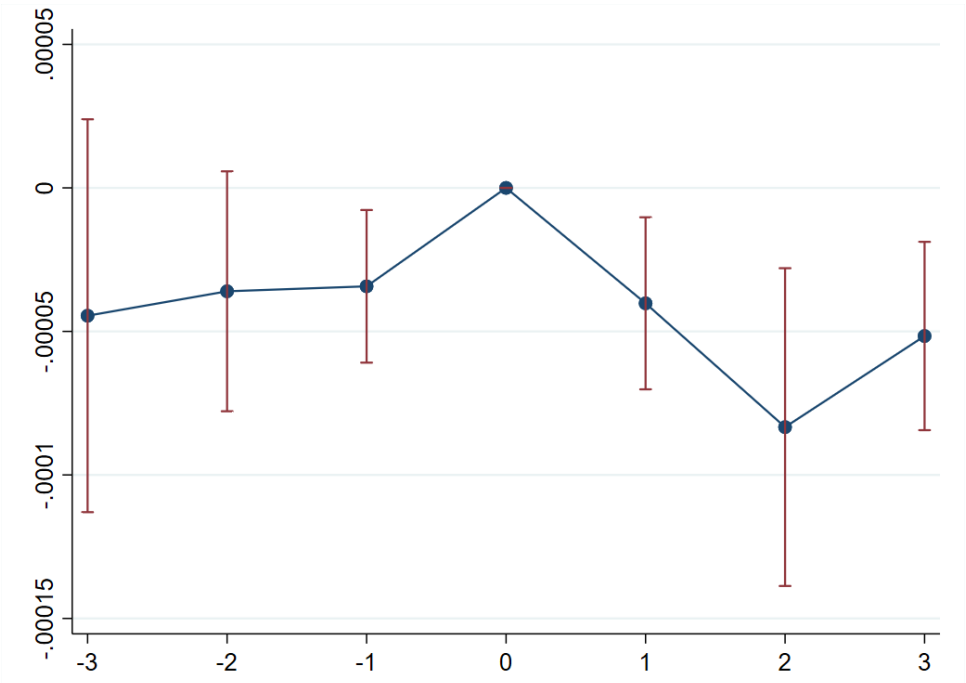
The distribution geography and by production macrosectors confirms the findings of Transcrime (2013) and Parbonetti (2021), showing a higher concentration of mafia firms in low tech sectors and in provinces where mafia infiltration is more entrenched.

Figure 2: Dynamic diff-in-diff estimates on sales revenue (ln)



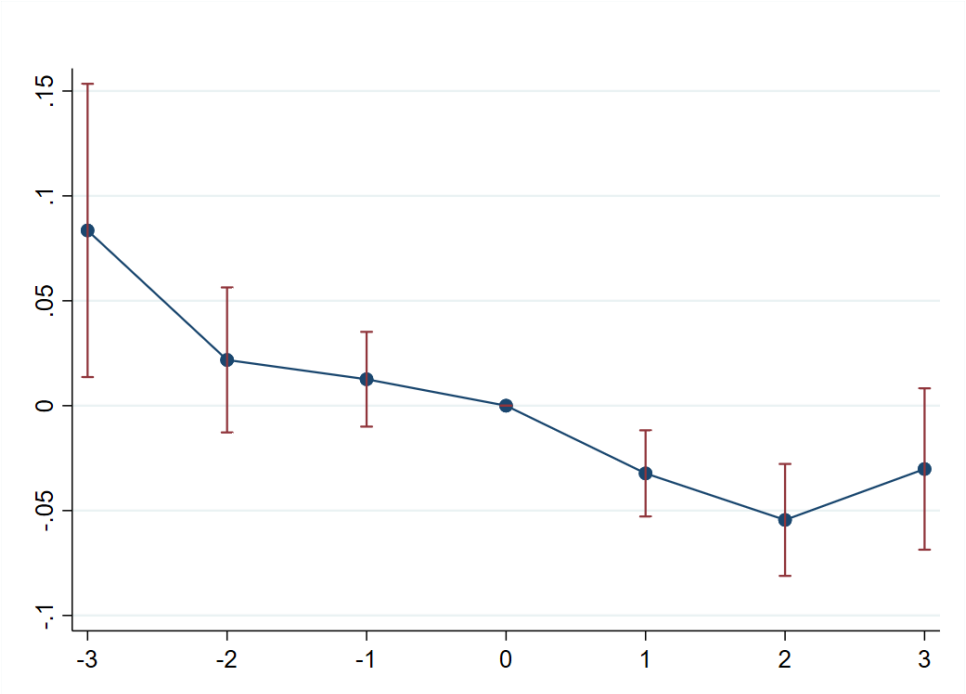
The results, obtained with did_multiplegt, show the performance of sales revenue (ln) three years before and three years after one or more neighboring enterprises within a 10-km radius and active in the same macrosector went into receivership. The treatment variable is continuous and is equal to the number of neighboring enterprises subjected to JA year by year. The confidence interval is set at 90%.

Figure 3: Dynamic diff-in-diff estimates on net income (ln)



The results, obtained with did_multiplegt, show the performance of net income (ln) three years before and three years after one or more neighboring enterprises within a 10-km radius and active in the same macrosector went into receivership. The treatment variable is continuous and is equal to the number of neighboring enterprises subjected to JA year by year. The confidence interval is set at 90%.

Figure 4: Dynamic diff-in-diff estimates on the number of employees (ln)



The results, obtained with did_multiplegt, show the performance of number of employees (ln) three years before and three years after one or more neighboring enterprises within a 10-km radius and active in the same macrosector went into receivership. The treatment variable is continuous and is equal to the number of neighboring enterprises subjected to JA year by year. The confidence interval is set at 90%.