Origins of the Sicilian Mafia: The Market for Lemons

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Abstract

Since its first appearance in the late 1800s, the origins of the Sicilian mafia have remained a largely unresolved mystery. Both institutional and historical explanations have been proposed in the literature through the years. In this paper, we develop an argument for a *market structure*-hypothesis, contending that mafia arose in towns where firms made unusually high profits due to imperfect competition. We identify the market for citrus fruits as a sector with very high international demand as well as substantial fixed costs that acted as a barrier to entry in many places and secured high profits in others. Using the original data from a parliamentary inquiry in 1881-86 on all towns in Sicily, we show that mafia presence is strongly related to the production of orange and lemon. This result contrasts recent work that emphasizes the importance of land reforms and a broadening of property rights as the main reason for the emergence of mafia protection.

Keywords: mafia, Sicily, protection
JEL Codes:

1 Introduction

The Sicilian mafia is arguably the most famous and one of the most successful criminal organizations in the world. After its birth in Sicily, it soon infiltrated the economic and political spheres of Italy and the United States and has at times been considered a serious threat to the rule of law in both countries. Although outcomes of the mafia's actions such as murder, bombings, and embezzlement of public money have been readily observed since its initial appearance around 150 years ago, its origins have largely remained a mystery.

In this paper, we provide a study of the origins of the Sicilian mafia using data from the later part of the nineteenth century. The main hypothesis that we explore is that the origins of the mafia is associated with unusually high profits in certain sectors characterized by imperfect competition. We argue that the source of this market imperfection, mainly in the case of the market for citrus fruits such as orange and lemon, was to be found in high and geographically varying fixed costs of production. These high barriers to entry implied that only certain areas could cultivate the most profitable crops and that producers in these areas earned substantial profits.[1] The combination of high profits, a weak rule of law, a low level of interpersonal trust, and a large number of poor men, implied that lemon producers were natural objects of predation by thieves. Given the impotence

*Notes

[1] We argue that citrus production was associated with unusually high barriers to entry due to the high fixed cost of planting trees and waiting several years for them to grow, the need to build protective walls to keep thieves out, etc. Due to a large regional variation in soil suitablility for growing lemon, the fixed costs for starting up a cultivation was very different across towns.

of the government in protecting private property rights, lemon producers tended to hire the mafia for private protection.

Using historical statistics and a formal model featuring households, producers, and a mafia, we develop the argument that the market for citrus faced an exceptionally high demand during the late 1800s and that the high and regionally varying fixed costs of production implied an imperfect market structure. In the empirical section, we then present data from Sicilian towns that we have gathered from a parliamentary inquiry from 1881-86 (Damiani, 1881-86). Our results indicate that mafia presence is strongly associated with the prevalence of citrus cultivation, controlling for a number of other potential covariates. No other crop or industry has a robust impact on mafia presence. We interpret these findings as being consistent with a *market structure*-explanation to the origins of the mafia, in contrast to other *institutional* or *historical* theories proposed in the literature.

Our paper is most closely related to Bandiera (2003). Bandiera's main hypothesis is that it was the increase in land fragmention as a result of the Bourbon-era land reforms (1816-1860) that provided the breeding ground for mafia protection. The increase in the number of land owners increased the need for private protection. In Bandiera's model, a key feature is that the protection of one producer has a negative externality on other producers since it makes them more likely objects of predation. The main explanation for mafia origins, according to this view, is thus institutional reform. In an empirical section where she also uses information from Damiani (1881-86), Bandiera (2003) finds that a variable capturing land fragmentation is a significant determinant of mafia presence.

Whilst our analysis also identifies landowners' demand for private protection as the main process through which the mafia was mobilized, our analysis explicitly focuses on market structure rather than on land fragmentation as the key explanation. Whereas Bandiera only includes 70 towns from the western parts of Sicily in her empirical investigation, we use information on all available Sicilian towns (127 in total) from Damiani (1881-86). Using this more complete sample, we find that the land fragmentation variables indeed explain some of the variation in mafia presence but we also find some support for that mafia is associated with the prevalence of large scale plantations. The latter finding confounds the interpretation that mafia appeared as a result of land reform. Our main result is that the most robust determinant of mafia activity is production of citrus fruits.

Our analysis is related to a long tradition of works in anthropology, sociology and history on the Sicilian mafia. The classical contributions include early investigations such as Villari (1875), Sonnini and Franchetti (1877) and Colajanni (1885, 1895). A more recent authoritative scholarly work is for instance the political economy treatment in Gambetta (1996), who like us considers the roots of the mafia to be found in the protection business. Dickie (2004) provides a historical treatment of the mafia in Sicily and the United States and emphasizes the crucial role of lemon plantations in the Conca d'Oro area as the birth place of the mafia.[2]

In summary, we believe the paper makes the following contributions to the existing literature: Firstly, it provides a formal model of how market structure and the prevalence of a cross-sectional variation in fixed costs affect the demand for mafia protection. Secondly, we offer the most comprehensive empirical analysis to date on the origins of the mafia in the 1880s and identify a novel explanation for the emergence of mafia during the period.

The paper is structured as follows: In section 2, we give a brief background to the Sicilian

[2] See also Lupo (2009) for a general history and Monroe (2009) for a description of the agricultural practices in Sicily at the time.

economy and to the history of the mafia. In section 3, we outline the formal model. Section 4 includes the econometric specification and a discussion of the data, whereas the main empirical results are found in section 5. Section 6 concludes.

2 Background

In this section, we provide a brief background to the Sicilian economy and to what is known regarding the origins of the mafia.

2.1 Sicily

Sicily is the largest island in the Mediterranean and geographically it has always been considered as a strategic location because of its central position within the Mediterranean trade routes. Because of its importance its past is marked by contiuunous foreign dominations. It was first controlled by Romans, followed by Byzantine, Arabs, Normans, Spanish, French, and then Spanish again. This long period of different foreign domination has shaped its long term development. In fact, from the economic and institutional point of view Sicily has always been one of the most lagging regions in Italy.

Before joining the Reign of Italy in 1860 the island was still under Spanish domination and the vast majority of the population was employed in agriculture. The production system in agriculutre was still based on a typical feudal system with lords who owned the largest share of the land and peasants who worked either under a sharecropping, a fixed rent contract, or on a daily basis. The French who reigned over the island from 1805 to 1815 tried to modernize this archaic system introducing a new constitution in 1812 which abolished the feudal privileges and the primogeniture. However, after Ferdinand I of the Two Sicilies took back power over the island in 1815 this constitution was abolished (in 1816) and most of the feudal privileges (including the primogeniture) were re-established. In 1840 there were still 127 princes, 78 dukes, 130 marquises and an unknown number of earls and barons who had a complete control over the largest share of the land (Travelyan, 2001).

The situation did not change much after Sicily joined the Reign of Italy. In 1887 the number of landowners was still the lowest in Italy with an average number smaller than 2.05 owners per hundred citizens compared to 15 owners per hundred in Piedmont (Colajanni, 1885). In addition almost 56 percent of the population employed in agriculture owned less than one hectare of land and most of these laborers used to work on daily basis for a landowner who paid an average wage of less than one Lira per day.

Despite its underdeveloped economy, Sicily was a leading producer of wheat, olive oil, wine, and citrus. In particular, the island had a dominant position in the production of citrus which according to Pescosolido (2010) represented almost 73 percent of the total production of citrus in Italy. This dominant position was consolidated throughout the XIX century as a result of a significant expansion of the sector which brought the total surface area devoted to the production of citrus from the 7,695 hectares in 1853 to the 26,840 hectares in 1880 (Pescosolido, 2010). This expansion was the result of the large profits associated with the production of citrus which according to Monroe (1909) yielded the largest returns from the soil. It is estimated that in a good season the average returns from lemons were almost $200 (at current US dollars) per acre providing a net profit of more than $150 per acre (Monroe, 1909). With the production of citrus the export also grew for the entire century. In 1850 the quantity of citrus exported was equal to 250,000 quintals while in the period 1881-85 the quantity exported became almost equal to 949,000 (Pescosolido, 2010). A large share of this production was exported abroad mainly to France, the UK, the USA, Russia and Austria.

Table 1 reports descriptive statistics for the most important goods exported, quantity, and revenues from the Harbor of Messina in 1850. The total export revenues for the year are approximately 21.6 million of Lire (at current price). Revenues from citrus and derived products are almost equal to 9.2 million of Lire, accounting for almost 42.4 percent of the total export revenues. The importance of citrus for the local economy grew over the next few years and according to Battaglia (2003) in 1873 citruses accounted for more than 50 percent of the total export.

Table 1

The USA were one of the most important importer of Sicilian citrus. Table 2 reports the export of oranges and lemons in the USA throughout the 19th. The total number of boxes of oranges and lemons exported in 1892 to the USA is 1,061,624 and 2,595,702 respectively. Given that the total production of oranges and lemons in 1892 was almost 933,306,525 oranges and 1,362,975,888 lemons (Di San Giuliano, 1894) and considering that each box of oranges contained almost 240 fruits and each box of lemons contained almost 360 lemons we can estimate that the total boxes of oranges and lemons in 1892 were equal to 3,888,777 and 3,787,044 respectively. Therefore almost 28 percent of the production of oranges and 68 percent of the production of citruses was exported to the USA. It is not surprising therefore that the contraction of the US demand for oranges at the end of the 19th century due to the expansion of the production in Florida had a negative shock for the local economy. The negative shock became more severe at the end of the 19th century when a worldwide contraction of the demand determined a deterioration of the terms of trade and a reduction of the production price. This fall in the production price led to a drop in the export revenues and to a massive emigration.

Table 2

The large export revenues from citrus associated with its dominant position in the international market together with the cost opportunity related to the huge investment made for the development of the citrus-sector determined a sort of vulnerability of producers to potential losses. Because of the absence of state-protection, mafia exploited this systemic vulnerability in order to extort part of the profit made in the industry. As a consequence we consider profit coming from imperfect market structures as a natural condition for the development of mafia.

2.2 Historical origins of the mafia

According to Gambetta (1996) we can define mafia as a sort of secret organization which provides private protection. Its origin is almost impossible to track given the secrecy feature of this organization. The first evidence we have about the presence and way of operating of this secret sect (cosca) is an account by Dr Galati in 1872 who denounced the presence of some "man of honour" who made an increasing use of violence and extortion in order to force him to sell its lemon grove located just outside Palermo (Dickie, 2004). His notes were the first document which brought to light a business which at the time was only known in Sicily. When the Minister of Home Affairs came to know about Galati's notes he soon asked for a written report from the chief of police in

Palermo and then he ordered parliamentary enquiries (the Bonfadini enquiry in 1876 and later the Damiani enquiry in 1881-86) about the economic conditions and crime in Sicily.[3]

The reasons why mafia developed in Sicily are still debated. The heritage of the Spanish domination, the feudalism, the development of a "greedy" middle class ("gabellotti"), the fractionalization of land are all possible sources which have been discussed in the literature. Above all there is an institutional absence which allowed a private organization to provide a typical public good.

Pasquale Villari (1875) is one of the first Italian politician/economist who tried to analyse the origin of the mafia in Sicily. According to Villari the development of mafia is mainly explained by class divisions in Sicily during the 19th century. Villari reckons that in Sicily there are three classes: 1) Landlords, 2) a middle class ("gabellotti")[4], and 3) peasants which are normally exploited by the "gabellotti". The "gabellotti" lease the land from landlords and then they rent small pieces of this land to peasants. Peasants work the land and then they give back to the "gabellotti" a share of the harvest depending on the kind of contract stipulated.[5] These contracts were relatively short and the "gabellotti" literally exploited peasants in order to get the maximum out of it. Most of the times, when the yield was not enough, peasants had to borrow from the "gabellotti" at interest rates which made it impossible to pay back the debt.[6] Through the use of "usury" and the exploitation of peasants they increased their power and became a private provider of protection and justice.

One year later, in 1876, Sonnino and Franchetti initiated a private enquiry on the economic status of Sicily which was then published in 1877. Apart from the institutional deficiency and the poor economic conditions of peasants they consider the latifund as one of the main factor of the development of mafia. According to Sonnino and Franchetti (1877), the patronage and individualistic behaviour, that developed in Sicily were the result of the feudal heritage and of the typical social relationships developed in *latifund*. Because of the lack of "social capital" individuals preferred to refer to a private form of protection and justice rather than a public one. Similar arguments were developed by Doria (1710) when he considers the Bourbon domination as deleterious for the "fede pubblica" (public trust). As a result the "fede privata" (private trust) was the only one on which individuals could rely on.

Colajanni (1885) also considers the *latifund* and the related economic under-development as the main factor for the development of mafia. From the economic and social point of view Colajanni (same as Damiani, 1881-86) divides the island in three different regions: 1) Catania and Messina where the economic conditions of peasants are good; 2) Siracusa, Trapani, Caltanissetta, and Palermo where the economic conditions are mediocre; 3) Girgenti where peasants are very poor. The first group of towns is characterized by: i) a higher fractionalization of the land (maximal in Messina) with peasants owning from 4 to 8 hectares of land; ii) the largest concentration of lemon gardens, vineyards, and olive groves; iii) the highest level of literacy. On the other hand, the province of Girgenti is characterized by the highest concentration of land, non-intensive farming, the lowest level of literacy, and a large number of sulfur mines. Given that the province of Girgenti

[3] Iin its relation to the Parliament Bonfadini (1876) argued that mafia cannot be considered as an organization with a proper statute and "bosses". He considered the mafia as nothing else that the development of arrogance and private violence meant to achieve a private profit using illegal means.

[4] The name "gabellotti" comes from "gabella" which in Sicily was the way to denote the lease of land.

[5] The "maggese", "il terraggio", and "mezzadria" (sharecropping) were the most common forms of tenancy contract.

[6] According to Villari, at that time in Palermo there were 4 landlords and 6 middle class families who used to make profits from the negotiation of wheat and from the oppression of peasants.

ranked the highest in terms of number of murders, criminal convictions, and share of peasants convicted for robbery, Colajanni (1885) considers the latifund and the presence of sulfur mines as a condition for the development of mafia.

Coming to recent years the origin of mafia has also been discussed in Gambetta (1996), Dickie (2007), and Lupo (2009). While Lupo and Dickie consider profits related to the industry of lemons in the West part of the island as a pre-condition for the development of the mafia, Gambetta focuses on the division of land resulting from the abolition of feudalism and other policies introduced by the Italian government after 1860 (i.e. sale of land owned by the church and the crown before the unification). These policies opened a market for private protection in which mafia acted as an incumbent. The effect of the fractionalization of the land is also analysed further by Bandiera (2003).

3 The model

The model considers three active agents - households, lemon producers, and the mafia - as well as a (latent) government that determines the strength of property rights. The aim of the model is to explain how the structure of fixed costs affect the decision whether to produce lemon or not and, if production occurs, under what circumstances that the lemon producers choose to pay the mafia for protection against thieves. The model is meant to describe the situation in the 1880s and is not necessarily relevant for understanding the contemporary nature of mafia operations.

3.1 Consumers

Let us assume that the utility of a representative household is given by

$$U = \alpha \ln C + (1-\alpha) \ln X$$

where U is utility, C is consumption of lemon from Sicily and X is consumption of other goods. The representative household might be thought of as the average Italian household in 1880. The individual's budget constraint is $Y = pC + X$ where Y is average household income at the time and p is the relative price of lemon consumption (price of other goods X is normalized to unity).

From the first-order conditions for profit-maximization, we can obtain the inverse demand function for Sicilian lemon:

$$p(C) = \frac{\alpha Y}{C}$$

As usual, there is a negative association between price and the total level of demand C whereas demand rises with income and with the preference for lemon α.

3.2 Lemon producers

There are in total $I > 0$ towns or municipalities in Sicily and $1 < n \leq I$ towns where lemon is produced. For simplicity, we assume that each town has one (representative) producer. Total supply of Sicilian lemon is $C = \sum_{i=1}^{I} C_i$ where C_i is the local level of production in town i. Total supply always equals total demand.

Profit of the local producer in town i is

$$\pi_i = p(C) \cdot C_i - \gamma(C_i) - F_i = \frac{\alpha Y}{C} \cdot C_i - \psi C_i - F_i$$

where $p(C)$ is the price level (that depends on total demand), $\gamma(C_i)$ is a marginal cost function such that $\gamma'(C_i) = \psi > 0$ and F_i is the local fixed cost of entry into lemon cultivation. F_i depends on local characteristics such as soil quality, water access, altitude, and slope of the land, as well as non-community specific fixed costs such as costs of building protective walls, etc. Typically, it will take several years before planted lemon trees have grown to produce lemons. Once a lemon plantation has been established, the marginal cost ψ is the same across localities.

The first-order condition for profit maximization can be written as

$$p(C)\left(1 + p'(C) \cdot \frac{C_i}{p(C)}\right) = \gamma'(C_i).$$

Since marginal cost ψ and inverse demand $p(C)$ is the same everywhere, C_i must in optimum be identical in every town. Hence, $C = nC_i$. The expression above can therefore be written as

$$\frac{\alpha Y}{nC_i^*}\left(1 - \frac{1}{n}\right) = \psi$$

The fact that the number of towns $n \leq I$ is bounded from above implies that there will be a positive mark-up over marginal cost and that the market is not fully competitive.

Solving for the equilibrium supply of lemon from town i gives us

$$C_i^* = \frac{\alpha Y (n-1)}{n^2 \psi}. \tag{1}$$

Not surprisingly, equilibrium supply will increase with average income Y and decrease with marginal cost ψ. Furthermore, it can be easily shown that C_i^* will decrease with n for all $n > 2$.

Inserting C_i^* back into the profit function, we receive after some algebra the optimal profit level

$$\pi_i^* = \frac{\alpha Y}{nC_i^*} \cdot C_i^* - \psi C_i^* - F_i = \frac{\alpha Y}{n^2} - F_i.$$

In this very simple expression, profits increase with income and decrease with the number of towns producing n. Obviously, lemon will only be produced in community i if $\pi_i^* = \frac{\alpha Y}{n^2} - F_i \geq 0$. Hence, fixed costs and the number of other producers are potential barriers to entry into lemon production.

Let us assume that towns $i \in \{1, 2, 3, , , I\}$ are ordered such that $F_1 < F_2 < F_3 ... < F_I$. Let us further assume that fixed costs are uniformly distributed across towns and are simply given by

$$F_i = a + bi$$

where $a > 0$ is a component common to all towns and where $b > 0$ is a parameter describing the gradient of fixed costs across towns. One might for instance think of a as capturing the cost of building protective walls, which is roughly the same everywhere, whereas b might capture the difference in fixed costs that arises due to differences in soil quality that makes it more costly in terms of time and effort to establish a lemon plantation in some places than in others. Clearly, a b close to zero would imply small differences between towns. The mean fixed cost across towns is

$\bar{F} = a + (I+1)\,b/2$.

With these assumptions, the last producer who will choose to produce lemon ($i = n$) will be the one where[7]

$$\pi_n^* = \frac{\alpha Y}{n^2} - F_n = \frac{\alpha Y}{n^2} - a - bn = 0. \qquad (2)$$

All potential producers $i \in \{1, 2, 3, , , n\}$ will thus produce whereas $i \in \{n+1, ...I\}$ will not. By using the implicit function theorem, we can deduce from the equation above that the equilibrium level of lemon growing towns is a function $n = n\,(a, b)$ such that

$$\frac{\partial n}{\partial a} = n_a = \frac{-1}{\frac{2\alpha Y}{n^3} + b} < 0; \quad \frac{\partial n}{\partial b} = n_b = \frac{-n}{\frac{2\alpha Y}{n^3} + b} < 0.$$

Although the explicit solution to n is mathematically messy, it is easily illustrated in a graph as in figure 1. The figure shows the two components of the profit level, $\alpha Y/i^2$ and $a + bi$, as a function of i when towns are ordered, starting from that with the lowest fixed costs to the left. Equilibrium happens at the point where the two lines cross. At n, profits for the nth firm is zero whereas it is given by the distance between $\alpha Y/n^2$ and $a + b$ for the firm with the lowest fixed costs.[8] The triangle D in the figure shows the total profits made by the lemon producing sector in Sicily.

It is clear from the figure that an increase in a and/or b would shift the F_i-curve to the left and would result in a lower n. Over time, it is likely that such barriers to entry have varied in the lemon trade just as in other sectors. As a thought experiment, one might imagine another agricultural good (perhaps wheat) with the same profit function except that it had lower barriers to entry $a_l < a$ and $b_l < b$ as shown in the bottom of figure 1. Such low levels of fixed costs would imply that all towns ($n = I$) would produce the good and that average profits would be quite small. Total profits in the sector are given by the distance between the fixed cost-curve $F_i = a_l + b_l i$ and the profit level $\alpha Y/I$ (the area E).

Hence, the individual profit for an actual producer is

$$\pi_i^* = \frac{\alpha Y}{n\,(a,b)^2} - a - bi \geq 0 \quad \text{for all } i \leq n.$$

An increase in the fixed cost coefficients a and b thus have two effects on equilibrium profits: On the one hand, they reduce the equilibrium number of lemon producers, which has a positive effect on profits in town i. On the other hand, they also lead to an increase in the fixed costs for all producers, which decreases profits. The sign of the comparative statics will depend crucially on the level of i.[9] In general, for a given n, profits fall with i. Profits always increase with household demand αY. We can therefore express $\pi_i^* = \pi\,(\alpha Y, a, b, i)$.

3.3 Government

As described above, Sicily in the 1880s was characterized by weak property rights institutions and a substantial number of thieves who predated on agricultural production. Let us assume that in

[7] In the expression below, we assume for simplicity that there is always a level of profits where $\pi_n^* = 0$. In reality, the equlibrium number of lemon producing towns n^* would probably rather be defined by $n^* = \arg\min$ $max\left\{\frac{\alpha Y}{n^2} - a - bn, 0\right\}$.

[8] The profit level for the 1st firm is equal to $b\,(n-1) > 0$.

[9] We can for instance see from Figure 1 that a rise in b with a unchanged will increase profits for the town with the lowest fixed costs whereas the previous nth firm will then have negative profits and should cease to produce.

each community, there are $d > 0$ thieves. In the absence of property rights and other forms of protection, thieves would steal the full profit from lemon production and each thief would obtain an amount π_i^*/d. Lemon production would then make zero profits. The government in Rome offers some protection of property rights captured by the term $\theta \in [0,1]$ where $\theta = 1$ implies perfect enforcement of property rights whereas $\theta = 0$ implies total absence of government protection. For Sicily in 1880, θ was presumably closer to 0.

The total proportion of profits saved from thieves by the individual lemon producer is given by the "predation success function"

$$\rho(m_i) = \frac{m_i}{m_i + d(1-\theta)}$$

where m_i is the level of private protection offered in i.

The functional form implies that if $\theta = 1$ there is no need for private protection since $\rho(m_i) = 1$ for any level of m_i. If $\theta > 0$, then $\rho'(m_i) > 0$ and $\rho''(m_i) < 0$, i.e. the proportion of protected profits is a positive, concave function of the level of private protection. Lemon producers then retain $\rho(m_i) \cdot \pi_i^*$ of their profits and lose $(1 - \rho(m_i)) \cdot \pi_i^*$ to the thieves.

Lemon producers cannot provide protection themselves and need to employ people to do this job for them. This is where the mafia comes in.

3.4 Mafia

The local mafia organization in i has no influence over n (no central coordinating mafia authority in the 1880s) and considers the choice between allocating effort to either protecting local producers of lemon or to pursuing normal economic activity.

A representative mafioso's utility function in town i is

$$U_i^M = \omega_i \rho(m_i)\pi_i^* + (1-m_i)A$$

where $m_i \in [0,1]$ is available effort that can be spent on protecting the local lemon producer's profits. The parameter $A > 0$ reflects productivity in normal production (farming, fishing, herding sheep, etc). $\omega_i \in (0,1)$ is the share of total protected profits that the local producers offer to the mafia in return for protection. For now, let us take ω_i as given. Note that ω_i must be somewhere within the interval $(0,1)$ for any interaction to occur between the two.

The mafia maximizes the utility function

$$\max_{m_i} U^M = \frac{\omega_i m_i \pi_i^*}{m_i + d(1-\theta)} + (1-m_i)A.$$

After manipulating the first-order conditions, we can derive the optimal (interior solution) level of mafia activity in town i:

$$m_i^* = \sqrt{\frac{\omega_i d(1-\theta)\pi_i^*}{A}} - d(1-\theta) \tag{3}$$

The expression in (3) implies that we can express the following proposition:

Proposition 1: *The mafia will be active in town i ($m_i^* > 0$) only if $\omega_i \pi_i^* = \omega_i \left(\frac{\alpha Y}{n(a,b)^2} - a - bi \right) > d(1-\theta)A$.*

This proposition offers some of the key insights of the model. If the opportunity costs of being a mafioso A are very large, there will be no mafia. Furthermore, it will obviously be the case that there will be no mafia if property rights are fully enforced, i.e. if $\theta = 1$. It can be shown that m_i^* is a decreasing, convex function of θ so that the mafia shrinks as government-enforced property rights are strengthened. Similarly, there will be no mafia if there are no thieves so that $d = 0$. All these factors are assumed to be identical throughout Sicily but might explain the varying presence of mafia over time.

What distinguishes towns are the offers given to the mafia ω_i and the level of profits in lemon production π_i^*. If the offer from the local producers ω_i is very low, the mafioso will not find protection worthwhile. The central result is of course that the likelihood of mafia presence increases with π_i^*. As discussed above, we argue that one of the key distinguishing features of lemon production at the time was the relatively high demand αY and the high barriers to entry emanating from high and geographically differentiated fixed costs, represented by the parameters a and b. If these are high, then only $n < I$ towns will be able to produce and the average profit among these producers will be relatively high. For other goods, we argue that a and b should be fairly low, implying low profits in general and no large geographical variation in profits. The lower part of figure 1 depicts such a scenario. Profits are then less likely to motivate a mafia to arise from (**??**).

The most likely place for mafia presence would be town $i = 1$ where fixed costs of lemon production are lowest and profits are highest. In our empirical investigation, we do not have data on profits from various types of production. What we do have data on is the presence of sectors in each town. According to our model, the presence of lemon production in some town should be an indicator of profitability and of low fixed costs. Similarly, the presence of other types of production are interpreted as indicating that profits in that sector were also positive. Holding the presence of other types of production constant, we hypothesize that the prevalence of lemon production in a town should thus have a positive association with the probability of mafia activity.

3.5 Endogenous mafia contract

A potential concern in the analysis above is that the offer to the mafia ω_i was assumed to be exogenously given. In this section, we will extend the analysis and endogenize the offer that the local producers make to the mafia. In doing so, we will also reach a more complete characterization of the model and demonstrate that the main qualitative implications remain in place even after this extension.

Firstly, note that the final level of profit that the lemon producer retains after attacks by thieves and mafia "taxation" for protection, is:

$$\tilde{\pi}_i = (1-\omega_i)\,\rho\,(m_i^*)\,\pi_i^* = (1-\omega_i)\,\pi_i^*\rho\,(m_i^*) = (1-\omega_i)\,\pi_i^*\left(1-\sqrt{\frac{d\,(1-\theta)\,A}{\omega_i\pi_i^*}}\right)$$

A proportion $(1-\rho\,(m_i))$ is lost to the thieves and $\omega_i\rho\,(m_i)$ to the mafia, summing up to a total loss of $(1-\rho\,(m_i^*)\,(1+\omega))\,\pi_i^*$ for the lemon producers.

What is the optimal compensation that the producers can offer to the mafia? The expression for the optimal level of mafia effort in (3) shows that mafia protection will increase in a concave manner with ω_i. Retained profits for the lemon producers $\tilde{\pi}_i$ is also a function of ω_i and involves an intuitive tradeoff: On the one hand, a higher ω_i implies that the level of retained profit decreases directly and in a linear fashion. On the other hand, a higher ω_i will induce the mafia to exert more effort which means that a greater proportion $\rho\,(m_i^*)$ will be saved from the thieves. Clearly, there will be some interior equilibrium since the extreme points $\omega_i = 0$ will result in no mafia protection and thieves taking everything, whereas the level $\omega_i = 0$ would imply that the mafia was allowed to take the whole protected profit.

Exactly how the profit was shared in Sicily probably varied across time and from town to town. Let us imagine a Stackelberg type of model where the lemon producers act as leaders and give an offer ω_i to the mafia first, whereupon the mafia reacts by setting their level of m_i according to their best response function given by (3). In the first stage of such a game, the lemon producers would anticipate the mafia's reaction and internalize the known level of m_i^* in their profit maximization problem. The optimal contract would then be implicitly defined by the first-order condition for maximum:

$$\frac{\partial \tilde{\pi}_i}{\partial \omega_i} = \pi_i^* \frac{\partial \rho(m_i^*)}{\partial \omega_i} - \pi_i^* \rho(m_i^*) - \omega_i \pi_i^* \frac{\partial \rho(m_i^*)}{\partial \omega_i} = 0 \tag{4}$$

By using the condition in (4), we can reach the following result:

Proposition 2: If ω_i^* is determined in a two-stage game where lemon producers make an initial offer to the mafia, taking into account the mafia's best response function, the equilibrium mafia contract is $\omega_i^* = \omega(x_i)$ where $x_i = \sqrt{\frac{\pi_i^*}{Ad(1-\theta)}}$ and where $\omega'(x_i) < 0$.

Proof: See appendix.

In other words, if for instance there was an increase in profits π_i^*, the optimal proportion ω_i^* offered to the mafia would decrease. The intuition for this is that π_i^* and ω_i^* are substitutes for the mafia since a lower π_i^* can be compensated by a higher ω_i^*, and vice versa. Furthermore, a strengthening of property rights θ would increase x_i and would also lead to a less generous equilibrium offer to the mafia. The reason is that a stronger rule of law decreases the demand for mafia protection.

The main implications are described in figure 2. In the figure, we have assumed certain parameter values in order to illustrate the mechanics of the model. The initial situation is given by the mafia's best response function m_i^* which, as described above, is a concave function of ω. In the example, the lemon producer optimally offers slightly more than half of the profits saved from thieves to the mafia ($\omega_i^* = 0.526$). The mafia responds in the predicted fashion by exerting a positive but relatively low level of protection to the producers ($m_i^* = 0.09$). For the producers, the net result is that thieves steal nearly 70 percent of total profits ($1 - \rho(m_i^*) = 0.69$) whereas the mafia takes roughly 15 percent, leaving merely about 15 percent (0.147) of total profits π_i^* to the producers.

If we use the same parameter values and assume a substantial increase in profits by 400 percent, then both curves in figure 2 shift to m^{**} and ω^{**}. The new equilibrium offer to the mafia is now roughly 30 percent of protected profits ($\omega_i^{**} = 0.297$) and the level of mafia effort increases by around 0.15 to $m_i^{**} = 0.236$. The share of total profits that the lemon producers now manage to retain is almost 40 percent ($\tilde{\pi}_i / \pi_i^{**} = 0.39$).

The bottom line of these examples is that even when the mafia contract is endogenized in a standard manner, the intensity of mafia presence will increase with lemon profits.[10]

[10] One might of course imagine other mechanisms for determining ω_i. A plausible alternative process might be Nash bargaining.

4 Econometric Specification and Data

4.1 Econometric Specification

From the econometric point of view we can consider equation (3) as the latent equation which will determine the probability of mafia. In this equation the probability of mafia depends on profits, the enforcement of property rights, and the number of thieves. The latter are considered equally distributed across the region even though there may be a variation in the efficiency of the state at town level which can explain the presence of mafia across the region. For this reason the efficiency of the enforcement of property rights will represent part of the control variables.

The model to be esitmated can be written as:

$$M_i^\star = \alpha_i + \beta_1 \Pi_i + \beta_2 X_i + \mu_i \tag{5}$$

where

$Mafia_i = 1$ if $M_i^\star \geq 0$

$Mafia_i = 0$ if $M_i^\star < 0$

In the latent equation (5) the dependent variable $M_i^\star$ represents the response variable which will drive the probability of mafia. A response variable larger than zero will be associated with towns with a positive level of mafia. On the other hand the probability of mafia will be zero if the response variable ($M_i^\star$) is smaller than zero.

The main independent variable is the profit in the industry which we denote by Π_i. Profits depend on fixed cost which in our model represent a sort of barrier to entry. As a result, the smaller is the number of producers in the industry (n) the larger are the profits made which in turn increase the potential offer to mafia (ω_i) in return for protection. Even though we do not have data on profits we can consider the dominant position in the market of citrus (73% of the total Italian production) as the result of a fixed cost which prevented the entry of new competitors in the market. This dominant position generated large profits for peasants and therefore we expect the probability of mafia to increase with the production of citrus. On the other hand X_i represents a set of possible control variables which also may affect the probability of mafia.This set of variables will include controls for the trust citizens have in the law and for the peripherality of the town. These measures do not perfectly capture the enforcement of property rights by the incumbement state, but they should provide an idea of the efficiency of the state in enforcing property rights. Finally α_i represents provincial fixed effects which may be correlated with the error term.

4.2 Data

Data at town level for the entire island[11] are collected from the Damiani Enquiry 1881-1886. This enquiry is available in its original format from the Archive of State in Rome. The questionnaire provided to prefects is composed by three different sections. The first section deals with the condition of the agriculture. The relations between owners of the land and peasants are considered

[11] Caltanissetta is the only province missing in our sample because files for this province were no longer available

in the second section. Finally the third section regards the moral conditions of peasants. There is also an additional table which provides summary statistics about issues which typically affected the island at the time. One of these issues relate to the the most common form of crime. The question asked in the enquiry is: *"What is the most common form of crime in the town?"* There are a range of possible crimes Prefects considered. Some of these crimes are related to rustling, robbery, murders, and so on. However the one which matters to us is mafia. Because of the structure of the question in the enquiry it is possible that some towns had some mafia activity even though the Prefect does not reckon it as the main source of crime. This problem may slightly affect our results.

Table 3 reports descriptive statistics. The dependent variable, mafia, is a dummy variable for whether the prefect of the town reckons mafia as the most important source of crime in the town. This data is collected from the Damiani's Enquiry (1881-86). 35 percent of all towns were strongly affected by mafia which means that almost 44 out of the 127 towns in our sample are affected by some sort of mafia activity. Girgenti is the province with the highest incidence of mafia with almost 14 out of 17 towns having a strong mafia presence. In Trapani mafia is operative in 6 out of 15 cities. On the other hand almost one third of the cities in the province of Palermo are affected by mafia (mainly those in the Conca d'Oro) which is the same as in Catania. Messina and Siracusa are the provinces with the lowest incidence of mafia. This summary statistics is consistent with the description in Colajanni (1885) when he divides the island in three macro-regions considering Girgenti as the one with the highest rate of murders, convictions, and therefore the one with the highest level of Mafia.

Table 3: Distribution of Mafia Across Provinces in 1881-86

Next we move to the description of some of the most important independent variables. We use three sets of independent variables which should control for some of the most important sources of mafia discussed in the previous section. Colajanni (1885), Dickie (2004), and Lupo (2007) consider the production of citrus and sulfur as important determinants of mafia and because of that the first set of independent variables is related to production. The second set is related to the political status of towns given that feudal cities are likely to experience a larger loss of "social capital" as discussed in Sonnino and Franchetti (1877), and Doria (1710). We also use a control for policies which may have triggered a market for private protection as argued by Gambetta (1996). These policies are related to the end of the feudalism, the auction of crown and church land after the unification of Italy, and other policies aimed at increasing the small scale ownership of land (i.e. "enfiteusi").[12] The third set of variables is related to the distribution of land and to the length of the tenancy contract. Damiani (1881-86) is the source for most of our variables except for a few cases in which we use data from Di Vita (1906). In each case the source will be clearly specified.

Colajanni (1885) argues that the production of sulfur is predominant in the province of Girgenti, while olive and citrus groves are dominant in the province of Messina (the most developed province). In Table 4 we report summary statistics related to production. Wheat, olives, grape, citrus, and sulfur are the commodities we consider. In order to consider dominant crops produced in each town we use dummy variables which are coded one in case the town is a dominant producer of these crops. The relative question in the Damiani Enquiry is: "Which is the dominant crops produced

[12] "Enfiteusi" is a sort of perpetual lease which allows a person to use a good which belongs to somebody else as if it is its own.

in the city?" Prefects normally listed few crops (sometime they also report quantity but just for few cities) and because of that dummies for crops are non-mutually exclusive.

Data on sulfur mines instead are provided by Di Vita (1906). As argued by Colajanni (1885) sulfur mines are almost exclusively concentrated in the province of Girgenti (almost in 12 out the 17 cities). Outside Girgenti there are only 5 mines in the province of Catania, 3 in Palermo, and 1 mine in Messina and Trapani. On the other hand the production of citrus is the highest in the province of Messina and the lowest in the province of Siracusa. Wheat is produced in the entire province of Girgenti and the production is the lowest in the province of Messina. Grapes and olives are almost equally distributed across the island. These summary statistics seem to reproduce quite well the description in Colajanni (1885).

Table 4: Descriptive Statistics for Production in 1881-86

In Table 5 we consider the set of independent variables related to the political status of city-towns before the unification of Italy, and to the effectiveness of policies aimed at increasing private ownership of land.Since XIII century Sicilian towns could have three different sort of political organization. A typical feudal system was the first form of political organization with a small elite minority owning the land and a large peasant population that lived in small villages and who passively accepted its subservient role. The second form of political organization was the "ecclesiale" (church-ruled cities) in which bishops used to act as typical lord. Finally, crown-ruled city towns ("demaniali") were the last form of political organization. "Demaniali" towns were independent of local lords and bishops and had some sort of self-regulation. Using data from Di Vita (1906) we find that feudal cities represent almost 67 percent of our sample which means that almost 79 out of the 127 in our sample had a feudal heritage. Crown-ruled ("demaniali") cities represent almost one fourth of the sample (32 cities). Finally, we have only 10 "ecclesiale" cities (church-ruled).

With the end of the feudalism and the unification of Italy in 1860 the land in crown- and church-ruled cities was sold to citizens. The intent of this policy was to increase the private ownership of land among peasants and according to Gambetta (1996) these policies created a potential market for private protection. However, in the majority of cases the policy had an opposite effect. Rich landowners were the only ones who had enough money to bid in auctions for land and because of that, the policy failed. In order to capture the effectiveness of these policies on the fractionalization of land we use a second dummy which we call "Fractionalization-Policies".[13] The average effectiveness of this policy is 45 percent which means that according to Prefects these policies had some effect on the fractionalization of land in only 54 out of the 119 towns for which we have information. These policies seem to be more effective in cities which had a feudal heritage (in provinces of Girgenti and Siracusa mainly) and less effective in provinces (i.e. Messina) which were ruled either by the crown or the church. This is because land in crown-ruled cities was already quite fractionalized given the absence of lords.

Table 5: Descriptive Statistics for the Political Organization Before the Unification of Italy (1860)

Table 6 provides descriptive statistics for the scale of the plantation and the fractionalization of land. Damiani (1881-86) is the source for these data. The question asked for the scale of

[13] The dummy variable captures any effect of policies and reform following the abolition of the feudal system on the fractionalization of land.

plantation and fractionalization is: "What is the dominant scale of the plantation? And what is the fractionalization of land?". Most of the time Prefects answered that a large, a medium, and a small scale are dominant and for this reason the sum of the three variables is larger than 1. However, the small scale plantation seems to be more frequent while the large scale is the less frequent. Regarding the fractionalization of land, this is highly fractionalized in almost 44 towns, and relatively low fractionalized in almost 29 towns.

Table 6: Descriptive Statistics for Land in 1881-86

In Table 7 we show the distribution per province. The small scale plantation is relatively more frequent in the province of Messina which in average has a medium fractionalization of the land. In the province of Catania the small scale plantation also seems to be prevalent (in almost 16 out of 23 towns) as well as in Trapani and Siracusa. Girgenti is the province with the lowest frequency of small scale plantations and the second largest percentage of large scale plantations. Because of that the fractionalization of land in this province is the lowest.

Table 7: Scale of the Plantation per Province in 1881-86

Finally in Table 8 we show the pairwise correlation among a selected number of variables. Mafia activity seems to be positively correlated with citrus (0.39 correlation), with the large scale plantation (0.25 correlation), and with the effectiveness of the fractionalization-policy (0.26 correlation). The presence of sulfur mines is also positively correlated with mafia activity (0.19 correlation). A feudal origin and the high fractionalization of land which also have been considered important for the diffusion of mafia are weakly correlated with mafia (0.05 and 0.04 correlation respectively). Finally, population density which captures wealth is weakly correlated with mafia. All these variables are weakly cross-correlated preventing problems of multicollinearity.

Table 8: Pairwise Correlation

5 Empirical analysis

Table 9 presents probit estimates. We start with a simple model in which the origin of mafia only depends on variables capturing the economic activity in the town and then we enter additional variables in order to control on observables. In Model 1 the diffusion of the mafia only significantly depends on production of citrus and sulfur. At the mean, the production of citrus increases the probability of mafia by 45 percent, whether the production of sulfur increases the probability of mafia by 24 percent. In Model 2 we control for province-dummies in order to capture regional fixed effects and the citrus dummy is the only variable which keeps significance at a 5 percent significant level at least. The sulfur-mines dummy is now not significant, while the grape dummy becomes marginally significant at a 10 percent level. In Model 3 we enter few additional controls. We use the fractionalization policy dummy and population density in order to control for policies which may have affected the private ownership of land and wealth. Population density is not significant, while the fractionalization policy dummy has a marginal and significant effect on the probability of mafia. In Model 4 we drop variables which are not significant to prevent an excessive reduction of the degrees of freedom. In addition we enter the dummy for the high fractionalization of land in order to check whether the fractionalization policy dummy truly captures the effect of increasing the fractionalization of land (as argued by Bandiera, 2003) or something else.[14] The dummy for whether the land is highly fractionalized in Model 4 is not statistically significant which in some sense is more consistent with our hypothesis. In fact, given the fixed cost which farmer had to afford in order to expand the production of citrus (and other crops which could generate higher profits i.e. grape) we should expect that profits were much higher in towns with a relatively low fractionalization. For this reason in Model 5 we enter a dummy for the prevalence of large scale plantation. The idea is that investments for the expansion of the sector were more likely in towns with a large scale plantation (because of the decreasing cost) making producers more vulnerable to a potential loss due to extortion. The dummy for the scale of the plantation is significant at a 1 percent significance level and it increases the probability of mafia by 39 percent. Model 5 is our preferred specification and in this model mafia is a significantly determined by the production of citrus, by the effect of policies for private ownership , and by the scale of the plantation. The production of grape also marginally explains the diffusion of mafia (significant at a 10 percent).

Table 9: Mafia Probit Model

In Table 10 we add to our preferred specification additional controls which are suggested to have an important effect on mafia. In Model 1 we enter controls for the distance from Palermo and from Mazzara del Vallo. The first variable should capture the distance from the mafia-base center, while the distance from Mazzara del Vallo is used to capture the possible diffusion of citrus given that this plant was introduced by the Arabs in the 10th century who entered in Sicily from Mazzaro del Vallo. Both variables are statistically insignificant. In Model 2 we enter the altitude of the town in order to proxy inland cities given that the control of the harbor may have been an important factor of mafia diffusion. Altitude is also not significant. In Model 3 we control for the level of enforcement of the law. We use the distance from the railway station (collected from Di Vita, 1906) and three dummies for whether citizens trust, mistrust, or do not care about the law (the excluded group is whether they fear the law). These dummies are coded using the information in Damiani (1881-86). Among these proxies, the only one which is significant at a 5 percent level is the dummy for citizens not caring about the law. Towns in which citizens do not care about the law have almost 60 percent higher probability of mafia. Finally in Model 4 we control for the length of the tenancy contract which also has a significant and negative effect on the probability of mafia. The citrus dummy in Table 10 still increases the probability of mafia by a mere 55 percent, the scale of the plantation by an average 40 percent, the private ownership policies increase mafia by an average 38 percent, while the grape dummy is still marginally significant increasing the probability of mafia by almost 25 percent. The average probability of mafia estimated in these model is around 31 percent.

Table 10: Mafia Probit Model: Additional Controls

Finally in Table 11 we control for the robustness of our preferred model to alternative estimators. In Model 1 we use a Linear Probability Modell and all variables in our baseline model are statistically significant at a 5 percent level at least. Also the grape dummy which in the Mafia Probit model was marginally significant is now significant at a 5 percent. Citrus increases the probability of mafia by almost 30 percent, grape by 17 percent, fractionalization policies by almost

[14] The fractionalization policy dummy could also capture an increase in the use of the "gabella" as a result of a larger concentration of the land which is due to the fact that existing landowners bought most of the available land.

23 percent, and large scale plantations by almost 24 percent. In Model 2 we use an OLS-IV estimator. Altitude is the instrument we choose for citrus. This choice is based on Monroe (1909) who argues the fruit industry of the island may be divided into three zones. "The marine, or lemon belt, from sea-level to fifteen hundred feet. The middle, or orange zone, from fifteen hundred to three thousand feet. The forest belt above three thousand feet" (Monroe, 1909, pg 190-91). According to his description of the island, the hillside is less favorable to the citrus industry because of the presence of clay and other minerals which are deleterious to citrus fruit trees. Therefore according to description in Monroe (1909) altitude seems to be a suitable instrument for citrus given that the altitude should only affect the quality of soil and therefore the suitability of land to the production of citrus[15]

Results from the OLS-IV estimator provide a picture which is quite similar to OLS estimates, but the effect of citrus on Mafia activity increases by almost 13 percent (with respect to the OLS estimates). The grape dummy, the scale of the plantation, and the post-unification effect dummy are still significant at a 5 percent level at least. In Model 3 we use an IV-Probit and the only difference with respect to the OLS-IV estimator is that the grape dummy goes back to be significant at a 10 percent level only. Finally in Model 4 we use a Spatial Linear Probability Model to control for spatial autocorrelation in the error term.[16] In this model the citrus dummy significantly increases the probability of mafia by 32 percent, the scale of the plantation by 21 percent, and the fractionalization policies dummy by 24 percent. The grape dummy is still marginally significant at a 10 percent level only and it increases the probability of mafia by 14.5 percent.

Table 11: Robustness Check – Alternative Estimators

6 Conclusions

In this paper, we have developed a market structure-hypothesis for the origins of the Sicilian mafia. Unlike existing works that emphasize institutional and historical factors, our analysis studies the importance of the presence of fixed costs as a source of market imperfections and very high profits in certain towns. We argue that the production of orange and lemon is associated with a strong international demand as well as substantial fixed costs.

In the empirical analysis, using data from a parliamentary inquiry from the 1880s, we show that the presence of mafia is strongly related to the production of citrus fruits. The effect remains when we include several control variables and use alternative estimators.

7 Appendix

7.1 Proof of Proposition 2

As explained in the text, we assume a two-stage game where lemon producers move first by making an offer to the mafia, whereupon the mafia reacts by setting their optimal level of m_i. Using standard backward induction, we start in the second stage by deriving the mafia's best

[15] It can be argued that the enforcement of law is less efficient in towns on the hillside because it is more difficult to reach them. In this case the IV estimates would be biased. However, we should expect to under-estimate the effect of citrus on the probability of mafia. If we define the asymptotic bias in the IV as: $ABias(\hat{\beta}_{IV}) = \frac{\rho_{Z\mu}}{\rho_{ZX}\rho_{X\mu}} ABias(\hat{\beta}_{OLS})$ then the OLS bias should be positive while the first term should be negative providing a downward bias.

[16] The idea is that mafia is spatially distributed given that neighbouring towns are more likely to be affected.

response function m_i^* given by (3).In the first stage, the lemon producers internalize this response and determine the level of ω_i^* that maximizes $\tilde{\pi}_i$.

In order to reach the result in Proposition 2, please first note that

$$\rho(m_i^*) = \frac{m_i^*}{m_i^* + d(1-\theta)} = \frac{\sqrt{\frac{\omega_i d(1-\theta)\pi_i^*}{A}} - d(1-\theta)}{\sqrt{\frac{\omega_i d(1-\theta)\pi_i^*}{A}}} = 1 - \sqrt{\frac{d(1-\theta)A}{\omega_i \pi_i^*}}.$$

The key derivatives of this function are

$$\frac{\partial \rho(m_i^*)}{\partial \omega_i} = \frac{1}{2\omega}\sqrt{\frac{d(1-\theta)A}{\omega_i \pi_i^*}} > 0; \quad \frac{\partial^2 \rho(m_i^*)}{\partial \omega_i^2} < 0.$$

The optimal level of ω_i is implicitly given by the level where

$$\begin{aligned} \frac{\partial \tilde{\pi}_i}{\partial \omega_i} &= \pi_i^* \frac{\partial \rho(m_i^*)}{\partial \omega_i} - \pi_i^* \rho(m_i^*) - \omega_i \pi_i^* \frac{\partial \rho(m_i^*)}{\partial \omega_i} = \\ &= \pi_i^* \frac{\partial \rho(m_i^*)}{\partial \omega}\left(1 - \frac{\rho(m_i^*)}{\frac{\partial \rho(m_i^*)}{\partial \omega}} - \omega\right) = 0 \end{aligned} \tag{(A1)}$$

The second-order condition shows that

$$\frac{\partial^2 \tilde{\pi}_i}{\partial \omega_i^2} = \pi_i^*(1-\omega_i)\frac{\partial^2 \rho}{\partial \omega^2} - 2\pi_i^* \frac{\partial \rho}{\partial \omega} < 0$$

which ensures a maximum. Since we have established that $\frac{\partial \rho(m_i^*)}{\partial \omega} > 0$, the key condition for satisfying the first-order condition is the expression inside the parenthesis in the lower row of (A1). After having inserted $\rho(m_i^*)$ and $\frac{\partial \rho(m_i^*)}{\partial \omega}$ into $1 - \rho(m_i^*) / \frac{\partial \rho(m_i^*)}{\partial \omega} - \omega$, we can express a function

$$\begin{aligned} \frac{1}{\omega_i^*} - \sqrt{\frac{4\omega_i^* \pi_i^*}{d(1-\theta)A}} + 1 &= \frac{1}{\omega_i^*} - 2\sqrt{\omega_i^*} \cdot x_i + 1 = 0 = G \\ \text{where } x &= \sqrt{\frac{\pi_i^*}{d(1-\theta)A}}. \end{aligned}$$

Since an explicit solution for ω_i is very complicated to obtain, we use the implicit function theorem on the basis of G to calculate comparative statics:

$$\frac{\partial \omega_i^*}{\partial x_i} = -\frac{\frac{\partial G}{\partial x}}{\frac{\partial G}{\partial \omega^*}} = \frac{2\omega^{1/2}}{-\frac{1}{\omega^2} - \omega^{-1/2}x} < 0$$

Hence, we have demonstrated the main finding in Proposition 2 that we can write $\omega_i^* = \omega(x_i)$ where $\omega'(x_i) < 0$.

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Table 1: Export from the Harbor of Messina in 1850

Product	Quantity	Units	Lire	Description
Silk	1,100	Balle	4,469,850	Oz 645 x Balla
Olive Oil	320,000	Cafissi	2,419,200	Approx 3 Litres x Cafisso
Oranges	500,000	Casse	2,726,325	Approx 240 oranges x cassa.
Lemons	600,000	Casse	3,779,622	Approx 360 lemons x cassa
Lemon Juices	1,000	Barili	503,986	Oz 40 per barile
Salted Lemons	200	Barili	151,200	Oz 6 per barile
Citrus Parfumes	400,000	Libre	2,014,740	
Sulfur	90,000	Quintali	302,211	
Wheat	50,000	Salme	2,477,790	
Flax	20,000	Salme	1,007,937	4 salma = 2 hl
Wine	2,000	Salme	37,800	1/2 salma= 801 hl
Nuts	4,000	Salme	655,169	4 salma = 3 hl
Almond	20,000	Cantaia	1,763,370	Oz 7 x cantaio
Pistacchio	200	Cantaia	30,240	Oz 12 x Cantaio
Walnuts	2,000	Salme	50,387	4 salma = 3 hl
Liquorice	16,000	Cantaia	680,400	Oz 9 per cantaio
Sardines	4,000	Barili	151,162	Oz 2 per Barile
Carob	4,000	Sacchi	90,720	24 sacchi = 90Kg
Wool	2,000	Cantaia	453,600	6 cantaio = 80Kg
Linen	7,000	Quintali	264,600	Oz 3 x quintali
Cotton	4,000	Quintali	30,240	

Source: Battaglia (2003)

Table 2: Exports to the USA

Year	Boxes of Oranges	Boxes of Lemons
1873	737,551	454,035
1883	1,448,057	1,544,220
1892	545,292	2,268,702
1893	1,061,624	2,595,901

Source: Di San Giuliano (1894)

Table 3: Distribution of Mafia Across Provinces in 1881-86

Province	Mean	Std. Dev.	Freq.
Catania	0.318	0.476	22
Girgenti	0.823	0.392	17
Messina	0.24	0.435	25
Palermo	0.296	0.465	27
Siracusa	0.142	0.358	21
Trapani	0.4	0.507	15
Total	0.346	0.477	127

Numbers in the Table represent percentages of towns in which mafia is operative.

Table 4: Descriptive Statistics for Production in 1881-86

province	**Freq.**	**Grape**	**Olives**	**Wheat**	**Citrus**	**Sulfur**
Catania	22	0.826	0.347	0.782	0.478	0.227
Girgenti	17	0.611	0.388	1	0.5	0.705
Messina	25	0.739	0.521	0.478	0.608	.04
Palermo	27	0.777	0.444	0.740	0.370	0.111
Siracusa	21	0.85	0.35	0.75	0.35	0
Trapani	15	0.8	0.6	0.8	0.4	0.066
Total	127	0.769	0.436	0.746	0.452	0.14

Numbers in the Table represent the percentage of towns with a dominant production of each commodity.

Table 5: Descriptive Statistics for the Political Organization Before the Unification of Italy (1860)

province	**Freq.**	**Feudal**	**Crown-Ruled**	**Church-Ruled**	**Frac. Policies**
Catania	22	0.5	0.409	0	0.631
Girgenti	17	0.764	0.176	0	0.714
Messina	25	0.4	0.28	0.24	0.285
Palermo	27	0.629	0.185	0.148	0.346
Siracusa	21	0.857	0.142	0	0.5
Trapani	15	0.666	0.333	0	0.285
Total	127	0.622	0.251	0.078	0.447

Numbers in the Table represent the percentage of towns which fall in each of the above categories.

Table 6: Descriptive Statistics for Land in 1881-86

Variable	Obs	Mean	Std. Dev.	Min	Max
Plantation Scale - Large	117	0.350	0.479	0	1
Plantation Scale - Medium	112	0.482	0.501	0	1
Plantation Scaale - Small	117	0.666	0.473	0	1
High Land Fractionalization	110	0.4	0.492	0	1
Medium Land Fractionalization	110	0.336	0.474	0	1
Low Land Fractionalization	110	0.263	0.442	0	1

Numbers in the Table represent the percentage of towns which fall in each of the above categories.

Table 7: Scale of the Plantation per Province in 1881-86

Province	Freq	High Frac	Low Frac	Scale Large	Scale Small
Catania	23	0.409	0.363	0.260	0.695
Girgenti	14	0.461	0.076	0.357	0.461
Messina	20	0.277	0.277	0.35	0.789
Palermo	26	0.52	0.32	0.461	0.576
Siracusa	20	0.35	0.15	0.35	0.666
Trapani	14	0.333	0.333	0.285	0.923
Total	117	0.4	0.263	0.350	0.678

Numbers in the Table represent the percentage of towns which fall in each of the above categories.

Table 8: Pairwise Correlations

	Mafia	Citrus	Wheat	Olive	Grape	Sulfur	Feudal	Frac. Policy	Density	High Frac	Large Scale
Mafia	1.0000										
Citrus Dummy	0.3863	1.0000									
Wheat Dummy	0.0946	-0.2390	1.0000								
Olive Dummy	0.0014	0.2289	-0.1850	1.0000							
Grape Dummy	0.0680	0.0424	-0.0158	0.1391	1.0000						
Sulfur Mines Dummy	0.1914	-0.0124	0.2903	-0.0366	-0.0589	1.0000					
Feudal Syst. Dummy	0.0556	-0.1212	0.0598	-0.0119	-0.1321	0.0519	1.0000				
Fractionaliz. Policy	0.2637	0.0713	0.2214	-0.0567	0.0552	0.1771	0.0531	1.0000			
Pop. Density	-0.050	0.1145	-0.3410	-0.0395	0.0492	-0.1821	-0.2375	-0.0575	1.0000		
High Land Fract.	0.0413	0.0491	-0.1047	0.0946	-0.0657	-0.0481	-0.0386	0.0730	0.1596	1.0000	
Large Scale Plant.	0.2465	0.1623	0.1054	-0.0201	0.1406	0.0299	0.0642	-0.1500	-0.2317	-0.1886	1.0000

Table 9: Mafia Probit Model

	Dependent Variable: Mafia Activity				
Estimation Method: Probit	Model 1	Model 2	Model 3	Model 4	Model 5
Production of Citrus	1.277***	1.491***	1.504***	1.556***	1.388**
	(0.28)	(0.30)	(0.37)	(0.33)	(0.68)
Production of Grapes	0.295	0.612*	1.125**	1.041**	0.953*
	(0.28)	(0.34)	(0.48)	(0.47)	(0.50)
Production of Olives	-0.192	-0.324	-0.377		
	(0.27)	(0.29)	(0.34)		
Production of Wheat	0.534	0.337	0.176		
	(0.33)	(0.36)	(0.38)		
Sulfur Mines	0.620**	-0.329	-0.152		
	(0.30)	(0.36)	(0.38)		
Population Density			-0.0389		
			(0.06)		
Fractionalization Policies			0.583*	0.828**	0.975***
			(0.32)	(0.33)	(0.23)
High Land Fractionalization				-0.319	
				(0.34)	
Large Scale Plantation					1.089***
					(0.13)
Constant	-1.655***	-1.468**	-1.757***	-2.001***	-2.148***
	(0.39)	(0.63)	(0.68)	(0.64)	(0.30)
Predicted Probability	33.33	30.04	30.42	33.10	31.30
Area under ROC curve	0.768	0.851	0.890	0.877	0.904
Province Dummies	No	Yes	Yes	Yes	Yes
Observations	123	123	112	103	109
Robust z statistics in parentheses	.	.	.	.	.
*** p<0.01, ** p<0.05, * p<0.1					

Table 10: Mafia Probit Model: Additional Controls

	Dependent Variable: Mafia Activity			
Estimation Method: Probit	Model 1	Model 2	Model 3	Model 4
Production of Citrus	1.382***	1.301***	1.795***	1.469***
	(0.34)	(0.36)	(0.44)	(0.37)
Production of Grapes	0.930*	0.919*	1.086*	0.862
	(0.55)	(0.55)	(0.61)	(0.53)
Fractionalization Policies	0.855**	1.012***	1.238***	1.017**
	(0.37)	(0.36)	(0.43)	(0.41)
Large Scale Plantation	1.127***	1.155***	1.192***	0.659*
	(0.37)	(0.35)	(0.39)	(0.38)
Distance from Palermo (in log)	-0.319			
	(0.27)			
Distance from Mazzara del Vallo (in log)	-0.286			
	(0.32)			
Altitude (in log)		-0.0797		
		(0.12)		
Trust in Law Dummy			0.759	
			(0.55)	
Mistrust in Law Dummy			0.695	
			(0.62)	
Not Care of Law Dummy			2.047**	
			(0.90)	
Distance from Railway St. (in Log)			-0.222	
			(0.15)	
Length of Contract (in Log)				-0.774**
				(0.33)
Constant	0.148	-1.743*	-3.564***	-0.620
	(1.43)	(0.96)	(0.93)	(0.91)
Predicted Probability	0.307	0.318	0.275	0.342
Area under ROC curve	0.9085	0.904	0.917	0.8596
Province Dummies	Yes	Yes	Yes	Yes
Observations	109	108	96	90
Robust z statistics in parentheses	.	.	.	.

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

Table 11: Robustness Check – Alternative Estimators

	Dependent Variable: Mafia Activity			
	Model 1	Model 2	Model 3	Model 4
Estimation Method	LPM	IV	IVPROBIT	SPATIAL LPM
Production of Citrus	0.305***	0.430**	1.764***	0.320***
	(0.08)	(0.21)	(0.62)	(0.08)
Production of Grapes	0.168**	0.173**	0.917*	0.145*
	(0.08)	(0.08)	(0.53)	(0.08)
Fractionalization Policies	0.223***	0.217***	0.927**	0.240***
	(0.08)	(0.08)	(0.38)	(0.08)
Large Scale Plantation	0.239***	0.218**	0.998**	0.215**
	(0.08)	(0.09)	(0.40)	(0.08)
Spatial Autocorrelation				-0.998
				(-0.665)
Province Dummies	Yes	Yes	Yes	Yes
Constant	0.0560	0.0145	-2.205***	0.0815
	(0.14)	(0.15)	(0.68)	(0.11)
Observations	109	108	108	108
R-Squared	0.44	0.42	0.902	0.44.
Predicted Proability	0.377	0.376	0.319	0.379
Excluded Instrument: Altitude (in log)		-0.0075***	-0.158***	
		(5.44)	(-5.35)	
Anderson LR Statistics		20.064		
Cragg-Donald F-Statistics		20.006		
Stock and Yogo 10% critical value		16.38		
Partial F-statistics		0.5186		
Endogeneity Test (p-values)		25.54		

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

Robust t statistics in parentheses

Figure 1: Equilibrium number of lemon producing towns

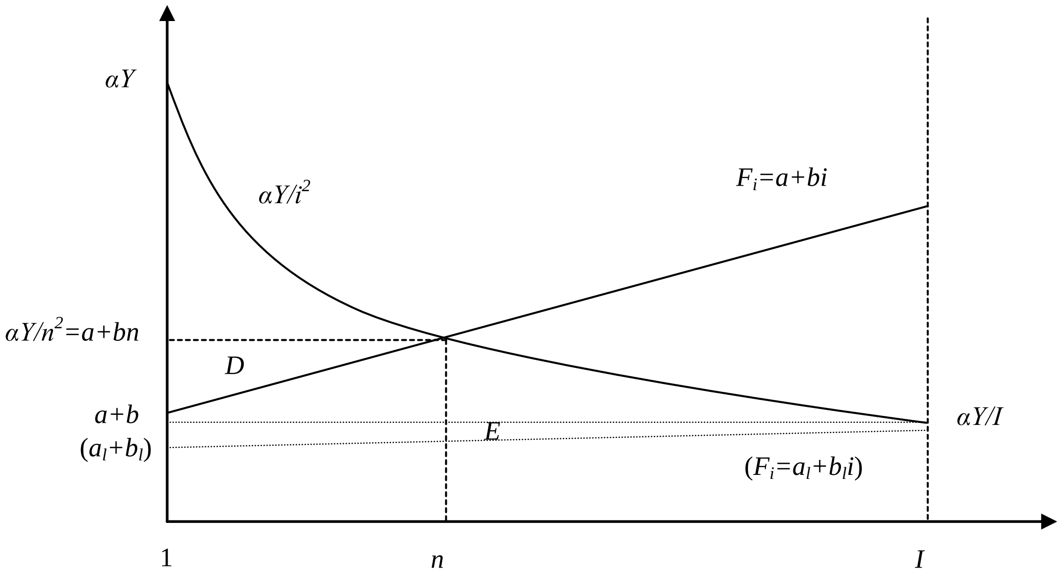
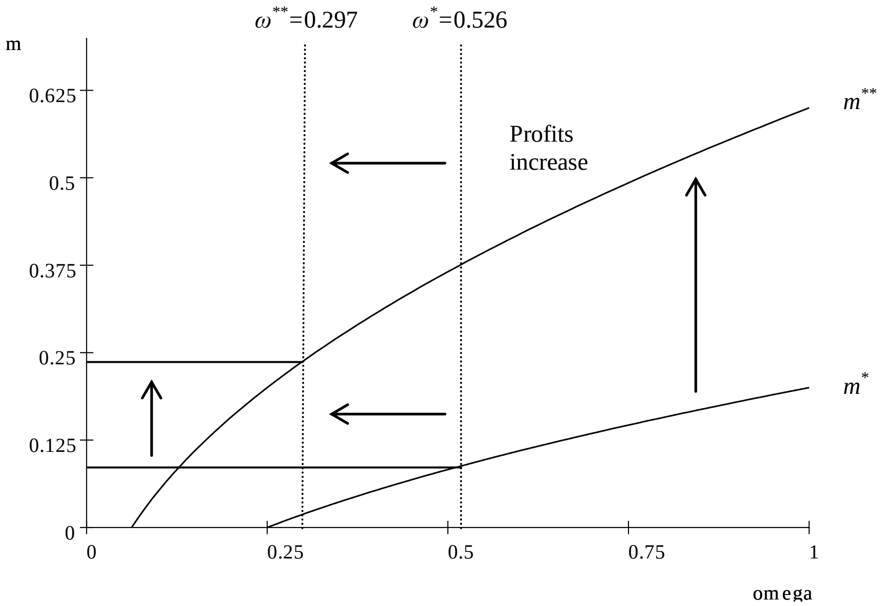


Figure 2: Optimal mafia effort m^* at varying level of profits π^*



Note: The initial example above (giving the curves m^* and ω^*) assumes the following parameter levels: d=0.4, θ=0.5, π^*=8, A=10. In the second example, we alter only the level of profits to π^*=32 which yields the new curves m^{**} and ω^{**}. The equilibrium level of mafia activity thereby increases from m^*=0.09 to m^{**}=0.236.