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Organized crime, Extortion Racketeering, Resource Misallocation, Welfare Loss, within-industry OP covariance

### JEL codes:

K42, O17, D61, O4, C5

# Uncovering Illegal and Underground Economies:

## The Case of Mafia Extortion Racketeering \*

Author: Lavinia Piemontese<sup>†</sup>

August 31, 2020

### Abstract

This paper proposes a new approach for quantifying the economic cost of hidden economies. I specifically apply the method to the case of mafia racketeering in Northern Italy, and in so doing, provide the first explicit estimate of the economic cost of mafia spread in this area. I show both theoretically and empirically that acts of extortion imposed on certain firms are linked to resource misallocation. I quantify the share of output that the mafia extorts from firms, which ranges between 0.5 and 5 percent of firm-level output for the taxed firms. I then consider what these estimates imply and find that between 2000 and 2012, the Northern Italian economy suffered an aggregate loss of approximately 2.5 billion Euros. Quite remarkably, only one-fourth of this cost consists of the aggregate transfer to the mafia. The remaining three-fourths corresponds to the contraction of production due to misallocation.

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<sup>†</sup>lavinia.piemontese@ens-lyon.fr Univ Lyon, ENS de Lyon, GATE UMR 5824, F-69342 Lyon, France

# 1 Introduction

Addressing illegal and underground economies is a priority for many governments and international organizations. Yet, how these economies influence economic agents—such as firms and consumers—and the magnitude of such effects are relatively unknown. In large part, this is due to the hidden intrinsic nature of such economies and the consequent general lack of data concerning both the agents behind them (i.e., perpetrators of illicit activities) and those that are impacted by their effects (i.e., their victims). There is a clear need to develop new methodologies able to surmount this challenge. One alternative is to explore the microeconomic mechanisms behind the relationship between underground economies and their aggregate effects, particularly as aggregate outcomes are often readily observable. I make a step in this direction and propose a new method that provides valuable insights into the costs of illegal economies.

I tackle the lack of data on illicit activities at the micro level using a “bottom-up” perspective. Specifically, I analyze how the unobservable idiosyncratic distortions introduced by illegal economies have aggregate observable effects. This allows me to summarize and identify these distortions by looking at aggregate outcomes. I use this methodology to study the economic effects of mafia racketeering (*pizzo*) of firms located in Northern Italy.<sup>1</sup> In line with relevant literature on misallocation ([Bartelsman et al., 2013](#); [Hsieh and Klenow, 2009](#); [Restuccia and Rogerson, 2008](#)), I develop a model where I show that in a market with heterogeneous producers, firms’ response to *pizzo*

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<sup>1</sup>The word *pizzo*, derived from Sicilian dialect, indicates extortion perpetrated by the mafia. In this paper, I do not distinguish between different types of mafia organizations, which in Italy belong to either Cosa Nostra, Camorra, ‘Ndrangheta, or Sacra Corona Unita.

can have aggregate effects. This occurs because *pizzo* is an idiosyncratic distortion on firm-level output; making it a highly suitable application for linking micro aspects to macro effects.

In this context, I do not observe either which firms are coerced, nor the amount of *pizzo*. The only information related to mafia activity I rely on is the share of firms subject to extortion. The data, gathered from official national records, gives the annual total number of reports of extortion that occurred in each Northern Italian province between 1998 and 2012. For the purposes of the analysis, this information, together with an index of resource misallocation measured using the within-industry covariance between size and productivity, are sufficient to estimate the cost of the Italian mafia. In particular, I argue that misallocation arises because only certain firms (i.e., those that are coerced) must shrink their production and thus end up being smaller than less productive firms, which have not been impacted by the mafia. Therefore, by knowing how many firms have been extorted, I can back out the amount *pizzo* from the extent of resource misallocation that occurs in the markets infiltrated by the mafia.

The novelty of my method is that it successfully combines a panel data analysis with structural econometric techniques. Specifically, my empirical strategy consists of two main stages. In the first stage, I employ aggregate information on firms' performance to estimate the parameters needed to simulate what the Northern Italian economy would be like without the mafia. I estimate these parameters using fixed effect regressions that use aggregate output as the dependent variable. In the second stage, I use these parameters together with the data on extortion racketeering in a structural model. I simulate an economy affected by the mafia and infer *pizzo* by matching my simulated index of resource misallocation (the within-industry covariance between size and productivity)

to that observed in the data. The model developed here not only provides a way to estimate the amount of *pizzo*, but also a means of understanding and quantifying the welfare loss that occurs in the infiltrated markets. Such loss is due to the fact that firms must transfer resources that would otherwise have been used productively. My results suggest that the total cost suffered by the Northern Italian economy between 2000 and 2012 is approximately 2.5 billion euros. Quite remarkably, only one-fourth of this loss is constituted by the transfer of *pizzo* to the mafia. The remaining three-fourths consists of the forgone production due to misallocation. This means that the extortion of *pizzo* implies an economic loss, in terms of contraction of output, that is three times higher than what the mafia actually collects.

To quantify the extent of resource misallocation, I use the within-industry covariance between size and productivity derived in the decomposition of industry-productivity, proposed by [Olley and Pakes \(1996\)](#) (OP covariance henceforth). In this decomposition, aggregate productivity is the sum of firms' productivity weighted by their size, and can be split into an unweighted firm-level average and a covariance term. The covariance term measures the extent to which more productive firms tend to be larger than less productive ones. I make use of [Bartelsman et al. \(2013\)](#) results showing that in markets with few or no distortions, i.e., with no misallocation, the distributions of firms' productivity and firms' size are highly correlated. However, the strength of this link is weakened if firms face idiosyncratic distortions that impact their scale of output, which in turn implies a decrease of the OP covariance.

Along these lines, I explain how idiosyncratic distortions introduced by *pizzo* racketeering can impact the OP covariance of the infiltrated markets. Specifically, I propose a static multi-sectorial model of heterogeneous producers, in which firms differ in their

level of permanent total factor productivity and choose employment to produce in a monopolistic competition environment, taking wages as given. The mafia impacts firms randomly, i.e. their targeting is orthogonal to any firm's individual characteristic.<sup>2</sup> This distortion is idiosyncratic because some producers are not subject to extortion racketeering, while others are. A central prediction of the model is that in an environment without the mafia, the distribution of firms' productivity and that of their size are perfectly correlated. If instead the mafia infiltrates the market and coerces a randomly chosen group of firms, the strength of the link between the two distributions is weakened, meaning that the market is affected by resource misallocation.

To provide a quantitative estimate of *pizzo* and its related welfare loss, I build a panel dataset that provides information on every Northern Italian province over the period 1998-2012. This dataset combines information on mafia activity in Northern Italy, i.e., the yearly number of reports of extortion for every northern province, and aggregate information on firms' characteristics and performance over several industries, including the within-sector OP covariance of every observed year and province. Importantly, mafia infiltration in Northern Italy is a relatively recent phenomenon, which has been particularly acute in certain regions ([Confesercenti, 2012](#)), and within specific sectors of the economy ([Transcrime, 2013](#)). I accordingly develop a definition of *mafia-infiltrated markets* with a temporal, a spatial, and a sectorial dimension. The structure of my dataset, whose statistical unit is sector-province-year, allows me to define as mafia-

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<sup>2</sup>This assumption is supported by suggestive evidence that extortion racketeering in Northern Italy is not as deeply rooted as it is in Southern Italy ([Confesercenti, 2012](#)). *Pizzo* is modeled as a proportional tax on firm-level output. This might imply that the mafia does not have enough information to carry out a rational targeting. I relax this assumption in the second part of the paper, where I consider an alternative scenario in which the mafia coerces the most productive firms.

infiltrated: (i) specific industries, (ii) located in given Northern Italian provinces, (iii) observed after a certain point in time. All the remaining sectors-provinces-years are considered as non-mafia markets. Thanks to this three-dimensional definition of mafia-infiltrated market and a set of identifying assumptions included in my theoretical model, I can use non-mafia markets as the best counterfactual of the infiltrated markets without mafia activity. This is a crucial aspect for my estimation strategy, as it allows me to control for any attribute of each mafia-infiltrated market that is unrelated to mafia activity, and estimate *pizzo* as the only determinant of resource misallocation, other things being equal.

In the empirical part of the paper, I begin by providing suggestive evidence of a significant correlation between mafia activity and resource misallocation. In particular, I apply a triple difference-in-differences strategy, showing that the OP covariance of mafia-infiltrated markets decreases after the arrival of organized crime, compared to the remaining markets. I then bring my theoretical model to the data, developing a two-stage analysis. First, I estimate the parameters of the model that are unrelated to mafia with fixed effect regressions using data on non-mafia markets. These parameters allow me to control for any characteristic that is unrelated to mafia activity. Second, I apply the method of simulated moments (MSM) to quantify the magnitude of *pizzo* imposed in each mafia-infiltrated market, by minimizing the distance between the simulated OP covariance delivered by the model and that observed in the data. The resulting estimates of the sectorial amount of *pizzo* range between 0.5 and 5 percent of the output level of impacted firms. To the best of my knowledge, this paper is the first to provide an explicit estimate of the amount of *pizzo* imposed by the mafia on firms operating in Northern Italy in different industries. A crucial finding that emerges from these esti-



mates is that, on average, mafia-infiltrated sectors suffer a loss that ranges between 0.1 and 0.7 percent of the counterfactual total value added without mafia activity.

Finally, I extend the analysis in order to consider the impact of mafia activity on the Northern Italian economy in a scenario where the mafia targets firms according to their productivity, i.e., where more productive firms have a higher risk of being coerced than less productive ones. The estimates of *pizzo* obtained in this alternative specification are strongly correlated to those observed in the baseline specification of the model and are, on average, slightly higher. The sectorial average amount of *pizzo* ranges between 1 and 6 percent of the output of impacted firms. Since in this scenario the mafia extorts *pizzo* from the most productive firms, they are able to reap larger transfers compared to a scenario with random targeting. The yielded welfare loss is more than twice that computed in the baseline specification, and the total cost is approximately 6.7 billion euros. One-fourth of this cost is the aggregate transfer to the mafia while the remaining three-fourths corresponds to the contraction of production due to misallocation.

## **Related literature**

This paper contributes to an emerging body of literature that studies, from a firm level perspective, the economic consequences of weak institutions. [Ranasinghe \(2017\)](#), for example, explores the role of property rights and their link to acts of extortion, while [Ranasinghe and Restuccia \(2018\)](#) quantify the effects of institutional differences in the degree of financial development and the rule of law on aggregate outcomes and economic development. [Besley and Mueller \(2018\)](#) examine the consequences of predation and estimate the welfare loss due to the misallocation of labor across and within firms. Compatibly with this work, I show that extortion perpetrated by the mafia has aggre-

gate effects, and I contribute a new methodology for measuring the economic consequences of specific idiosyncratic issues, even when they are not directly observable.

My study also relates to a number of theoretical and empirical analyses on misallocation. The relationship between firm-level idiosyncratic distortions and aggregate productivity has been theorized by [Restuccia and Rogerson \(2008\)](#) and developed by [Hsieh and Klenow \(2009\)](#), who provide an empirical analysis of resource misallocation to explain cross-country differences in productivity, measured with aggregate total factor productivity (TFP). [Bartelsman et al. \(2013\)](#) take a step further and propose within-industry covariance between firms' productivity and size as the most instructive index of resource misallocation. Along these lines, I explore how acts of extortion imposed by the mafia on heterogeneous firms can generate resource misallocation. I analyze this relationship *directly*, in the sense that I study the role of a specific distortion that is idiosyncratic across heterogeneous establishments.<sup>3</sup> Together with [Amodio and Di Maio \(2018\)](#), my paper is one of the first contributions that applies methods of this well-established literature to a new context: from a cross-country to a "cross-market" analysis.

The analysis also adds, naturally, to the literature on the economic impact of the Italian mafia. Specifically, it develops a link between evidence on aggregate outcomes as studied by [Pinotti \(2015\)](#) and that on micro outcomes as in [Mirenda et al. \(2019\)](#). While several contributions look at the effect of mafia activity on public funds and spending (see for example [Daniele and Dipoppa \(2019\)](#); [Galletta \(2017\)](#); [Barone and Narciso \(2015\)](#); [Acconcia et al. \(2014\)](#)), to date the role of the mafia in the legal economy has

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<sup>3</sup>For a comprehensive review of the literature on misallocation and a deeper discussion of the differences between a *direct* and the *indirect* approach to the topic, see [Restuccia and Rogerson \(2013\)](#).

received little attention. [LeMoglie and Sorrenti \(2020\)](#) make a step in this direction, exploring how investments by organized crime in the legal economy can play a role in the establishment of new enterprises. My analysis is complementary to this work, in that it looks at the other side of the coin, i.e., how criminal organizations infiltrate the legal economy by hampering, rather than financing, firms.

The remainder of the paper is organized as follows. Section 2 overviews the context in which I apply my methodology. Section 3 presents the conceptual framework of the analysis. I first describe the OP decomposition of aggregate productivity and explain how idiosyncratic distortions among heterogeneous producers can lower the OP covariance, leading to misallocation. I then present the model of allocative efficiency with idiosyncratic distortions produced by the mafia. In Section 4, I define what is meant by mafia-infiltrated market, introduce the data, and provide empirical evidence of the negative correlation between mafia presence and allocative efficiency. Section 5 presents the empirical method employed to estimate the cost of organized crime. In Section 6, I illustrate my findings and develop a counterfactual analysis that quantifies the cost of mafia activity. Section 7 considers an alternative specification of the model. Section 8 concludes.

## **2 Background: the Italian mafia**

To provide context to this paper, in this Section I give a brief overview of the criminal activities that the Italian mafia perpetrates, of how important *pizzo* is in relation to the other ways in which the mafia affects the economy, and of its presence in territories different than its historical settlements, i.e. the northern Italian regions.

The appearance of the first mafia-type organizations can be traced back to the second half of the Nineteenth century in southern regions such as Sicily, Calabria, Campania, and Apulia as suppliers of private protection (Buonanno et al., 2015; Skaperdas, 2001). Nowadays, the mafia engages in a wide range of activities, that goes from extortion racketeering to the manufacturing and marketing of illegal goods and services (such as drugs, gambling, and prostitution), or the direct investment in the legal economy (LeMoglie and Sorrenti, 2020; Mirenda et al., 2019). These businesses can produce huge revenues.<sup>4</sup> While other types of activities performed by the mafia might be more profitable than extortion racketeering, the stable practice of extortion in a given territory is the hallmark of each mafia-type organization (La Spina et al., 2014). Specifically, a territory is affected by actual mafia-rootedness (in Italian, *radicamento mafioso*) if and only if the mafia perpetrates regularly extortion racketeering. Otherwise, we talk about by mafia-incursions, i.e. when the mafia engages only in activities like money laundering and other business without settling permanently (Confesercenti, 2012).

La Spina et al. (2014) provide an accurate illustration of how the imposition of *pizzo* works in the real world, using actual data on extortion racketeering.<sup>5</sup> The process of extortion can be divided in three different phases: the *first approach* where the mafia reaches and intimidates its victim; the *negotiation* phase when there might be some bargaining between the victim and the perpetrator (however, it emerges from the data that

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<sup>4</sup>For example, The Italian Ministry of Internal Affairs (Transcrime, 2013) has estimated that the annual turnover of the Italian mafia from drug trafficking is 7.7 billion euros. This is the most profitable activity, followed by extortion (4.7 billion euros), sexual exploitation (4.6 billion euros) and counterfeiting (4.5 billion euros).

<sup>5</sup>Their analysis is based on extortion acts occurred in Sicily. The authors produced a database making use of interviews with victims of extortions and judicial sources.

this phase occurs rarely), and the *demand/consumption* phase when the mafia gets what was asked to the victim, i.e. when *pizzo* is actually collected. This last phase can take several forms. First of all, the extortion request can be periodic, when the mafia asks the victim *pizzo* regularly (e.g. every months, or during the main public holidays such as Christmas and Easter), or it can be episodic, i.e. it is a one-off event. Moreover, the actual payment of *pizzo* can be made in various ways: the mafia can extort money or goods (this form is defined as parasitic request) or it can impose to its victim some specific performances such as purchase of specific goods and services, recruitment of employees, restrictions and limitation of the normal economic activity (in this case the extortion act is defined as active). In the theoretical framework presented in Section 3, I model the imposition of *pizzo* as an episodic and parasitic request.

It is widely known that the mafia has gone beyond the borders of its settlements to reach the whole Italian territory. The spread of mafia in northern Italy has evolved over time. At a first stage, the mafia started controlling and coordinating illegal markets (drugs, prostitution, gambling), especially where there was no local criminal groups capable of managing them. An aspect that can explain how spread of the mafia to the Northern Italian provinces started is the interaction between the *Italian Confino system* and the influx of southern workers into northern regions (Buonanno and Pazzona, 2014).<sup>6</sup> After this first phase, the mafia started moving people and financial resources in order to establish an organization capable of attacking the legal economy. Confesercenti (2012) indicates as specific areas that facilitated this penetration the gambling sector,

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<sup>6</sup>*Confino* was a particular Italian policy measure implemented in the late 70s that imposed the compulsory displacement of people strongly suspected of belonging to mafia-like organizations.

the credit market, the construction sector (Scognamiglio, 2018), and, most importantly, the public procurement system (Piemontese, 2013; Calderoni and Caneppele, 2009). In fact, on the one hand the mafia is able to directly affect the awarding of public contracts (Barone and Narciso, 2015). On the other hand, when it comes to major infrastructure projects awarded by large contractors (e.g. the European Union), mafia groups localized in the territories that receive public funding can either impose subcontracts, or guarantee themselves the control over the infiltrated territories by perpetrating regularly *pizzo* racketeering. In Section 4, I make use of this argument and evidence presented in Confesercenti (2012) and Piemontese (2013) to determine which northern territories are infiltrated by the mafia.

### 3 Conceptual Framework

The mafia impacts economic activity by altering the optimal decisions of a certain number of firms, i.e., those that are forced to pay *pizzo*. Since I model *pizzo* as a proportional tax on the value of output, impacted firms reduce their size—compared to the scenario without the mafia—and may end up being smaller than firms with lower innate productivity. This idiosyncratic distortion thus has aggregate effects as it biases the allocation of resources among all the firms in the infiltrated markets.<sup>7</sup>

Before describing theoretically the mechanism through which extortion racketeering can alter allocative efficiency, I introduce the index used in this analysis to detect possible misallocation: the within-industry covariance between productivity and size de-

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<sup>7</sup>The fact that only a group of firms is subject to racketeering makes this distortion idiosyncratic.

rived by the decomposition of aggregate productivity established by [Olley and Pakes \(1996\)](#).

### **The OP decomposition**

The OP decomposition is derived from a measure of aggregate productivity introduced by [Olley and Pakes \(1996\)](#). In this seminal contribution, aggregate productivity is the weighted sum of firms' productivity, where the weight is firms' size. This index can be decomposed into two components: the unweighted average of firms' productivity and a covariance component, which measures the extent to which most productive firms are larger than the less productive ones.

Consider a market, defined as an industry in a given location observed at a given point in time, populated by  $N$  firms. The cross-section aggregate productivity is defined as follows:

$$\Omega \equiv \sum_{i \in N} \theta_i \omega_i = \bar{\omega} + \sum_{i \in N} ((\theta_i - \bar{\theta})(\omega_i - \bar{\omega})) \quad (1)$$

where  $\Omega$  is the aggregate productivity of the market,  $\omega_i$  and  $\theta_i$  are firm-level productivity and size, respectively, and a "bar" over a variable represents the unweighted average of the firm-level measure. Thus, the first term of the right hand side  $\bar{\omega}$  is the unweighted average productivity of the  $N$  firms operating in this market, and the second term is the so-called OP covariance between productivity and size of the  $N$  firms.

Proposition 1 helps to see the role of OP covariance in increasing aggregate productivity

and why it can be used as an informative measure of resource misallocation. The proof is provided in Appendix A.1.

**Proposition 1** *Consider the vector  $\omega$  containing  $N$  firm-level productivity ranked as follows  $\omega_1 > \omega_2 > \omega_3 > \dots > \omega_N$ , and the vector  $\theta$  containing  $N$  of firm-level size ranked as follows  $\theta_I > \theta_{II} > \theta_{III} > \dots > \theta_N$ . If aggregate productivity is defined as the sum of firm-level productivity weighted by firm-level size, the way to maximize it is to match  $\omega_1$  to  $\theta_I$ ,  $\omega_2$  to  $\theta_{II}$ , and so forth. Therefore, a market where aggregate productivity is maximized is a market in which there is no misallocation.*

This proposition simply says that aggregate productivity is maximized when the rankings of firm productivity and firm size are perfectly aligned, i.e., when the most productive firm is also the largest one, the second most productive is the second largest one, and so forth. A market where these rankings are not aligned is a market affected by resource misallocation. In this case, aggregate productivity would increase by reallocating production inputs to more productive firms, implying a higher OP covariance and, in turn, a higher aggregate productivity. In the next sub-section I link this concept to mafia infiltration, explaining how extortion acts impacting certain firms can have aggregate effects, weakening the strength of the link between firms' productivity and firms' size.

## **The model**

My modeling of how distortions introduced by the mafia lead to resource misallocation shares common features with [Hsieh and Klenow \(2009\)](#) and [Bartelsman et al. \(2013\)](#). Firms are heterogeneous in their level of productivity and face idiosyncratic distortions.



The curvature in the profit function, necessary for an equilibrium of firms with heterogeneous productivity, comes from decreasing returns to scale and a downward sloping demand curve implied by a monopolistic competition environment. Further, as in [Bartelsman et al. \(2013\)](#), the model includes overhead labor as a part of the technology, in order to guarantee that the distribution of labor productivity is not degenerate even in an economy with no distortions.

Consider an economy defined by  $p \times t$  markets, where each market consists of a specific geographical area  $p$  at a given point in time  $t$ . Assume that the final aggregate output  $Y_{pt}$  is produced by a representative firm that operates in a perfectly competitive market: the final good is sold at price  $P$ , which is taken as given. To produce  $Y_{pt}$ , this single representative firm combines  $s$  intermediate outputs  $Y_s$  produced from all  $S$  sectors of the economy in a Cobb-Douglas technology:

$$Y_{pt} = \prod_{s=1}^S Y_s^{\theta_s} \quad (2)$$

with  $\sum_{s=1}^S \theta_s = 1$ . Given that the final good price  $P$  is taken as given, cost minimization implies that  $P_s Y_s = \theta_s P Y$  for every sector  $s$ , where  $P_s$  is the sector specific price of the intermediate output  $Y_s$ .

In each sector  $s$  the production of the intermediate output  $Y_s$  is carried out by a single representative firm that combines  $N_s$  differentiated inputs in a CES production function. Every input  $Y_i$  is supplied by firm  $i$  at price  $P_i$  in monopolistic competition.<sup>8</sup> Industry  $s$

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<sup>8</sup>Note that both  $Y_s$  and  $Y_i$  are time dependent. I do not include the time subscript  $t$  for notation simplicity.

production is given by:

$$\begin{aligned}
Y_s &= \left( \sum_{i \in N_s} Y_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \\
&= \left( \sum_{i \in N_s} Y_i^\gamma \right)^{\frac{1}{\gamma}}
\end{aligned} \tag{3}$$

where  $\sigma > 1$  is the elasticity of substitution between any two varieties. For computational simplicity  $\sigma$  is rewritten as  $\frac{1}{1-\gamma}$ , with  $\gamma < 1$ .

In each industry  $s$  (located in area  $p$  at time  $t$ ) the  $N_s$  firms produce differentiated products in a monopolistic competition regime. Firm  $i$ 's production technology has labor as unique input, includes overhead labor, and exhibits decreasing return to scale:

$$Y_i = \Gamma_{pt} A_i (L_i - f_s)^\alpha \tag{4}$$

with  $\alpha$  smaller than one due to decreasing returns to scale.

I make the following assumptions: (i) firm  $i$ 's productivity has a firm-specific component  $A_i$ , i.e., total factor productivity (TFP), which can be seen as firm-level innate and permanent ability, and a time varying area-specific exogenous component  $\Gamma_{pt}$  that captures all the area-time specific factors affecting the production of every firm in every industry  $s$  in the same way; (ii) the firm-specific productivity component  $A_i$  is drawn from a log-normal distribution with average  $\mu_{sp}$  and standard deviation  $\sigma_{sp}$ , meaning that the moments of TFP are sector-province-specific but time invariant, capturing the idea that different provinces specialize in certain sectors; and (iii) overhead labor  $f_s$  is

exogenously determined and sector-specific.<sup>9</sup>

As introduced in Section 2, I model extortion acts as episodic and parasitic requests. Specifically, the mafia enters this scenario by imposing *pizzo* on a certain group of firms. Since some firms are subject to racket and others are not, mafia infiltration introduces an idiosyncratic distortion. I assume that the mafia targeting of firms is random, i.e. the fact that firm  $i$  is coerced by the mafia is unrelated to its productivity. Given that the effective establishment of the mafia in northern territories is a relatively recent phenomenon, and it involves a relatively low share of firms if compared to the southern regions, it is plausible to assume that the mafia is not able to observe firm-level productivity. Yet, since there is still scarce evidence on the functioning of the mafia in northern regions, in Section 7, I consider an alternative targeting rule and assume that mafia impact is positively correlated with firm productivity.

I model *pizzo* as a proportional tax on output. This output distortion results from the interaction of two terms. First, the idiosyncratic component, called “mafia exposure” parameter  $\tau_i$ , which is Bernoulli distributed with mean  $\lambda$ . This is a dummy variable that equals one if firm  $i$  is subject to racket and zero otherwise. The second element, called “mafia intensity” component, which measures the share of output that the mafia extorts, is given by  $\delta$ . I assume that, in each infiltrated market, impacted firms pay the same share of output  $\delta$ . Given that the purpose of my study is to measure the aggregate impact of extortion racketeering by matching an aggregate measure of misallocation, I assign to every impacted firm (i.e. each firm  $i$  with  $\tau_i$  equal to one) the same *pizzo* rate

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<sup>9</sup>The log-normal distribution assumption is consistent with evidence provided by [Angelini and Generale \(2008\)](#) and [Donati and Sarno \(2015\)](#).

(i.e.  $\delta$ ). This rate  $\delta$  represents the average extortion imposed in each infiltrated market that I intend to estimate in the empirical analysis.<sup>10</sup>

If the mafia infiltrates the market, firm's  $i$  profit is:

$$\Pi_i = (1 - \tau_i \delta) Y_i P_i - w_{st} L_i \quad (5)$$

where  $w_{st}$  is the cost of labor. I assume that  $w_{st}$  is exogenous and that it changes over sector and time but not across provinces.<sup>11</sup> Note that in this scenario, the minimization problem of each firm is static, i.e., there is no link between current profit-maximizing decisions and choices made in other time periods. *Pizzo* can be seen as a *one-off* tax, i.e., as explained in Section 2, a payment that is not demanded regularly but on sporadic occasions.

Profit maximization under monopolistic competition with product differentiation yields the standard condition that firm's output price  $P_i$ , which is endogenous to  $Y_i$ , is a fixed mark-up over the cost of labor:

$$P_i = \left[ \frac{1}{\gamma} \right]^{\frac{\alpha(1-\gamma)}{1-\alpha\gamma}} \left[ \frac{w_{st}}{\alpha} \frac{1}{(1 - \tau_i \delta)} \right]^{\frac{\alpha(1-\gamma)}{1-\alpha\gamma}} \left[ \frac{1}{\Gamma_{pt} A_i} \right]^{\frac{(1-\gamma)}{1-\alpha\gamma}} \quad (6)$$

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<sup>10</sup>Balletta and Lavezzi (2019) use a different approach, i.e., assume that the mafia extorts all firms in the market and the object of choice is how much to charge each firm, because they exploit a unique dataset on extortion in Sicily. This dataset allows them to observe the exact amount of *pizzo* that each coerced firm has transferred to the mafia. Conversely, in my data I do not observe neither which firm is impacted, nor the exact amount of *pizzo* that is extorted.

<sup>11</sup>This assumption is compatible with the fact that, in Italy, wages are mainly established through collective bargaining. Thus, in every industry they are homogeneous, at least across the northern regions.

Optimal labor demand and output are given by:

$$(L_i^* - f_s) = \left[ \frac{\alpha\gamma}{w_{st}} (1 - \tau_i\delta) \right]^{\frac{1}{1-\alpha\gamma}} [\Gamma_{pt} A_i]^{\frac{\gamma}{1-\alpha\gamma}} \quad (7)$$

$$Y_i = \left[ \frac{\alpha\gamma}{w_{st}} (1 - \tau_i\delta) \right]^{\frac{\alpha}{1-\alpha\gamma}} [\Gamma_{pt} A_i]^{\frac{1}{1-\alpha\gamma}} \quad (8)$$

Equations 6, 8, and 7 are combined to derive the expression of labor productivity:

$$LPR_i = \frac{P_i Y_i}{L_i^*} = \left[ \frac{w_{st}}{\alpha\gamma} \frac{1}{(1 - \tau_i\delta)} \right] - \left[ \frac{w_{st}}{\alpha\gamma} \frac{f_s}{(1 - \tau_i\delta) L_i^*} \right] \quad (9)$$

This simple expression for labor productivity, which I use as measure of firm-level productivity, yields several implications. First, in the absence of mafia infiltration, i.e., in an economy with no distortions, labor productivity varies across firms. This happens because firm-technology includes overhead labor. Second, in absence of distortions, labor productivity is increasing in size, measured by employment. This means that the distributions of firms' productivity and firms' size are perfectly correlated, i.e., the most productive firm is the largest one that has the highest level of employment. Therefore, according to Proposition 1, the OP covariance measured in terms of labor productivity and employment is maximized. Third, the idiosyncratic distortions brought on by mafia infiltration weakens this relationship. In particular, according to Equation 9, it is not necessarily true that the distributions of firms' productivity and size are perfectly aligned. Following Proposition 1, if this is the case, the market is affected by resource misallocation and the OP covariance characterizing this environment is lower than that

computed in the corresponding scenario without mafia.<sup>12</sup> This means that extortion racketeering of a certain number of firms perpetrated by the mafia has aggregate effects.

In the empirical analysis that follows, I provide suggestive evidence of the negative correlation between mafia presence and allocative efficiency discussed here. I then implement a structural estimation where I back out the amount of *pizzo*  $\delta$  extorted in every infiltrated market from the OP covariance (in terms of LPR and employment to measure shares) characterizing these markets.

## 4 Definitions, Data, and Preliminary Evidence

In this section, I define what is meant by a mafia-infiltrated market as well as present the data. Using this information, I then explore the relationship between mafia presence and allocative efficiency using a triple difference-in-differences approach that exploits the three-dimensional variation of mafia infiltration.

### Mafia-infiltrated markets

I focus on Northern Italy, a territory where mafia activity has only become pervasive in the past few decades, and is not yet entirely infiltrated by organized crime ([Confesercenti, 2012](#)). As northern Italy is characterized by homogeneous social and eco-

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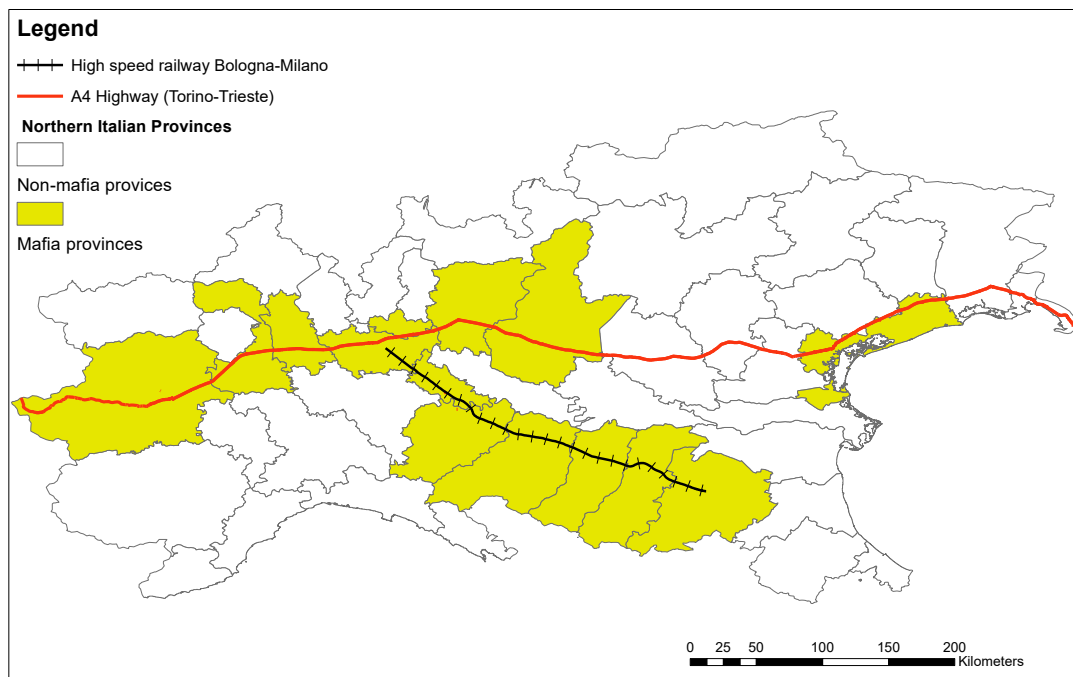
<sup>12</sup>The same reasoning can be applied in looking at Equation 8 and considering the OP covariance computed using TFP and output to measure productivity and shares, respectively. In this paper I compute OP covariance using labor productivity and employment as arguments, as their computation requires information widely available in firm-level datasets, that is less subject to measurement error than variables such as capital or total factor productivity.

nomic conditions, this area provides an ideal setting for my analysis. My definition of mafia-infiltrated markets involves three dimensions: geographic, temporal, and sectorial. Specifically, mafia-infiltrated markets are certain sectors of the economy in mafia-infiltrated provinces and observed after mafia arrival.

Given that a mafia-infiltrated market is an industry located in a mafia-infiltrated province after the arrival of the mafia, it is necessary to define how and when a province is infiltrated by mafia. As discussed in Section 2, mafia infiltrations are strongly linked to the public procurement sphere. This matter has been receiving considerable attention both from the academic community ([Calderoni and Caneppele, 2009](#)) and the media (e.g. inquiries related to the A3 Salerno-Reggio Calabria motorway) and is considered as one of the main factors that favors mafia settlement in new territories ([Confesercenti, 2012](#)). In this perspective, I follow [Piemontese \(2013\)](#), who explores the role of public investment in infrastructure on mafia expansion in Northern Italy. The paper shows that there was a significant increase in extortion cases in the provinces that received funding for the modernization of the A4 motorway and for the construction of the high-speed railway between Milan and Bologna, after their approval between 2000 and 2002. Therefore, I define as infiltrated provinces those that received public funding for the renewal of the Turin-Trieste highway and/or the Milan-Bologna railway. These provinces are visible in Figure 1, which maps the northern territories and the infrastructure studied by [Piemontese \(2013\)](#). With the exception of a single province, i.e. Venice, each province that I define as mafia-infiltrated belongs to the regions that [Confesercenti \(2012\)](#) indicates as impacted by effective mafia rooting, i.e. Piedmont, Lombardy, and

Emilia-Romagna.<sup>13</sup> For each infiltrated province, the mafia period starts the year of the approval of the public funding (2000 for some provinces and 2002 for the rest).

Figure 1: Provincial mafia presence



This map shows the Northern Italian provinces (NUTS 3). The red line depicts the A4 highway that connects the Province of Turin to the Province of Trieste. The black dashed line represents the Milan-Bologna high-speed railway. Provinces highlighted in yellow are those defined as mafia-infiltrated, whereas the others are non-mafia provinces. The territories crossed by the A4 highway that are not highlighted in yellow are those provinces that did not received any funding for the renewal of the road, i.e., only some stretches were modernized.

Given the little available work on mafia diffusion in Northern Italy, there is no scholarly consensus on when exactly the mafia migrated towards the northern regions and when it effectively settled. As introduced in Section 2, several studies argue that the mafia began moving to the North as early as the late 70s, due both to legal practices forcing

<sup>13</sup>The remaining northern regions, i.e. Aosta Valley, Liguria, Veneto, Trentino-Alto Adige, and Friuli-Venezia Giulia, show a less aggressive and steady mafia presence.



suspected *mafiosi* (people linked to the mafia) to relocate to towns historically unaffected by the mafia and to migration flows from Southern Italy (Scognamiglio, 2018; Buonanno and Pazzona, 2014).<sup>14</sup> The assumption of these studies of an earlier entry does not necessarily contradict that of a later arrival used here. In fact, even if *mafiosi* reached the North before the 2000s, it is plausible to assume a time lag between mere arrival and the effective infiltration of the legal economy, which boomed in the early 2000s.

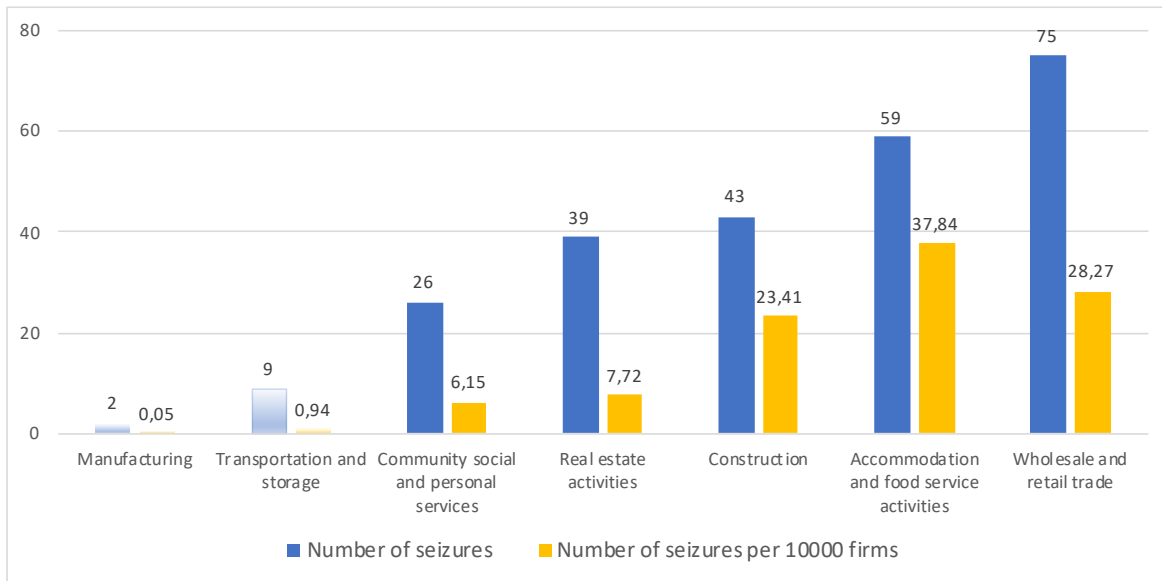
Finally, in order to define the specific sectors into which the mafia has spread, I use information on firms confiscated by the judicial system because they were found to be directly managed or linked to the mafia, between 1993 and 2015. These data, provided by the National Agency for the Administration and Management of Assets Seized and Confiscated from Organized Crime (ANBSC), reports information on the location and the sector of the confiscated firm, as well as the year of the final verdict of confiscation. Figure 2 ranks seven sectors of the economy according to the absolute and relative number of firms (amount per 10,000 firms) located in the northern provinces that have been seized from the mafia. Industries with a fairly large number of confiscations, displayed in the figure with bright colors, are defined as mafia infiltrated. In particular, these sectors include: wholesale and retail trade, accommodation and food services, construction, real estate activities, and community, social, and personal services.

In order to confirm that my definition of mafia-infiltrated market does indeed capture the spatial and temporal dimensions of mafia spread in Northern Italy, I perform a validation exercise in Appendix A.2. In particular, I perform a difference-in-differences

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<sup>14</sup>Although Buonanno and Pazzona (2014) and Scognamiglio (2018) focus on northern and central regions, their results do not specifically refer to the regions under the analysis here.

Figure 2: Sectorial mafia presence



Source: Computations based on ANBSC information on firms seized from the mafia. The blue bars depict the total number of confiscations of firms located in Northern Italy, for each of the seven sectors studied in this paper. The yellow bars reflect the relative size of each sector, reporting the number of confiscation per 10,000 firms. The bars plotted with brighter colors represent sectors that are defined as mafia infiltrated. The remaining bars, depicted with lighter colors, represent the non-mafia sectors, or those that have a negligible number of confiscations from organized crime.

analysis where I show that, on average, the confiscation of firms from the mafia (measured using the data from ANBSC, plotted in Figure 2) increased in provinces defined as infiltrated, after mafia arrival, compared to the remaining northern territories.<sup>15</sup>

## Data

For the purpose of this analysis I combine data from two main sources. The first is the *Small and Medium Enterprise Survey (SME)*, a yearly representative survey on small and medium enterprises registered in the Italian Statistical Business Register (ASIA), administered by the Italian National Institute of Statistics (ISTAT). The time span covered

<sup>15</sup>This result is robust to several alternative specifications. Specifically, I estimate regressions with different groups of fixed effects, i.e. region fixed effects and province fixed effects.

is 1998-2012.<sup>16</sup> As my analysis focuses on Northern Italy, I consider only information on firms operating in this part of the country. The resulting sample comprises between 20,000 and 29,000 firms per year and includes information on each firm's location (at the province level), sector, number of employees, revenue, and expenditure in intermediate inputs.<sup>17</sup> Unfortunately, the data provider's confidentiality requirements necessitated aggregating the information at the sector-province-year level, such that I lose data at the firm level. I consequently perform my analysis on the resulting panel, where the individual dimension is given by the sector-province-year triplet. The panel provides information on the 46 Northern Italian provinces, for 7 industries, from 1998 to 2012.<sup>18</sup> To carry out the empirical analysis described in Section 5, I construct the following variables: mean and variance of labor, mean and variance of value added, mean and variance of value added per worker (all of which are computed both in levels and logs), and number of firms. Finally, I construct the OP covariance in terms of (log) value added per worker and share of employment over total employment.

Second, I measure mafia intensity using information on reports of extortion provided by the Annual Criminal Statistics Report published by the Italian Statistical Institute (ISTAT). This information was gathered at the province-year level, for the years 1998-2012. Figure 3 shows the average extortion cases over time for two groups of observations:

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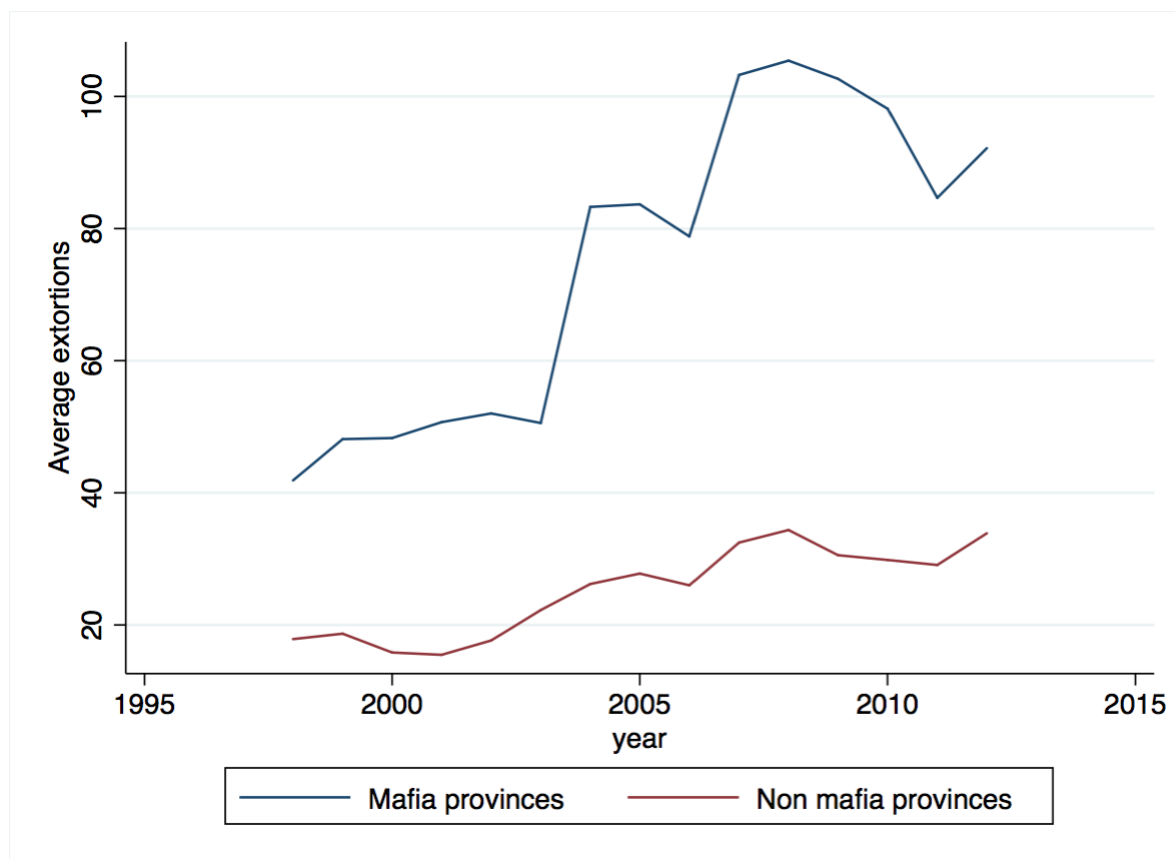
<sup>16</sup>The data can only be accessed and processed at the research center *Laboratory for Elementary Data Analysis (ADELE)*, managed by ISTAT.

<sup>17</sup>Sectors are defined according to ISIC activity Rev. 4. Revenues and expenditure in intermediate inputs are weighted with an industry-level deflator, which are gathered from the EU KLEMS Growth and Productivity Accounts: 2012 Release.

<sup>18</sup>This panel dataset is unbalanced, as not every sector is observed every year for every province. This is due to ADELE laboratory restrictions, according to which I could aggregate information on sector-province-year that includes at least 20 firms surveyed.

mafia and non-mafia provinces, i.e. provinces crossed by the renewed A4 motorway and by the Milan-Bologna high-speed railway, and the remaining ones. Overall, the number of average yearly extortion cases in mafia provinces (blue line) is greater than in the non-mafia provinces (red line). Further, there is a clear change in the trend of average extortion cases in mafia provinces around the year 2004, i.e. a few years after the approval of the public funding for infrastructure (occurred between 2000 and 2002) used to distinguish mafia-infiltrated provinces from the others.

Figure 3: Cases of extortion in Northern Italy



Source: computations based on ISTAT Yearly Book of Criminal Statistics (ed. 2014). The blue line reports the average number of extortion cases that occurred in mafia-infiltrated provinces between the years 1998 and 2012. The red line reports the average number of extortion acts in non-mafia provinces in the years 1998-2012.

I use this information to compute the yearly share of firms subject to extortion racketeer-

ing for every province defined as mafia infiltrated, i.e.  $\lambda_{pt}$ . In particular, the numerator of  $\lambda_{pt}$  is the *increase* in reports of extortion registered in the infiltrated provinces after mafia arrival, relative to non-mafia provinces.<sup>19</sup> The way  $\lambda_{pt}$  is constructed implies that this paper quantifies the economic consequences of the *increase* of mafia activity that occurred in mafia-infiltrated provinces after the settlement of organized crime in the northern regions, as shown in [Piemontese \(2013\)](#).

Mafia activity is thought of here as an extra component of allocative efficiency, which plays a role only in mafia sectors, located in the infiltrated provinces, after organized crime arrival. I rely on this point in what follows. First, I provide suggestive evidence of a negative correlation between mafia presence and allocative efficiency, measured with the OP covariance. Then, I implement a structural estimation where I compute the parameters of the model that are unrelated to mafia and next, back out the amount of *pizzo* imposed on impacted firms from the OP covariance that characterizes the infiltrated markets, given the share of impacted firms.

### **Suggestive evidence**

In a preliminary look at the data, I explore the relationship between mafia presence and resource misallocation by performing a triple difference-in-differences strategy, which employs the three-dimensional variation of the data, i.e. sector-province-year. In particular, I compare the average allocative efficiency of the infiltrated provinces to that of the remaining northern territories, in mafia sectors and in the other sectors of the economy,

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<sup>19</sup>Further details on the construction of  $\lambda_{pt}$  are provided in Appendix A.3.

over time. To this end, I estimate the following regression:

$$\text{OPcovariance}_{spt} = \alpha + \sum_t \beta_t (\text{mafia}_{ps} \times \text{year}_t) + \theta_s + \theta_p + \theta_t + u_{spt} \quad (10)$$

where the left hand side is the OP covariance in terms of (log) labor productivity and share of employment over total industry employment;  $\text{mafia}_{ps}$  denotes a dummy that varies at sector-province level and equals one if sector  $s$  is mafia infiltrated and is located in an infiltrated province  $p$ ; this dummy is interacted with each available time dummy  $\text{year}_t$ ;  $\theta_s$ ,  $\theta_p$  and  $\theta_t$  are sector, province, and time fixed effects respectively.

Figure 4 plots the estimates of the  $\beta_t$ s included in Equation 10, i.e.,  $\beta_{1998}$ ,  $\beta_{1999}$ , ...,  $\beta_{2012}$ , together with their 90% confidence bands.<sup>20</sup> These coefficients follow a clear decreasing trend.<sup>21</sup> These results point to the existence of a negative correlation between mafia presence and allocative efficiency. Interestingly, the decrease in the trend begins around the year 2004, i.e., the same time period when the sharp increase in extortion cases occurred in the infiltrated provinces, as shown in Figure 3.

In Appendix A.4 I propose a robustness check that accounts not only for mafia presence, but also for mafia intensity, measured with the data on reports of extortion presented above. The results corroborate the idea that mafia presence correlates negatively with the allocative efficiency of affected markets. Having established this idea, the next step is to bring the theoretical explanation of the mechanism through which mafia infiltra-

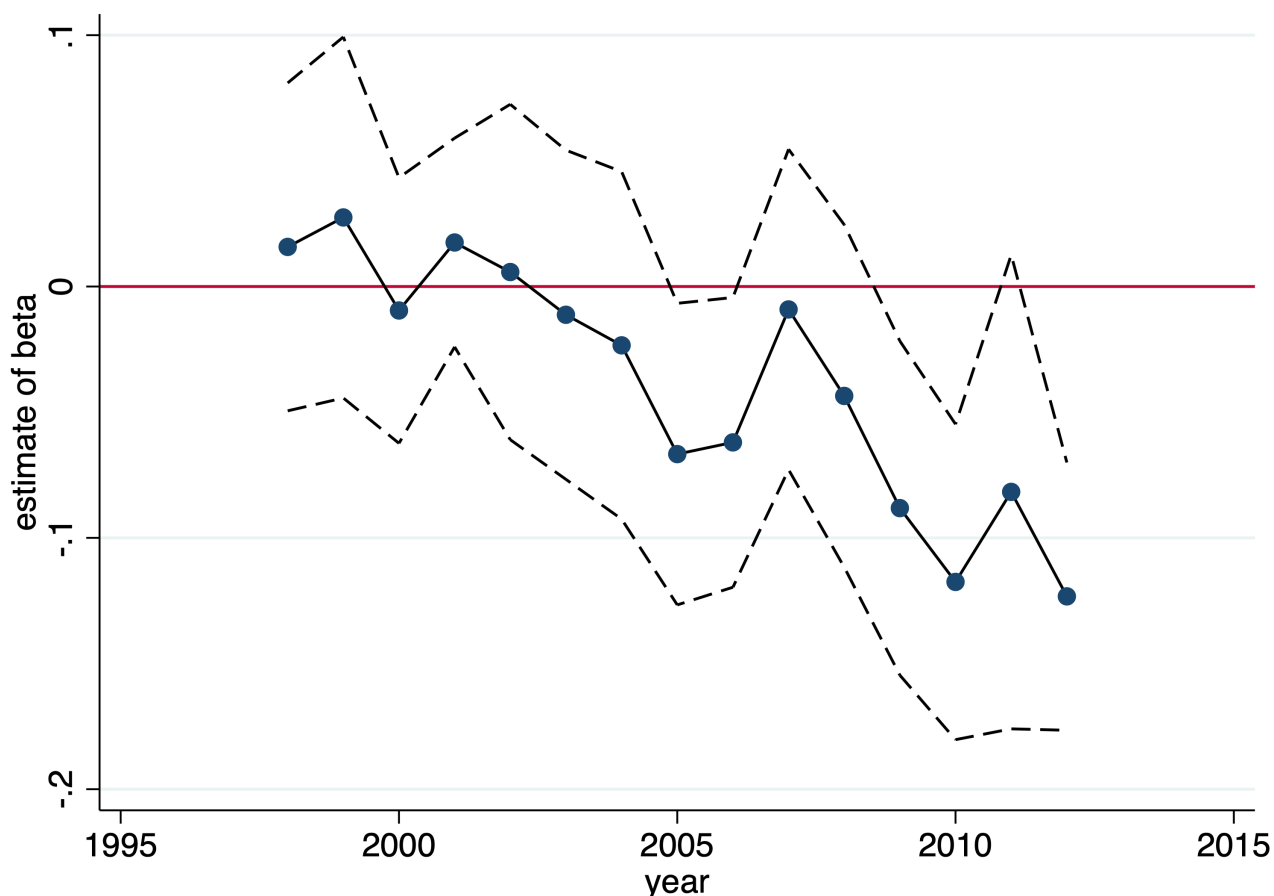
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<sup>20</sup>Standard errors are clustered at the province level

<sup>21</sup>The magnitude of the estimates is robust to the inclusion of province-year fixed effects. However, most of the betas lose statistical significance, likely due to the sizable reduction in variation implied by the high number of fixed effects.

tion is linked resource misallocation to the data, and compute the welfare loss of mafia infiltration.

Figure 4: OP covariance in mafia-infiltrated markets



Source: Computations based on ISTAT Yearly Book of Criminal Statistics (ed. 2014). This figure plots the parameters estimated from Equation 10 (blue dots) together with their 90% confidence intervals (dashed black lines), derived from standard errors clustered at the province level. The dependent variable of the regression is the OP covariance (measured with (log) labor productivity and share of labor over total labor). Each blue dot is the coefficient of the interaction between each single time dummy (1998 to 2012) and a dummy that varies at the sector-province level, equal to one if both the sector and province are defined as mafia-infiltrated, according to the definition provided above.

## 5 Empirical strategy

This section describes how I bring the model presented in Section 3 to the data, through a structural estimation consisting of two main stages. First, I use information on non-

infiltrated markets to estimate all the parameters of the model that are unrelated to the mafia. I then feed a structural model with these parameters and actual data on mafia presence (i.e., the share of firms subject to extortion racketing) in order to quantify, for each infiltrated sector-province-year, the amount of *pizzo* that impacted firms are forced to transfer to the mafia. Specifically, the two stages of the analysis comprise:

- OLS regressions to estimate the following parameters (presented in Section 3): (i) mean and standard deviation of firms' TFP,  $\mu_{sp}$ , and  $\sigma_{sp}$ ; (ii) the component of firms' productivity that is province-time specific,  $\Gamma_{pt}$ ; (iii) exogenous macroeconomic variables such as wages and overhead labor, i.e.  $w_{st}$  and  $f_s$ .
- MSM, which uses the parameters estimated in the previous stage to quantify the amount of *pizzo* imposed in every infiltrated sector-province-year, i.e.  $\delta_{spt}$ .

### First stage

In this stage, I focus on non-mafia markets, i.e., markets that are not defined as mafia infiltrated. Since, as explained in Section 4, this definition has a sectorial, a territorial, and a temporal variation, I can define a group of  $N_{NM}$  markets composed of: (i) sectors that are not infiltrated, in every Northern Italian province, observed during the years 1998-2012; (ii) mafia-infiltrated sectors, located in non-mafia provinces, observed during the years 1998-2012; (iii) mafia-infiltrated sectors, in mafia-infiltrated provinces, before mafia arrival, i.e., before 2000 for some mafia infiltrated provinces and before 2002 for the remaining provinces.

I use data on these  $N_{NM}$  sector-province-year in order to estimate two sets of parameters introduced in the theoretical model presented in Section 3. The first group con-



tains the parameters related to firms' productivity, i.e.,  $\mu_{sp}$ ,  $\sigma_{sp}$ , and  $\Gamma_{pt}$ . The first two parameters are the mean and the variance of the log-normal distribution of the firm-level productivity component. These moments are assumed to be time-invariant, and sector-province specific. The idea is that these parameters identify the distribution of permanent unobserved heterogeneity in firm-level productivity, and the fact that they are sector-province specific means that different provinces can specialize in various sectors. The third parameter is the productivity component common to every firm located in a given province  $p$  at time  $t$ . This element captures any time specific productivity shock that impacts in the same way all the firms located in a given province. The second set of parameters includes the exogenous macroeconomic variables, i.e., wages  $w_{st}$ , which is sector-time specific, and overhead labor  $f_s$ , which is sector specific and time invariant.

The three-dimensional structure of the data and the assumptions made on the variation of these parameters allow me to use non-mafia markets as the best counterfactual of infiltrated markets without mafia activity. In fact, I exploit the sector-province variation of mafia sectors and provinces before mafia arrival to estimate  $\mu_{sp}$  and  $\sigma_{sp}$ . Likewise, I estimate  $\Gamma_{pt}$  by exploiting the province-time data variation on non-mafia sectors. Finally, wage  $w_{st}$  and overhead labor  $f_s$  are computed exploiting the sector-time and sector variation of data on non-mafia provinces and mafia-infiltrated provinces before mafia arrival. I estimate these parameters with OLS regressions, whose equations are derived using the results of the model presented in Section 3. First, I compute from firm-level value added as the product of firm-level equilibrium price and output (Equations 6 and 8 respectively) in a scenario without the mafia:

$$VA_i = \left[ \frac{\alpha\gamma}{w_{st}} \right]^{\frac{\alpha}{1-\alpha\gamma}} [A_i\Gamma_{pt}]^{\frac{\gamma}{1-\alpha\gamma}} \quad (11)$$

Consequently, firm  $i$ 's log-value added is:

$$\log(VA_i) = \frac{\alpha}{(1-\alpha\gamma)} [\log(\alpha\gamma) - \log(w_{st})] + \frac{\gamma}{(1-\alpha\gamma)} [\log(A_i) + \log(\Gamma_{pt})] \quad (12)$$

Further, an expression for value added as a function of optimal labour can be derived using Equations 9 and 7:

$$VA_i = \frac{1}{\alpha\gamma} w_{st} (L_i^* - f_s) \quad (13)$$

Second, since I use aggregate data at the sector-province-year level, I have to derive aggregate expressions from Equations 11, 12, and 13. In particular, I compute average and variance of log-value added, and average value added in levels, as a function of labor. I express these moments as follows:

$$\overline{\log(VA)}_{spt} = \frac{\alpha}{(1-\alpha\gamma)} [\log(\alpha\gamma) - \log(w_{st})] + \frac{\gamma}{(1-\alpha\gamma)} \log(\Gamma_{pt}) + \frac{\gamma}{(1-\alpha\gamma)} \tilde{\mu}_{sp} \quad (14)$$

where  $\tilde{\mu}_{sp}$  is the mean of  $\log(A_i)$  that is province-sector specific.

$$\text{VAR}(\log(VA))_{spt} = \left[ \frac{\gamma}{(1-\alpha\gamma)} \right]^2 \tilde{\sigma}_{sp}^2 \quad (15)$$

where  $\tilde{\sigma}_{sp}^2$  is the variance of  $\log(A_i)$  that is province-sector specific.

$$\overline{VA}_{spt} = \frac{1}{\alpha\gamma} w_{st} (\overline{L}_{spt} - f_s) \quad (16)$$

Finally, I run the following OLS regressions:

$$y_{1,spt} = \theta_{st} + \theta_{pt} + \theta_{sp} + u_{1,spt} \quad (17)$$

where  $y_{1,spt}$  is the average of (log) value added in each sector-province-year, i.e., the left hand side of Equation 14, and  $\theta_{st}, \theta_{pt}$ , and  $\theta_{sp}$  are sector-time, province-time, sector-province fixed effects respectively.

$$y_{2,spt} = \eta_{st} + u_{2,spt} \quad (18)$$

where  $y_{2,spt}$  is the variance of (log) value added in each sector-province-year, i.e., the left hand side of Equation 15, and  $\eta_{st}$  are sector-time fixed effects.

$$y_{3,spt} = \beta x_{spt} + \zeta_s + u_{3,spt} \quad (19)$$

where  $y_{3,spt}$  is the average of value added in each sector-province-year, i.e., the left hand side of Equation 16,  $x_{spt}$  is the average of labor in each sector-province-year adjusted by the estimate of  $\hat{w}_{st}$  obtained from Equation 17, and  $\zeta_s$  are sector fixed effects.

I back out parameters  $\mu_{sp}, \sigma_{sp}, \Gamma_{pt}, w_{st}$ , and  $f_s$  from the sector-province, province-time, sector-time, and sector fixed effects of Equations 17, 18, and 19, using their expressions in Equations 14, 15, and 16. For example, I derive  $w_{st}$  from the following equation:

$$\hat{\theta}_{st} = \frac{\alpha}{(1 - \alpha\gamma)} [\log(\alpha\gamma) - \log(w_{st})] \quad (20)$$

where the left hand side  $\hat{\theta}_{st}$  is estimated from Equation 17 and the right hand is the first

component of the right hand side of Equation 14. I first assume specific values of  $\alpha$  and  $\gamma$  from the literature.<sup>22</sup> Then, I derive sector-time specific wages from Equation 20:

$$\hat{w}_{st} = \exp \left[ \log(\alpha\gamma) - \frac{(1 - \alpha\gamma)}{\alpha} \hat{\theta}_{sp} \right] \quad (21)$$

I follow the same reasoning to compute the other parameters.

## Second stage

The second stage of the analysis focuses on the mafia-infiltrated markets. For each of these  $N_M$  markets, I estimate the amount of *pizzo* that the mafia extorts from a randomly chosen group of firms, i.e.,  $\delta_{spt}$ , using the method of simulated moments (MSM). The set of parameters I compute in this stage is the vector  $\Delta$ , composed by the  $N_M$  values of  $\delta_{spt}$  that the mafia extorts in each sector-province-year defined as infiltrated. Given that  $\delta_{spt}$  cannot be disentangled using aggregate data, it is not possible to estimate vector  $\Delta$  using standard econometric techniques. The estimation of the parameters is instead achieved with the MSM, which minimizes a distance criterion between key moments from actual data and the corresponding moments computed using simulated data.

Specifically, for every sector-province-year, I generate a vector of firm-specific productivity  $A_i$  from a log-normal distribution with average  $\hat{\mu}_{sp}$  and standard deviation  $\hat{\sigma}_{sp}$ , estimated in the first stage.<sup>23</sup> Firm-specific productivity is then multiplied by the pre-

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<sup>22</sup>I follow [Bartelsman et al. \(2013\)](#), [Bloom \(2009\)](#), and [Atkeson and Kehoe \(2005\)](#) and assume a 20 percent markup that yields  $\gamma$  equal to 0.83, and that the decreasing return to scale parameter  $\alpha$  is equal to 0.85.

<sup>23</sup>The length of this vector is the observed number of firms that operate in the specific sector-province-year.

viously computed province-year component  $\widehat{\Gamma}_{pt}$ . Next, I simulate distortions implied by the mafia. From the theoretical framework presented in Section 3, recall that mafia impact is an idiosyncratic distortion that results from the interaction of the “mafia exposure” component  $\tau_i$  with the “mafia intensity” component  $\delta_{spt}$ . The “mafia exposure” component is assumed to follow a Bernoulli distribution with average  $\lambda_{spt}$ . Hence, in each mafia-infiltrated market,  $\lambda_{spt}$  gives the share of firms that are impacted by the mafia. I construct  $\lambda_{spt}$  from actual data on reports of extortion in Northern Italy.<sup>24</sup> Since mafia targeting is not correlated to firms’ productivity, I randomly select the share  $\lambda_{spt}$  of firms that, in each sector-province-year, must transfer *pizzo*  $\delta_{spt}$ . Then, I simulate firms’ labor, output, value added, and labor productivity according to the derivation presented in Section 3 and using the estimates of overhead labor  $\widehat{f}_s$  and wage  $\widehat{w}_{st}$  obtained in the previous stage of the estimation. In practice, I feed my model with previously estimated parameters, necessary to control for the determinants of aggregate productivity that are unrelated to the mafia, and actual data on mafia activity, i.e., the average  $\lambda_{spt}$  of the distortion component  $\tau_i$ , in order to estimate the unobserved amount of *pizzo* that the mafia imposes on firms, i.e., the component  $\delta_{spt}$ .<sup>25</sup>

I implement the MSM as follows: for each mafia infiltrated sector-province-year, I create a grid  $\Theta$  of values that  $\delta_{spt}$  can take, and choose a set of observed data moments  $\Phi^O$  that the model has to match.<sup>26</sup> For each possible value of  $\delta_{spt}$  in  $\Theta$ , the model is solved

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<sup>24</sup>The computation of  $\lambda_{spt}$  characterizing each impacted market is described in detail in Appendix A.3

<sup>25</sup>This approach speaks to the work of [Ranasinghe and Restuccia \(2018\)](#), who try to understand the role of crime and financial market development as sources of misallocation, using actual data on these frictions.

<sup>26</sup>The grid search method is useful for avoiding convergence problems with possible non-convexity of the objective function (see Equation 22), and given the potential for discontinuities in the model.

and the simulated moments of interest  $\Phi(\delta)^S$  are computed. The estimate of the vector containing the amount of *pizzo* imposed in each mafia-infiltrated market  $\widehat{\delta}_{spt}$  is derived according to the following criterion:

$$\widehat{\delta}_{spt} = \arg \min_{\delta} [\Phi^O - \Phi(\delta)^S]' W [\Phi^O - \Phi(\delta)^S] \quad (22)$$

where  $W$  is a weighting matrix. The procedure is iterated 2,500 times.<sup>27</sup>

I estimate an overidentified model, in which for each sector-province-year the set of moments to match includes: (i) the OP covariance between productivity and size, measured in terms of (log) labor productivity and employment share; (ii) average of (log) labor; (iii) and average (log) value added. The most important moment is the OP covariance between productivity and size. In fact, this analysis relies on the assumption that mafia extorting behavior generates factor misallocation. Thus, extortion acts perpetrated by the mafia can be seen as an *extra* determinant of allocative efficiency, which can be measured with the OP covariance. Controlling for any other factor that contributes to aggregate productivity that is unrelated to mafia, allows me to estimate  $\delta_{spt}$  as the parameter that minimizes distance between the simulated OP covariance and the observed one. The other two moments are included in order to estimate an overidentified model. The results obtained by estimating a just-identified model, i.e., by matching the OP covariance only, are congruent with those presented in this paper.

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<sup>27</sup>I estimate three versions of the model using three different weighting matrices: (i) the identity matrix, (ii) a weighting matrix that gives the OP covariance a weight that is twice that given to the other moment conditions, (iii) the optimal weighting matrix resulting from a two-stage estimation as in Hansen (1982). The results I present in this paper come from specification (i) and are comparable to those obtained in specifications (ii) and (iii). For a comprehensive description of the functioning of the MSM and its statistical properties see McFadden (1989).

## 6 Results

This section presents the results obtained from the estimation strategy described in Section 5, where I first estimate the parameters of the model, which allows to control for any determinant of allocative efficiency that is unrelated to the mafia through fixed effects regressions on data on non-mafia markets. I then use these parameters together with actual data on the share of firms impacted by the mafia to apply the MSM. In particular, for each mafia-infiltrated market I estimate the amount of *pizzo*  $\widehat{\delta}_{spt}$  by minimizing the distance between simulated OP covariance (measured in terms of (log) labor productivity and employment share over total market employment), (log) average labor, and (log) average value added, and the observed corresponding moments. This means that I quantify *pizzo* as the only unobserved component of allocative efficiency of the infiltrated market, other things equal.

More importantly, the structural approach adopted in this paper allows me to go beyond mere estimates of *pizzo*. I exploit these estimates and my model (Section 3) to understand the composition of the economic cost implied by extortion racketeering and to quantify it. Specifically, I first develop a simulation analysis where I show that the cost due to the mafia depends mainly on the output reduction for impacted firms. Next, I compute this economic loss through a counterfactual analysis that compares the aggregate value added of the infiltrated economy to the corresponding one without the mafia.

## 6.1 Model estimation

Estimates of *pizzo* are presented in Figure 5 (light grey bars). In particular, this figure reports the estimates of average *pizzo*, imposed in each mafia-infiltrated sector  $s$  (with the 95% confidence bands). The least impacted sector is real estate activity, where average *pizzo* is 0.5%. Construction and community, social, and personal services have the highest average *pizzo*, at 4.4% and 4.8% respectively. Finally, for the accommodation and food services sector the average tax is 1.7%, whereas for the wholesale and retail trade sector it is slightly more than 1%.

These results suggest that, on average, those firms located in mafia-infiltrated provinces that were extorted by organized crime in the years 2000-2012, lost between 0.5 and 5 percent of their output, depending on the sector. To the best of my knowledge, this is the first analysis to provide an explicit estimate of *pizzo*, expressed as a percentage of the output of the coerced firms located in Northern Italy.

### Placebo test

In my empirical strategy, I quantify *pizzo* as the only unobserved component of allocative efficiency of the infiltrated market, other things equal. This means that in non-mafia markets, allocative efficiency is entirely explained by parameters that are unrelated to mafia activity. Therefore, performing the MSM on non-mafia markets should give estimates of *pizzo* that are very close to zero.

I accordingly perform a validation exercise of my empirical strategy. In particular, I estimate the amount of *pizzo* in the two non-mafia sectors, i.e., Manufacturing, and transportation and storage, located in the infiltrated provinces after mafia arrival. For



the purposes of this exercise, I replicate the estimation strategy described in Section 5.<sup>28</sup> The results presented in Figure 5 clearly validate the hypothesis that mafia racketeering is a determinant of allocative efficiency only in markets defined as mafia-infiltrated. Average *pizzo* of non-mafia sectors, i.e., the bars depicted in dark grey, is significantly lower than that of the mafia-infiltrated markets, i.e., the light grey bars. More importantly, in both the manufacturing and the transportation and storage sectors, average *pizzo* is very close to zero, at approximately 0.1%.<sup>29</sup>

### Accounting for other possible sources of misallocation

The implicit assumption I make when quantifying *pizzo* is that all misallocation in the model is due to mafia infiltration. If public funds are inefficiently allocated across firms in mafia infiltrated industries (e.g., due to more entry or cronyism), then the estimates of *pizzo* presented above might also capture some of this misallocation and overstate the extent of extortion racketeering. Yet, several years after completion of the infrastructure projects, firms that have inefficiently benefited from public funds may shrink or exit, while extortion rates would be as observed in the data. Therefore, focusing on infiltrated markets several years after completion of the infrastructure projects may be

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<sup>28</sup>I first compute the parameters of the model that are unrelated to the mafia, using data on the new control group. Specifically, wages  $w_{st}$  and overhead labor  $f_s$  are measured exploiting data variation on non-mafia provinces. Mean and standard deviation of TFP,  $\mu_{A_{ps}}$  and  $\sigma_{A_{ps}}$ , are computed exploiting the variation of mafia sectors-provinces before organized crime arrival. Estimating the productivity component common to all firms that operate in the same province-time,  $\Gamma_{pt}$ , necessitates information on non-mafia sectors. Since, in this exercise, every sector is assumed to be infiltrated by mafia, I compute  $\Gamma_{pt}$  performing two rounds of the first stage of the estimation (one per sector). Each round includes only one non-mafia sector within the group of mafia sectors. Next, I use these estimates to perform the second stage of the estimation, i.e., the MSM.

<sup>29</sup>This result is also driven by few outliers. In most of the markets, the level of *pizzo* that results from the MSM is zero.

a proper way to get unbiased estimates of *pizzo*, which would control for the potential “public funds effect” on misallocation.

I compute average sectorial extortion rate on a subsample of mafia-infiltrated markets. Specifically, the renewal works of the A4 highway and the Milan-Bologna high-speed rail have been completed between years 2007 and 2008. The only exception involves provinces located in Piedmont (i.e., Turin, Vercelli, Novara), where the projects have been completed in 2017. Since my data spans until 2012, I consider as period after completion of the rail-highway projects years 2010-2012 and I exclude the provinces located in Piedmont.

Results are presented in Figure 6. The light-grey bars represent average *pizzo* (together with their 95% confidence bands) displayed in Figure 5 and serve as baseline reference. The grey bars represent average *pizzo* computed on the provinces that I observe several years after completion of the high speed rail and highway projects during the whole mafia infiltration period, i.e. from year 2000 to 2012.<sup>30</sup> Finally, the dark-grey bars represent average *pizzo* several years after completion of the infrastructure projects, i.e. in years 2010-2012. These findings suggest that estimates of average *pizzo*, while accounting for other possible sources of misallocation, do not change radically.<sup>31</sup> Extortion rates for construction and real estate activities do not change significantly. For wholesale and retail trade and community, social and personal services industries average *pizzo* increases, while it slightly decreases for accommodation and food service activi-

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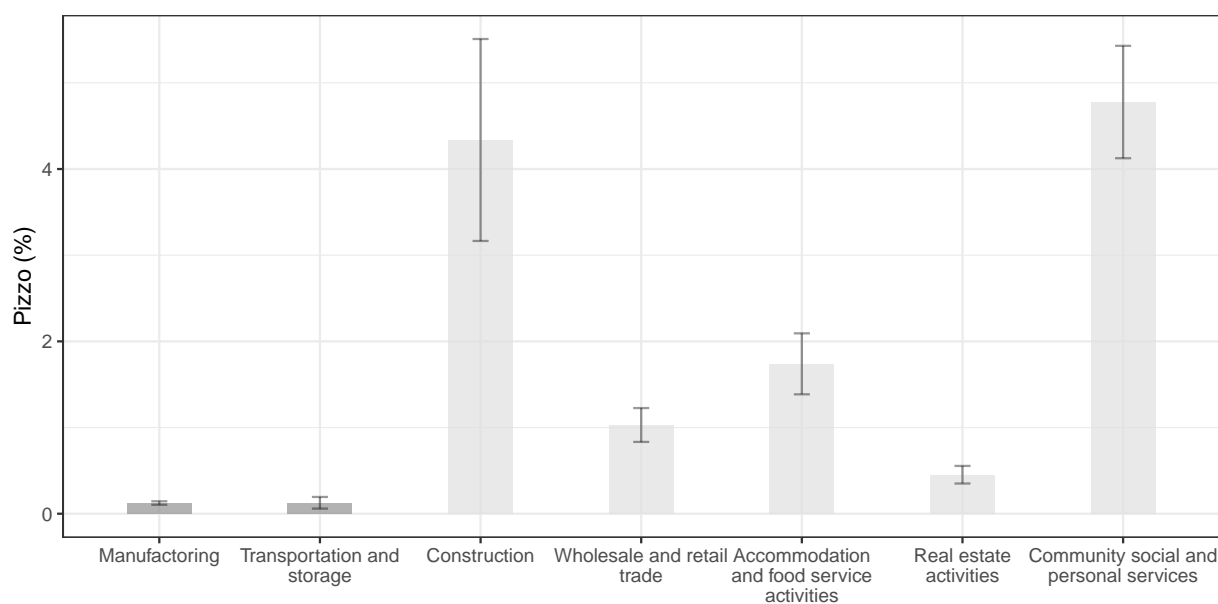
<sup>30</sup>I report estimate of *pizzo* computed in this subsample to show that excluding mafia-infiltrated provinces located in Piedmont does not affect the main results.

<sup>31</sup>They are less precisely estimated because of the reduction of the sample size implied by the nature of this exercise.

ties industry.

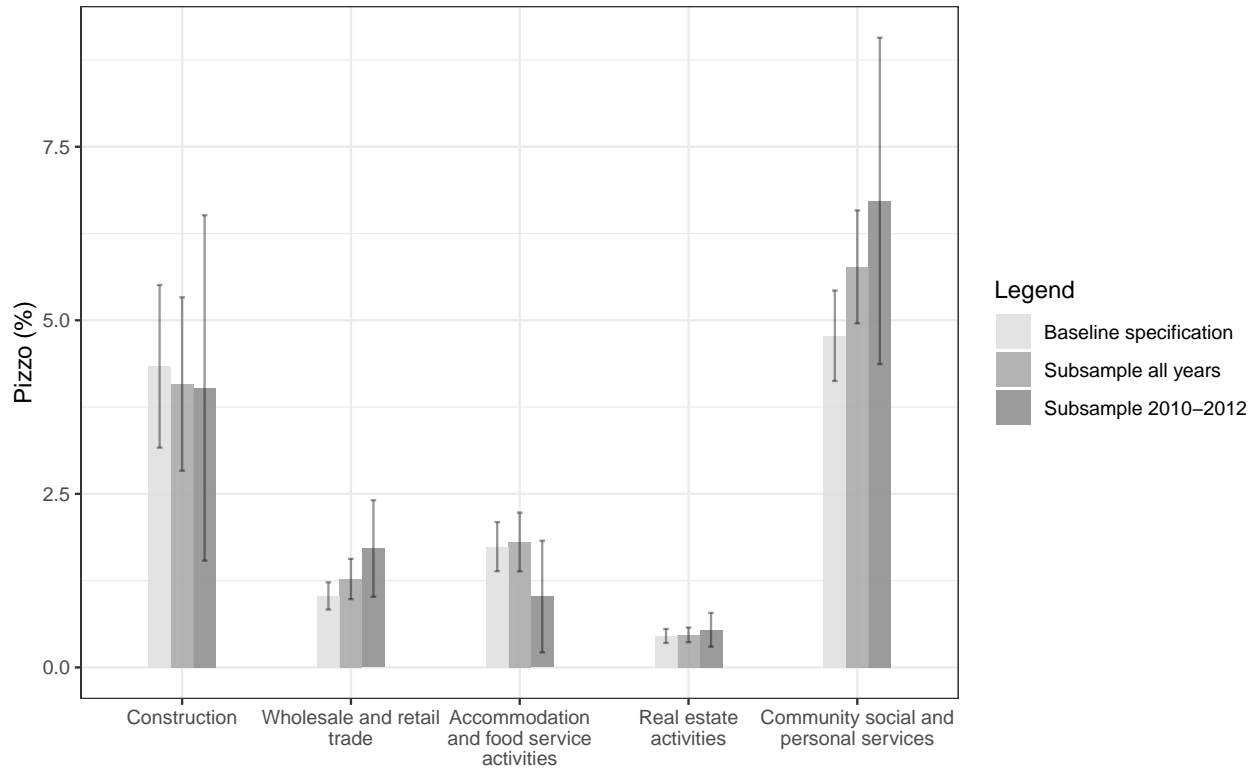
In Appendix A.5 I show that the number of firms did not increase in the infiltrated provinces, after the approval of the public funds for the renewal of the A4 highway and the Milan-Bologna high-speed rail. I also show in these provinces, after receiving funding for rail-highways, there are no differences in the change of the number of firms when comparing mafia and non-mafia sectors. This is a piece of evidence to support the idea that public funds did not lead to more entry and affect misallocation in provinces that received funding.

Figure 5: Estimated average *pizzo*  $\delta$  in each sector



The estimates are obtained using aggregate data from the *Small and Medium Entrepreneurs Survey* available at the ISTAT-ADELE laboratory and information from the Annual Criminal Statistics Report by ISTAT. Results derived from the application of the Method of Simulated Moments (MSM) through a grid search. For every mafia infiltrated market  $\delta$  takes values from a grid bounded between 0 and 0.4. Within this grid, the chosen value is the one that minimizes the distance between simulated OP covariance, average (log) labor, and average (log) value added and the corresponding observed moments. The process was iterated 2,500 times. Each bar represents the average sectorial *pizzo* over the 2,500 iterations, together with their 95% confidence bands. The dark-grey bars represent average *pizzo* computed in non-mafia sectors, while the light-grey bars represent average *pizzo* computed in mafia sectors.

Figure 6: Amount of *pizzo*  $\delta$  in mafia infiltrated sectors after completion of the projects



These estimates are obtained using aggregate data from the *Small and Medium Entrepreneurs Survey* available at the ISTAT-ADELE laboratory and information from the Annual Criminal Statistics Report published by ISTAT. The light-grey bars represent average *pizzo* displayed in Figure 5, as baseline reference. The grey bars represent average *pizzo* computed in the subsample of provinces that I observe several years after completion of the high speed rail and highway projects, i.e., excluding provinces located in Piedmont, during the whole time period of mafia infiltration. The dark-grey bars represent average *pizzo* computed in the subsample of provinces that I observe several years after completion of the infrastructures, during the years posterior to the completion of the projects (2010-2012).

## 6.2 Unpacking the economic cost of the mafia

In order to understand what exactly causes the economic loss due to mafia infiltration, I simulate the model of Section 3 to study how aggregate outcomes, such as market size and aggregate value added change, and how the aggregate transfer to the mafia and forgone production contribute to the total economic cost of extortion racketeering.

I focus in particular on accommodation and food service activities, simulating a ficti-

tious economy populated by 1,000 firms.<sup>32</sup> To generate this market, I choose parameters obtained in the first stage of the estimation strategy developed in Section 5.<sup>33</sup> Recall that, as explained in Section 3, extortion racketeering generates an idiosyncratic distortion that can be expressed by the interaction of the “mafia exposure” component  $\tau_i$  with the “mafia intensity” component  $\delta$ . The latter component is common to every firm that has to pay *pizzo* in a certain market. The former component is assumed to follow a Bernoulli distribution with average  $\lambda$ . Thus,  $\lambda$  gives the share of firms that are impacted by the mafia. In this simulation, I fix  $\delta$  equal to the average sectorial value ( $\delta = 1.7\%$ ), and let the share of coerced firms vary between zero and one, i.e.,  $\lambda \in [0, 1]$ . Then, for each value of  $\lambda$ , I compute: (i) the total amount of *pizzo* transferred to the mafia (this component represents a waste of resources that would otherwise have been used productively); (ii) the total forgone value added of the firms that pay *pizzo*; and (iii) the forgone value added of the firms that leave the market. Each component is measured as the percentage of aggregate value added without the mafia, i.e., aggregate value added when  $\lambda$  equals zero. Each simulation is iterated 25,000 times.

In practice, firm  $i$  extracts its value of TFP,  $A_i$ , from a log-normal distribution, and operates if its expected profit is positive, where the expectation is based on the probability of facing extortion, i.e.,  $\lambda$ . Conversely, if firm  $i$  has negative expected profit it stays inactive.<sup>34</sup> This fact has two main implications. First, aggregate value added decreases as

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<sup>32</sup>Results obtained simulating the other mafia-infiltrated sectors are reported in Appendix A.6.

<sup>33</sup>The mean and the standard deviation of TFP, and the sectorial wage are the median of the sectorial estimates  $\hat{\mu}_{sp}$ ,  $\hat{\sigma}_{sp}$ , and  $\hat{w}_{st}$ , where sector  $s$  is accommodation and food services activities. Overhead labor  $\hat{f}_s$  is that obtained for the sector at hand. Finally, the province-year component of firms’ productivity is the median value of the estimates  $\hat{\Gamma}_{pt}$ .

<sup>34</sup>This assumption is motivated by the fact that, in the real world, if a firm is solicited by the mafia, it has to transfer *pizzo* or face retribution (La Spina et al., 2014). Therefore, for the coerced firm, it is optimal

$\lambda$  increases. In fact, if the share of firms subject to extortion increases, more and more firms will produce less. Second, given that mafia racketeering might imply firm exit, an increasing share of impacted firms might be followed by a reduction in market size, measured in terms of the number of active firms.

Figure 7 plots the results of this simulation. Specifically, the total loss is the sum of components (i), (ii), and (iii) described above, represented respectively by the yellow, blue, and red areas. Clearly, this cost (thick blue line) increases with the share  $\lambda$  of impacted firms. Quite remarkably, more than three-fourths of this cost depends on forgone production. The estimation of the theoretical model developed in Section 3 thus provides a way not only to estimate the amount of *pizzo* extorted, but also to uncover the larger welfare cost in terms of lost production, which is more than three times higher than the mere transfer to the mafia. Moreover, we can observe that firm inactivity is a marginal concern. This is compatible with what I observe in the data (see Appendix A.5).

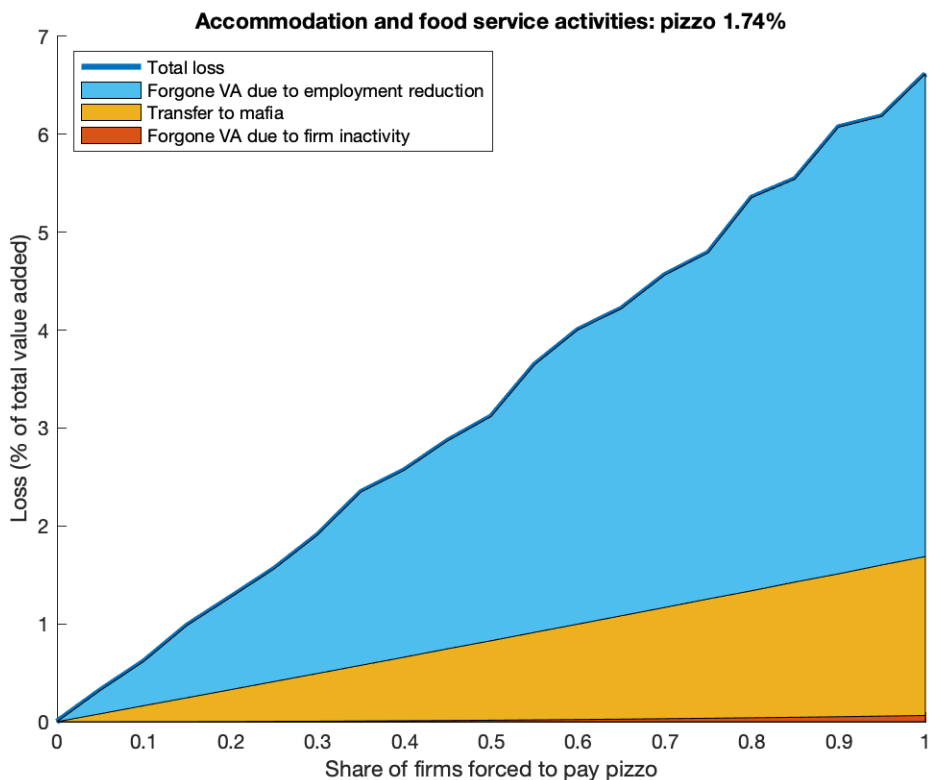
### 6.3 Mafia, misallocation and output loss

The previous subsection sheds light on the sources of the economic cost of extortion racketeering and the weight of each component. This loss depends mainly on the forgone production of firms subject to *pizzo* and, to a lesser extent, the actual transfer of protection money to the mafia. To provide an explicit estimate of the cost suffered by the Northern Italian economy, after mafia arrival, I implement a counterfactual analysis. Specifically, each mafia-infiltrated market is compared to its corresponding scenario

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to continue producing in order to make the transfer, even if this means earning negative profits.

Figure 7: The economic loss due to mafia



This figure depicts results from the simulation of the accommodation and food services sector. I set the value of *pizzo*, i.e.,  $\delta$ , to 1.7%. This means that if a firm is subject to mafia racketeering, it must transfer 1.7% of its output. I let the share of impacted firms, i.e.,  $\lambda$ , vary between zero and one. The yellow area shows how the loss implied by the transfer of *pizzo* changes as  $\lambda$  increases. I add to this component the loss implied by forgone production due to firm exit, i.e., the red area, and forgone production due to output reduction implied by the fact that impacted firms hire less workers, i.e., the blue area. These three components are expressed as the percentage of total value added without mafia infiltration. The total loss computed for each value of  $\lambda$  is given by the thick blue line.

without the mafia, i.e., where  $\lambda$  is equal to zero. For each market, I compute the forgone value added of the impacted firms, which depends either on decrease in production or on firm exit, and the total amount of *pizzo* transferred to the mafia.

Table 1 presents the results. Panel A of the table reports the aggregate loss per sector in million euros, showing that the share of the cost due to forgone value added is more than three-fourths of the total loss. The most heavily impacted sectors are construction, and community, social, and personal services, with an approximate total cost of 770 and 730 million euros respectively. These sectors are also those with the highest

average values of *pizzo* (Figure 5). Meanwhile, the sector with the lowest aggregate loss is accommodation and food services, with a total cost of approximately 200 million euros. Wholesale and retail trade show a total cost of 420 million euros, while that of the real estate sector reaches almost 330 million euros. The sum of the sectorial losses amounts to approximately 2.5 billion euros in cost suffered by Northern Italy. Again, approximately one-fourth of this cost consists of the mere transfer of *pizzo* to the mafia. The remaining three-fourths comprises the loss due to the reduction in production of infiltrated firms, a consequence of their need to pay *pizzo*. To understand the relative magnitude of these results, Panel B reports the sectorial average loss per year, as a percentage of aggregate value added. Column (3) of Panel B suggests that, on average, each mafia-infiltrated sector suffers a cost that ranges from 0.12% to 0.74% of the aggregate value added without mafia infiltration.



Table 1: Loss of value added due to the mafia (in million euros)

Panel A	(1)	(2)	(3)
Sector	Forgone value added	Transfer	Total Cost
Construction	584.67	186.71	771.37
Wholesale and retail trade	314.68	105.97	420.64
Accommodation and food service activities	139.07	49.98	189.05
Real estate activities	234.98	92.54	327.52
Community social and personal services	553.88	177.19	731.07
Total	1827.27	612.38	2439.66

Panel B	(1)	(2)	(3)
Sector	Average yearly percentage loss due to forgone value added	Average yearly percentage loss due to <i>pizzo</i>	Average yearly loss (total)
Construction	0.58%	0.16%	0.74%
Wholesale and retail trade	0.24%	0.08%	0.32%
Accommodation and food service activities	0.37%	0.12%	0.50%
Real estate activities	0.09%	0.03%	0.12%
Community social and personal services	0.46%	0.13%	0.59%

Panel A reports the aggregate economic loss for each mafia-infiltrated sector, located in mafia-infiltrated provinces and suffered as a result of extortion racketeering. Column (1) is computed by aggregating the forgone value added due to output reduction and to firm exit in each sector. Column (2) reports the aggregate *pizzo* transferred by impacted firms in each sector. Column (3) is the sum of columns (1) and (2). Panel B reports the yearly aggregate economic loss, as a percentage of aggregate value added without the mafia. Column (1) reports the average yearly percentage loss due to forgone value added. Column (2) reports the average yearly loss that accounts for the aggregate transfer to the mafia. Column (3) reports the sum of columns (1) and (2).

## 7 Alternative specification

This section considers an extension of the model presented in Section 3, in which I relax the assumption that the mafia impacts firms randomly and assume that their targeting positively correlates with firm-level productivity.<sup>35</sup> In other words, the mafia prefers to coerce more productive firms. Since *pizzo* is a proportional tax on firm-level output, the mafia thus obtains a larger transfer compared to the scenario with random targeting.

The only deviation from the baseline model is the assumption relative to the relationship between mafia targeting and firm-level TFP. In this case, the probability that a firm is asked to pay *pizzo* must increase with its level of TFP. I model this aspect by building a distribution of mafia-related distortions that is positively correlated with firm  $i$ 's draw of TFP,  $A_i$ . Therefore, firms can be ranked according to their individual probability of being extorted, and this probability is perfectly positively correlated with firm-level TFP. In each mafia-infiltrated market, firm  $i$ 's maximization problem expressed in Equation 5 (Section 3) can be rewritten as:

$$\Pi_i = (1 - \zeta_i \delta) Y_i P_i - w_{st} L_i \quad (23)$$

Recall that mafia impact results from the interaction of two components: the idiosyncratic “mafia exposure” component and the “mafia intensity” component, which gives the amount of *pizzo*. The latter is common to every coerced firm in a given infiltrated

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<sup>35</sup>This alternative specification of the model tries to follow the evidence presented in [Confesercenti \(2012\)](#) that in the transition from incursion to actual rooting, the mafia tries to target the wealthiest entrepreneurs and coerces *pizzo* as one-off requests.

market. That which is modeled differently in this alternative specification is the “mafia exposure” component. This parameter, i.e.,  $\zeta_i$ , follows a Bernoulli distribution, where the probability that  $\zeta_i$  equals one increases with firm-level TFP,  $A_i$ :  $\frac{\partial P(\zeta_i=1)}{\partial A_i} > 0$ .<sup>36</sup> As in the baseline specification, “mafia intensity”, i.e.,  $\delta$ , is unobserved and is the object of the estimation.

For each infiltrated market, I estimate the amount of *pizzo*, extorted from a share  $\lambda$  of firms, under the assumption that the mafia targets the most productive firms. To this end, I apply the second stage of the empirical strategy described in Section 5. Specifically, I implement the MSM and, in each mafia infiltrated market, *pizzo* is measured by minimizing the distance between simulated OP covariance (measured in terms of (log) labor productivity and employment share over total market employment), (log) average labor, and (log) average value added, and the observed corresponding moments.

Findings are presented in Figure 8, where I report the estimates of average *pizzo*, imposed in each mafia-infiltrated sector  $s$  (with the 95% confidence bands). A comparison of the results obtained in this model specification (dark grey bars) with those from the baseline specification (light grey bars) shows similarities. As in the baseline specification, the two most impacted sectors are community, social, and personal services followed by construction (with an average *pizzo* of 5.8% and 4.7% respectively), and the least impacted sector is real estate (where average *pizzo* is about 1%). In this application, the third most impacted sector is wholesale and retail trade, where average *pizzo* is almost 2.2%. Finally, the accommodation and food sector has an average *pizzo* of ap-

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<sup>36</sup>Details on how  $\zeta_i$  is constructed are provided in Appendix A.7.

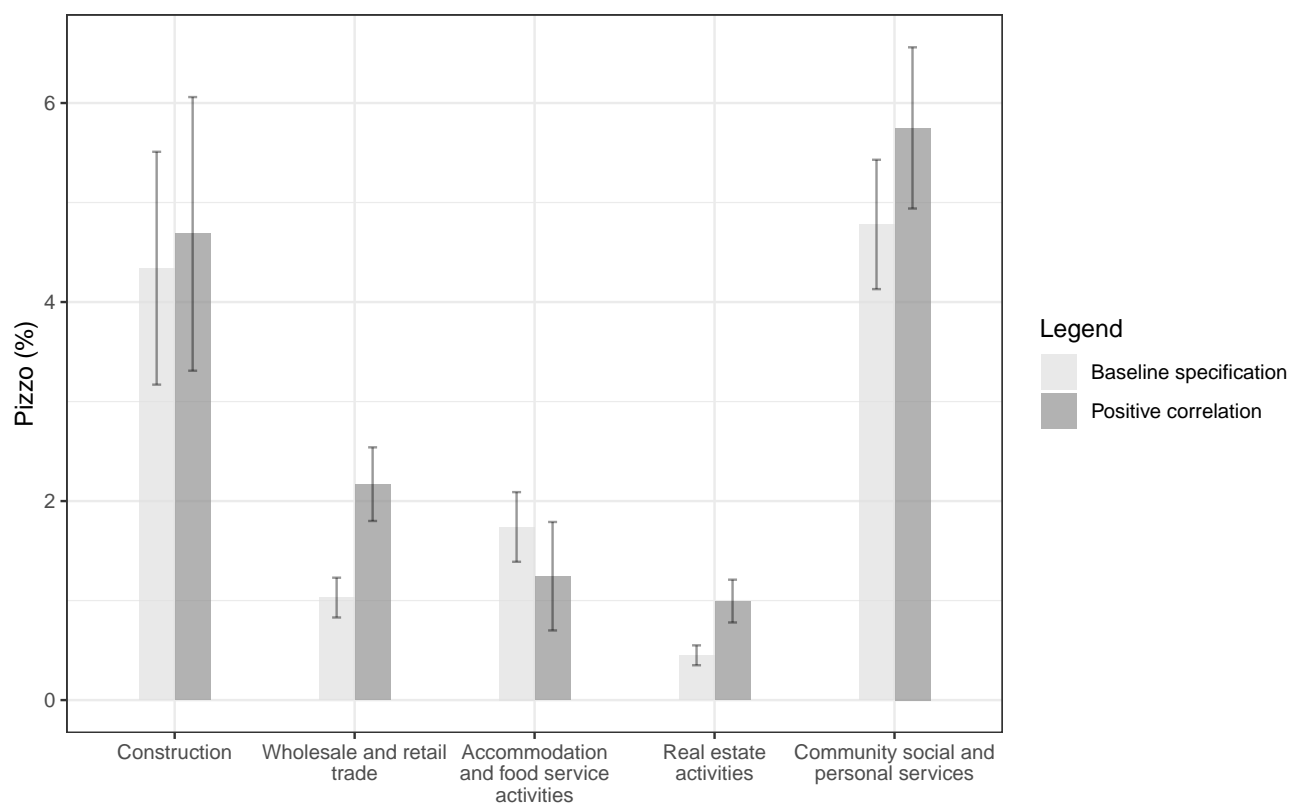
proximately 1.2%.

With regard to the magnitude of *pizzo*, with the exception of the accommodation and food sector, estimates obtained in this alternative specification are higher than those observed in the baseline model. Intuitively, *pizzo* is measured by matching an index of misallocation (the OP covariance), controlling for any other determinants of allocative efficiency (the parameters of the model unrelated to the mafia). Extortion racketeering yields misallocation as, due to *pizzo*, coerced productive firms may end up being smaller than less productive and non-impacted firms. Therefore, compared to the case where firms are randomly targeted, productive firms end up smaller than less productive ones if the mafia extorts a larger share of output, i.e., a larger *pizzo*.

To measure the economic cost of extortion racketeering in this scenario, I perform the counterfactual analysis described in Section 6. Specifically, I simulate each infiltrated market with and without mafia activity, i.e., in the latter case  $\lambda$  is set at zero. Then, for each market, I compute the total transfer to the mafia and the forgone value added due to both output reduction and firms' exit. Table 2 Panel A reports the results. In impacting firms in the upper tail of the TFP distribution, extortion racketeering reaches a total cost of approximately 6.7 billion euros. The average yearly loss suffered by each impacted sector ranges between 0.48% and 1.65% of the aggregate value added in a scenario without mafia infiltration (Table 2 Panel B). Unsurprisingly, this cost is much higher than that computed in the baseline model, which is around 2.5 billion euros. On the one hand, these results reflect the fact that the *pizzo* estimated here is larger than that obtained in the baseline model. On the other hand, by taxing more productive firms, the mafia is able to collect a larger transfer. Furthermore, the fact that the coerced productive firms end up being smaller than less productive ones implies a contraction of

output that is three times higher than what the mafia actually extorts.

Figure 8: Amount of *pizzo*  $\delta$  in mafia-infiltrated sectors



These estimates are obtained using aggregate data from the *Small and Medium Entrepreneurs Survey* available at the ISTAT-ADELE laboratory and information from the Annual Criminal Statistics Report published by ISTAT. Results derived from the application of the Method of Simulated Moments (MSM) through a grid search. For each mafia infiltrated market  $\delta$  takes values from a grid bounded between 0 and 0.4. Within this grid, the chosen value is the one that minimizes the distance between simulated OP covariance, average (log) labor, and average (log) value added, and the corresponding observed moments. The process is iterated 2,500 times. Each bar represents the average sectorial *pizzo* over the 2,500 iterations, together with their 95% confidence bands.

Table 2: Loss of value added (in million euros) when the mafia extorts the most productive firms

Panel A	(1)	(2)	(3)
Sector	Forgone value added	Transfer	Total Cost
Construction	1101.16	362.31	1463.47
Wholesale and retail trade	206.62	68.92	275.54
Accommodation and food service activities	1088.78	365.98	1454.76
Real estate activities	1325.64	434.08	1759.72
Community social and personal services	1325.64	434.08	1759.72
Total	5047.84	1665.37	6713.20

Panel B	(1)	(2)	(3)
Sector	Average yearly percentage loss due to forgone value added	Average yearly percentage loss due to <i>pizzo</i>	Average yearly loss (total)
Construction	1.25%	0.40%	1.65%
Wholesale and retail trade	0.80%	0.26%	1.06%
Accommodation and food service activities	0.54%	0.13%	0.66%
Real estate activities	0.36%	0.12%	0.48%
Community social and personal services	0.95%	0.31%	1.25%

Panel A reports the aggregate economic loss for each mafia-infiltrated sector, located in mafia-infiltrated provinces and suffered because of extortion racketeering. Column (1) is computed by aggregating the forgone value added due to output reduction and to firm exit in each sector. Column (2) reports the aggregate *pizzo* transferred by impacted firms in each sector. Column (3) is the sum of columns (1) and (2). Panel B reports the yearly aggregate economic loss, as a percentage of aggregate value added without the mafia. Column (1) reports the average yearly percentage loss due to forgone value added. Column (2) reports the average yearly loss accounting for the aggregate transfer to the mafia. Column (3) reports the sum of columns (1) and (2).

## 8 Concluding remarks

To shed greater light on the impact of illegal and underground economies, a better understanding of the link between micro idiosyncratic distortions and aggregate outcomes is crucial. Based on this idea, I develop a new methodology that allows to more accurately uncover the economic cost of such phenomena. In particular, I analyze how firms' response to *pizzo* racketeering impacts the allocation of resources in the infiltrated markets located in Northern Italy.

This paper is the first to estimate the amount of *pizzo* and to use these results to provide an explicit measure of the welfare loss due to extortion racketeering. Importantly, I show that the share of the cost given by output loss is three times larger than the size of the actual transfer to the mafia. This result suggests that *pizzo* racketeering implies a substantial cost even when the transfers imposed by organized crime are modest. My approach allows to uncover the actual size of the economic impact of extortion racketeering in Northern Italy.

While the mechanism I model may be context dependent, the empirical method to estimate it has general validity. It can, in fact, be applied to a wide range of contexts, as long as two indispensable pieces of information are available: (i) data on the extensive margin of the distortion, i.e., how many economic agents are involved; (ii) an instructive measure of the aggregate outcome that reflects the impact of the distortion of interest. Additionally, it is essential to make use of a robust counterfactual of how the studied framework would be without the hidden phenomenon. This is fundamental for controlling for any determinant of the studied aggregate outcome that is unrelated to the distortion of interest. Examples of new applications could include computing the eco-

conomic cost of corruption in public procurement to firms, or assessing investment in the legal economy on the part of organized crime.

Extending my model to a general equilibrium perspective is a relevant application that I leave for future research. This will provide additional insights on the behavior of the economic agents behind illegal and underground economies, allowing to gain deeper knowledge of the hidden nature of such phenomena.

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# A Appendix

## A.1

This appendix contains the proof of Proposition 1 introduced in Section 2.

**Proposition 1** Consider the vector  $\omega$  containing  $N$  firm-level productivity ranked as follows  $\omega_1 > \omega_2 > \omega_3 > \dots > \omega_N$ . Consider the vector  $\theta$  containing  $N$  of firm-level size ranked as follows  $\theta_I > \theta_{II} > \theta_{III} > \dots > \theta_N$ .

If aggregate productivity is defined as the sum of firm-level productivity weighted by firm-level size, the way of maximising it is to have the ranking of firm-level productivity and firm-level size perfectly aligned. In other words, aggregate productivity is maximised when  $\omega_1$  is matched to  $\theta_I$ ,  $\omega_2$  is matched to  $\theta_{II}$ , and so forth. **Proof.** Consider two elements of  $\omega$ ,  $\omega_1 > \omega_2$ , and two elements of  $\theta$ ,  $\theta_I > \theta_{II}$ . To prove Proposition 1, Equation 1 must be true:

$$\omega_1\theta_I + \omega_2\theta_{II} > \omega_1\theta_{II} + \omega_2\theta_I \quad (1)$$

Given that  $\omega_1 > \omega_2$ ,  $\omega_1$  can be written as follows:  $\omega_1 = \omega_2 + \Delta\omega$  (with  $\Delta\omega > 0$ ). For the same reasoning  $\theta_I = \theta_{II} + \Delta\theta$  (with  $\Delta\theta > 0$ ). Plugging these expressions into Equation 1 and rearranging we obtain:

$$(\omega_2 + \Delta\omega)(\theta_{II} + \Delta\theta) + \omega_2\theta_{II} > (\omega_2 + \Delta\omega)\theta_{II} + \omega_2(\theta_{II} + \Delta\theta)$$

$$\omega_2\theta_{II} + \Delta\omega\Delta\theta + \Delta\omega\theta_{II} + \Delta\theta\omega_2 + \omega_2\theta_{II} > \omega_2\theta_{II} + \Delta\omega\theta_{II} + \omega_2\theta_{II} + \Delta\theta\omega_2$$

That leads to:

$$\Delta\omega\Delta\theta > 0$$

which is always true.

Pick two other elements from vector  $\omega$  and vector  $\theta$ , such that  $\omega_A > \omega_B$  and  $\theta_C > \theta_D$ .

Given the computations provided above, we know that:

$$\omega_A\theta_C + \omega_B\theta_D > \omega_A\theta_D + \omega_B\theta_C \quad (2)$$

therefore:

$$\omega_1\theta_I + \omega_2\theta_{II} + \omega_A\theta_C + \omega_B\theta_D > \omega_1\theta_{II} + \omega_2\theta_I + \omega_A\theta_D + \omega_B\theta_C \quad (3)$$

We can apply this reasoning to every element of vector  $\omega$  and vector  $\theta$ . ■

## A.2

In what follows, I present a validation exercise of the definition of mafia-infiltrated market (Section 4). I show that, in provinces and years defined as mafia infiltrated, there was an increase in mafia activity, even if quantified with an alternative measure than [Piemontese \(2013\)](#). I measure it by the number of confiscations that occurred in each northern province, between the years 1993 and 2015.<sup>37</sup> I implement a DD strategy to check whether there is an increase in average seizures in mafia-infiltrated provinces, after the approval of renewal works of the A4 highway and the Milan-Bologna high speed railway, relative to the other northern provinces. I estimate the following model:

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<sup>37</sup>Data on confiscations from the mafia are provided by the ANBSC and are described in Section 4.

$$\text{Confiscation}_{pt} = \alpha + \gamma \times \text{Mafia}_{pt} + \theta_t + \theta_r + u_{pt} \quad (4)$$

The left hand side variable is the number of confiscations that occurred in province  $p$ , at time  $t$ . The variable  $\text{Mafia}_{pt}$  is a dummy that equals one if province  $p$  is mafia-infiltrated and  $t$  indicates a year after the arrival of the mafia. Finally,  $\theta_t$  and  $\theta_r$  are year and region fixed effects. I use the latter in the baseline specification as the process of confiscation is carried out by the Anti-Mafia District Directorate (*Direzione Distrettuale Antimafia, DDA*), which is a regional judicial body.<sup>38</sup> I also implement other specifications of the model: (i) I include province fixed effects; (ii) I estimate a more demanding model that includes region-year and province fixed effects; (iii) I control for province-specific time trends to capture the possible presence of time-varying characteristics at the province level. Finally, given that the data shows that the number of seizures in the province of Milan is significantly higher than in any other province, I remove it from each specification in order to exclude the hypothesis that this province is driving the results.

The findings are presented in Table A1 and show that the coefficient of the variable  $\text{Mafia}_{pt}$  is always positive and strongly significant in each specification, suggesting that on average, relative to non-mafia territories, mafia activity is higher in provinces defined as mafia-infiltrated, after mafia arrival. These results corroborate the hypothesis studied in [Piemontese \(2013\)](#) and, consequently, my definition of mafia-infiltrated market.

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<sup>38</sup>To be precise, the *DDA* is not officially a regional body, but in Northern Italy there is a *DDA* office located in each regional capital, with the exception of Aosta Valley, which shares the *DDA* with Piedmont.

Table A1: Mafia presence and confiscation of firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Seizures	Seizures	Seizures	Seizures	Seizures	Seizures	Seizures	Seizures
Mafia infiltrated province-year	1.527*** (0.297)	0.894*** (0.216)	1.027*** (0.226)	0.668*** (0.185)	1.194*** (0.306)	0.679*** (0.251)	2.513*** (0.504)	1.118*** (0.359)
Observations	1,155	1,051	1,155	1,051	1,155	1,051	1,155	1,051
R-squared	0.316	0.285	0.570	0.492	0.691	0.679	0.659	0.616
Region FE	YES	YES	NO	NO	NO	NO	NO	NO
Province FE	NO	NO	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Region-time FE	NO	NO	NO	NO	YES	YES	NO	NO
Province Time Trend	NO	NO	NO	NO	NO	NO	YES	YES
Exclude Milan	NO	YES	NO	YES	NO	YES	NO	YES

Source: Computations based on ANBSC data on firms seized from the mafia. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . The dependent variable in columns (1)-(8) is the number of confiscations of firms that occurred in province  $p$  at time  $t$ . Variable “Mafia province after mafia arrival” is a dummy that equals one if province  $p$  is defined as mafia infiltrated and time  $t$  is a year posterior to mafia arrival. Columns (1) and (2) include region and year fixed effects; the latter excludes the province of Milan from the sample. Columns (3) and (4) include province and year fixed effects, the latter again excludes the province of Milan from the sample. Columns (5) and (6) control for region-time fixed effects; the latter excludes the province of Milan from the sample. Columns (7) and (8) include province-specific time trends, the latter excludes the province of Milan from the sample.

### A.3

In this appendix I describe in detail how I construct the share of firms subject to extortion racketing in each mafia infiltrated market,  $\lambda_{pt}$ . This variable must be zero in markets that are not defined as mafia-infiltrated. Therefore, for each mafia province, I tailor yearly reports of extortion in a difference-in-differences fashion. In particular, I compute  $\lambda_{pt}$  as the *increase* in reports of extortion registered in the infiltrated provinces after mafia arrival. To this end, I adjust the number of extortion cases observed in every mafia-infiltrated province-year as follows:

$$\tilde{e}_{pt} = \text{mafia province year}_{pt} \times [(e_{pt} - \bar{e}_{p,PRE}) - (\bar{e}_{-pt} - \bar{e}_{-p,PRE})]$$

where  $\tilde{e}_{pt}$  is the adjusted number of extortion cases,  $\text{mafia province year}_{pt}$  is a dummy that equals one if the province-year is infiltrated,  $e_{pt}$  is the number of extortion cases observed in the raw data,  $\bar{e}_{p,PRE}$  and  $\bar{e}_{-p,PRE}$  are the averages of reports of extortion from 1998 until the year of the infrastructure renewal approval in mafia provinces and non-mafia provinces, respectively, and  $\bar{e}_{-pt}$  is the yearly average for every mafia-year of the number of extortion cases observed in non-mafia provinces.<sup>39</sup> Then, I compute the share of impacted firms as follows:

$$\lambda_{pt} = \max \left[ \frac{\tilde{e}_{pt}}{N_{pt}}, 0 \right]$$

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<sup>39</sup>Note that some mafia-infiltrated provinces start to be infiltrated in 2000. For these provinces,  $\bar{e}_{p,PRE}$  and  $\bar{e}_{-p,PRE}$  are computed between the years 1998 and 2000. For the remaining mafia-infiltrated provinces,  $\bar{e}_{p,PRE}$  and  $\bar{e}_{-p,PRE}$  are computed between 1998 and 2002.



where  $N_{pt}$  is the number of firms operating in province  $p$  at time  $t$ .

This measure of the share of firms impacted in every mafia province-year uses the number of reports of extortion observed in the specific province-year, adjusted by the difference in the average extortion cases between mafia and non-mafia provinces from 1998 until the year of renewal work approval, and adjusted by the average extortion cases in the non-mafia provinces after mafia arrival. If this value is lower than zero, I replace it with zero and exclude that specific province-year from the analysis. This results in the exclusion of two mafia-infiltrated provinces from the analysis.<sup>40</sup>

## A.4

This appendix presents several robustness checks of the suggestive evidence presented in Section 4, where I show that mafia *presence* correlates negatively with allocative efficiency. The main aim here is to show that mafia *intensity* also correlates negatively with allocative efficiency. To this end, I implement the following IV strategy. Equation 5 describes the core specification of the model.

$$\text{OP covariance}_{spt} = \alpha + \beta \times \text{Mafia intensity}_{spt} + \eta_p + \theta_{st} + u_{spt} \quad (5)$$

The outcome variable is the OP covariance between size, i.e., share of employment over total labor, and productivity, i.e., labor productivity, computed for every sector  $s$  province  $p$  and year  $t$ . Mafia intensity is measured through the interaction between

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<sup>40</sup>Given that I don't have information on the sectorial intensity of extortion, I assume that the mafia evenly impacts every sector. Thus, in order to obtain the sectorial share of firms that is impacted ( $\lambda_{spt}$ ), I divide  $\lambda_{pt}$  by five, i.e., the number of sectors defined as mafia infiltrated.

“extortion cases per 1,000 firms” reported in each province  $p$  and year  $t$ , and a dummy variable that equals one if sector  $s$  is classified as mafia infiltrated. Mafia intensity is instrumented with a dummy that takes a value of one if the market is defined as mafia infiltrated, according to the definition introduced in Section 4.<sup>41</sup> The core specification of the model includes province fixed effects  $\eta_p$  and sector-year fixed effects  $\theta_{st}$ . In order to control for a higher degree of unobserved heterogeneity, two additional specifications include sector-year and province-year fixed effects and sector-year, province-year, and province-sector fixed effects. The three model specifications exclude the construction sector in order to avoid any bias introduced by the potential violation of the exclusion restriction assumption. Indeed, the approval of renewal works of public infrastructure is likely to have an impact in itself on the allocative efficiency of the construction sector. Table A2 shows the results, with column (1) presenting the estimates of the main specification of the model. The coefficient of mafia intensity suggests that an increase of mafia intensity correlates negatively with the allocative efficiency of mafia-infiltrated sectors located in the provinces where the mafia successfully infiltrated, after mafia arrival. Results reported in column (2) support this idea. In column (3), the coefficient on mafia intensity is negative, but it loses significance. This may be due to the quite limited variation brought by the high number of fixed effects.

These findings suggest that extortion racketeering, which increased significantly in some northern provinces due to investment in public infrastructure ([Piemontese, 2013](#)), negatively biased the OP covariance between productivity and the size of the mafia-infiltrated

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<sup>41</sup>Sector  $s$  located in province  $p$  observed at time  $t$  is mafia infiltrated if, in province  $p$  and year  $t$ , public works for the A4 highway or the high speed railway have been approved and sector  $s$  is mafia-infiltrated.

markets. This outcome is in line with the suggestive evidence presented in Section 4, where I show a decreasing trend in the OP covariance in the mafia-infiltrated sectors located in mafia-infiltrated provinces after the arrival of the mafia.

Table A2: Mafia intensity and allocative efficiency

	(1) OP covariance	(2) OP covariance	(3) OP covariance
Mafia Intensity	-0.091** (0.036)	-0.099*** (0.032)	-0.128 (0.231)
Observations	7,359	7,359	7,359
R-squared	0.138	0.202	0.359
Province FE	YES	NO	NO
Year FE	NO	NO	NO
Sector-Year FE	YES	YES	YES
Province-Year FE	NO	YES	YES
Province-Sector FE	NO	NO	YES

Source: Computations based on ISTAT's SME Survey and its Annual Criminal Statistics Report (ed. 2014). Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . The dependent variable in columns (1)-(3) is OP covariance for log-labor productivity and share of employment computed using data from the *Small and Medium Entrepreneurs Survey* available at the ISTAT-ADELE. Variable "Mafia intensity" is obtained interacting "extortion cases per 1000 firms" and "mafia-infiltrated sector" dummy, i.e., a dummy that takes a value of one if sector  $s$  is labeled as mafia infiltrated. Data on reports of extortion is provided by the Annual Criminal Statistics Report published by ISTAT. "Mafia intensity" is instrumented by a dummy that takes a value of one if sector  $s$  located in province  $p$  observed at time  $t$  is defined as mafia infiltrated.

## A.5

In what follows, I explore whether the number of firms changed in mafia-markets, after receiving funding for infrastructures (A4 motorway and the Milan-Bologna high speed

rail). Specifically, I perform the following triple difference-in-differences:

$$\text{Number of firms}_{spt} = \alpha + \theta \text{Mafia-market}_{spt} + \gamma_1 x_{1st} + \gamma_2 x_{2pt} + \gamma_3 x_{3sp} + \eta_s + \eta_p + \eta_t + u_{spt} \quad (6)$$

The dependent variable is the number of firms observed in a given sector  $s$ , province  $p$ , at time  $t$ . Variable  $\text{Mafia-market}_{spt}$  is a dummy that equals one if the specific sector  $s$ , in province  $p$ , at time  $t$  is mafia-infiltrated, according to the definition presented in Section 4.  $x_{1st}$ ,  $x_{2pt}$ , and  $x_{3sp}$  are interaction terms between the dummies that defines mafia sectors, mafia provinces, and mafia years, i.e.,  $x_{1st}$  equals one if sector  $s$  and year  $t$  are mafia-infiltrated,  $x_{2pt}$  equals one if province  $p$  and year  $t$  are mafia-infiltrated,  $x_{3sp}$  equals one if sector  $s$  and province  $p$  are mafia-infiltrated. The model includes sector, province, and year fixed effects (column (1) Table A3). In a second specification I include region-time fixed effects (column (2) Table A3). Finally, I perform a more demanding model where  $x_{1spt}$ ,  $x_{2spt}$ , and  $x_{3spt}$  and the fixed effects are replaced by sector-province, province-time, and sector-time fixed effects (column (3) Table A3).

Results are reported in Table A3. The three specifications do not show any significant correlation between mafia presence and firm entry. In particular, the number of firms does not increase in mafia infiltrated compared to non-mafia sectors in provinces that received funding for infrastructures. Moreover, the change in number of firms in provinces that received funding is not stronger than that characterizing the non-mafia provinces.

Table A3: Public funds and firm entry

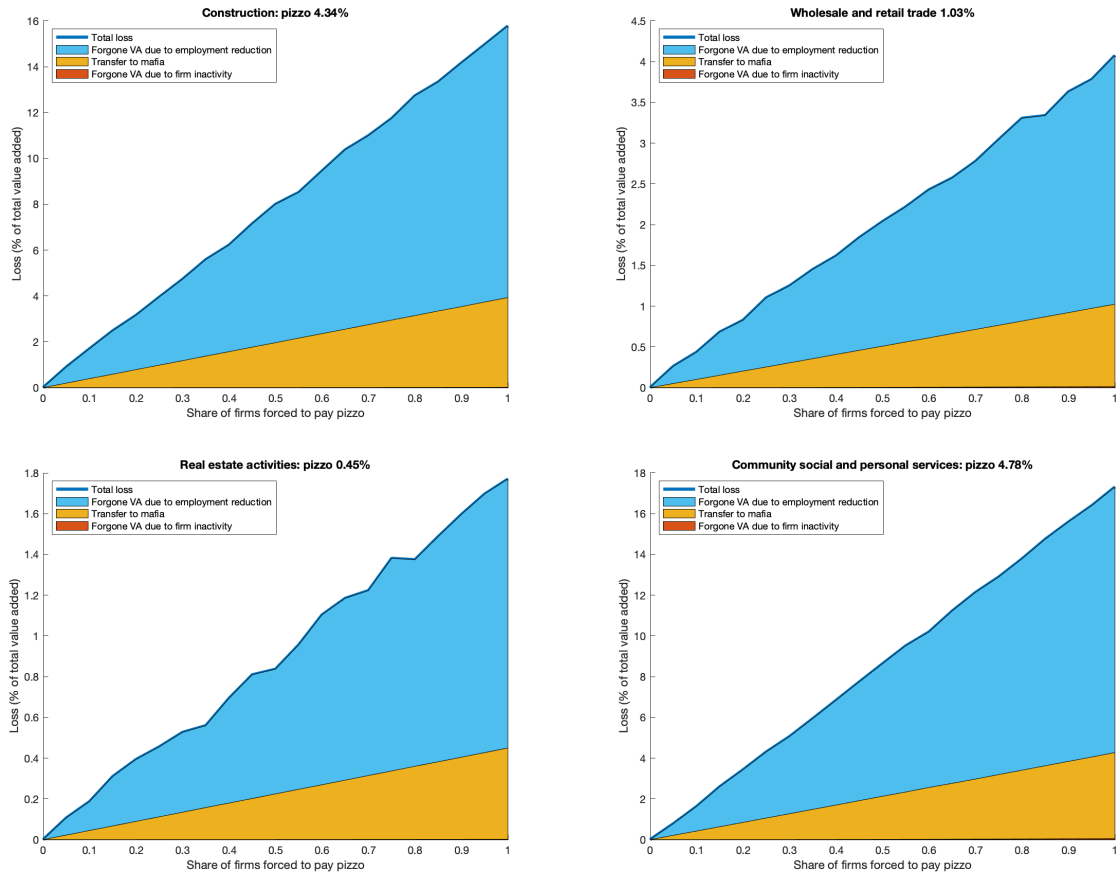
	(1)	(2)	(3)
	Number of firms	Number of firms	Number of firms
Mafia infiltrated market	1.918 (6.386)	1.639 (6.466)	-9.576 (7.624)
Mafia infiltrated sector-year	6.436 (3.935)	6.696 (4.022)	
Mafia infiltrated province-year	-3.992** (1.839)	2.179 (1.937)	
Mafia infiltrated sector-province	16.009 (19.046)	16.262 (19.183)	
Observations	9,081	9,081	9,081
R-squared	0.485	0.498	0.839
Province FE	YES	YES	NO
Year FE	YES	NO	NO
Sector FE	YES	YES	NO
Region-Year FE	NO	YES	NO
Province-Sector FE	NO	NO	YES
Province-Time FE	NO	NO	YES
Sector-Time FE	NO	NO	YES

Source: Computations based on SME Survey. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . The dependent variable in columns (1)-(3) is number of firms observed in sector  $s$ , province  $p$ , at time  $t$ . Mafia-infiltrated market is a dummy that defines a mafia-infiltrated sector, in a mafia province, after mafia arrival. Mafia sector-year is a dummy that equals one if sector  $s$  and year  $t$  are both mafia infiltrated. Mafia province-year is a dummy that equals one if province  $p$  and year  $t$  are both mafia infiltrated. Mafia sector-province is a dummy that equals one if sector  $s$  and province  $p$  are both mafia infiltrated.

## A.6

In this Appendix, I report the results of the simulation exercise presented in Section 6.2 performed on the remaining mafia-infiltrated sectors, i.e., construction (top-left panel), wholesale and retail trade (top-right panel), real estate activities (bottom-left panel), community, social, and personal services (bottom-right panel).

Figure A6: The economic loss due to mafia



This figure depicts results from the simulation of mafia-infiltrated sectors. I set the value of *pizzo*, i.e.,  $\delta$ , to the estimate reported in Figure 5 and I let the share of impacted firms, i.e.,  $\lambda$ , vary between zero and one. The yellow area shows how the loss implied by the transfer of *pizzo* changes as  $\lambda$  increases. I add to this component the loss implied by forgone production due to firm exit, i.e., the red area, and forgone production due to output reduction implied by the fact that impacted firms hire less workers, i.e., the blue area. These three components are expressed as the percentage of total value added without mafia infiltration. The total loss computed for each value of  $\lambda$  is given by the thick blue line.

## A.7

This appendix shows how the construction of a positive relationship between mafia targeting and firm-level TFP. Recall that mafia impact results from the interaction of: “mafia exposure” component and “mafia intensity” component. The former parameter,  $\zeta_i$  follows a Bernoulli distribution, where the probability that  $\zeta_i$  equals one increases with firm-level TFP,  $A_i$ , i.e.  $\frac{\partial P(\zeta_i=1)}{\partial A_i} > 0$ .

Figure A7 plots the relationship between  $P(\zeta_i = 1)$  and  $A_i$ .<sup>42</sup> This relationship can be described by a parabola whose vertex  $V$  has coordinates  $(x_V = \bar{A}, y_V = 1)$ , which cross the x-axis in point  $P$  with coordinates  $(x_P = \underline{A}, y_P = 0)$ , where  $\bar{A}$  and  $\underline{A}$  are the maximum and the minimum value of  $A_i$  respectively. This means that the most productive firm in terms of TFP is subject to mafia extortion with probability one, and the least productive firm is not exposed with probability zero. In every mafia-infiltrated market, each firm draws its level of TFP and its probability of being impacted by the mafia as follows:

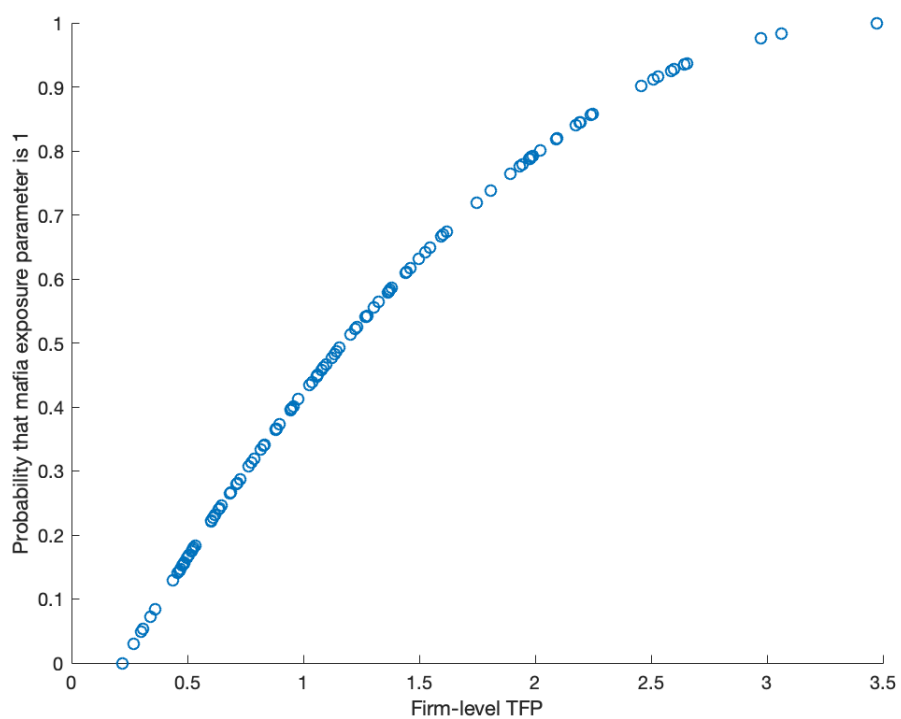
$$P(\zeta_i = 1) = -\frac{1}{(\bar{A} - \underline{A})^2} A_i^2 + \frac{2\bar{A}}{(\bar{A} - \underline{A})^2} A_i + 1 - \frac{\bar{A}^2}{(\bar{A} - \underline{A})^2} \quad (7)$$

Then, according to its own realization of  $\zeta_i$ , firm  $i$  is impacted by the mafia or not. If the share of firms with  $\zeta_i = 1$  exceeds the observed share of firms extorted by mafia,  $\lambda$ , a subsample of firms is randomly drawn from those firms with  $\zeta_i = 1$ , such that the share of impacted firms is exactly  $\lambda$ .

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<sup>42</sup>I plot, as example, results obtained from one specific mafia-infiltrated market.

Figure A7: Mafia targeting positively correlated with firm-level TFP



This figure plots the non-linear relationship between firm-level TFP and the probability of being impacted by the mafia. This relationship can be described by a parabola with the following equation:  $P(\zeta_i = 1) = -\frac{1}{(\bar{A}-\underline{A})^2}A_i^2 + \frac{2\bar{A}}{(\bar{A}-\underline{A})^2}A_i + 1 - \frac{\bar{A}^2}{(\bar{A}-\underline{A})^2}$ . Its vertex  $V$  has coordinates  $(x_V = \bar{A}, y_V = 1)$ . The parabola crosses the x-axis in point  $P$  with coordinates  $(x_P = \underline{A}, y_P = 0)$ .  $\bar{A}$  and  $\underline{A}$  are the maximum and the minimum value of  $A_i$  respectively.