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JEL Classification:

Keywords: mafia, Sicily, protection, barrier to entry, dominant position

Centre for Research in Economic Development and International Trade, University of Nottingham

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Outline

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Arcangelo Dimico* Alessia Isopi Ola Olsson

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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 production of 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. We argue that the mafia arose out of the need to protect citrus production from predation by thieves. Using the original data from a parliamentary inquiry in 1881-86 on Sicilian towns, 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.

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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 19th 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

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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 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, 1886). 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 a broad sense, our paper is related to the literature on the historical emergence of "extractive" institutions that retard economic development and which can appear at critical junctures in a country's history (Acemoglu et al, 2006; Acemoglu and Johnson, 2012). The mafia is undoubtedly an example of an extractive institution that appeared during a critical period in history (Italian unification). Our analysis is however somewhat different from this tradition since we emphasize the economic or market structure-related factors behind mafia institutions rather than political origins (such as a weak and oppressive Bourbon state in Sicily with substantial social inequalities, as discussed further below).

Our theory and results further have strong associations with research on the "curse of natural resources" (see van der Ploeg, 2011, for a recent overview). Our main finding that the boom in citrus exports in the late 19th century was a key factor behind the rise of the mafia, is well in line with the more recent observation that windfall gains from natural resources often are associated with intense rent seeking. In this sense, resource windfalls might actually deteriorate institutions even further if key groups in society believe that predation is more profitable than production (Mehlum et al, 2006; Congdon Fors and Olsson, 2007).

Our analysis of the Sicilian mafia is most closely related to Bandiera (2003). Bandiera's main hypothesis is that it was the increase in land fragmentation 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 political reform. In an empirical section where she uses information from the report that Damiani (1886)[2] submitted to the Parliament,

[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 the climate and soil suitability for growing lemon, the fixed costs for starting up a cultivation was very different across towns.

[2] The bill which set up the Parliamentary Inquiry was passed in 1877 but the inquiry in Sicily only started in 1881. In 1883, Damiani sent surveys to mayors and pretori, and the inquiry was finally completed in June 1885.

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. In addition, we also improve in terms of sample size with respect to Bandiera (2003) by using a primary source of data regarding answers that *pretori* (lower court judges) provided to questions related to crimes within the survey that Damiani sent out in 1883 (see Figures A1 and A2 in the Appendix). Whilst Bandiera (2003) relies on a sample size limited to 70 towns located in the western part of the island where land was more fractionalized (which considerably reduces the cross-county variation in the variable), we use information on all available Sicilian towns (127 in total) for which pretori provided answers. 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 an association of mafia 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.

The information available from the Damiani's Inquiry has previously been used also by other scholars studying the origin of the mafia.[3] Cutrera (1900), a police officer in Palermo, also provides some figures on the level of mafia in almost all Sicilian cities at the beginning of the 20th century which are based on information from police headquarters. However, these figures refer to the situation almost 20 years later (than the Inquiry). Over these twenty years, mafia extended its activity to cities which initially were not affected and because of that, the data from Cutrera is more useful to understand the temporal evolution of mafia. This is confirmed by Gambetta (1996) who argues that in the period between the late 1870s and late 1890s, mafia evolved quite markedly as a results of *"economic and political conflicts among local factions, especially in connections with the institutional changes affected by the Italian state between 1869-1890"* (Gambetta, 1996, p 83).

The working paper by Buonanno et al (2012) also studies the importance of export markets for mafia appearance and use the data in Cutrera (1900).[4] They find in particular that sulphur production had a strong association with mafia presence in 1900. However, Buonanno et al. (2012) do not develop an explicit argument for why export revenues were associated with mafia revenues in certain sectors. In the current paper, we present a formal model as well as detailed data to motivate our hypothesis of a link between profits in citrus production and the emergence of mafia protection.

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)

[3] See for instance Colajanni (1885, 1895), Hess (1973), Arlacchi (1986), Catanzaro (1992), Gambetta (1996), Dickie (2004), Lupo (2007), etc.

[4] This paper emerged in parallel with ours without any of us being aware of the other groups' work.

who considers the roots of the mafia to be found in the protection business, a result which to some measure we are able to confirm. 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.[5]

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 history of the mafia and to the Sicilian economy. 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 and Literature Review

2.1 Organized Crime

According to Gambetta (1996), mafia can be defined as a sort of secret organization which provides private protection. Its origin is almost impossible to track given the secrecy feature of its operations. 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 honor" who made an increasing use of violence and extortion in order to force him to sell his 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 inquiries (the Bonfadini Inquiry in 1876 and later the Damiani Inquiry in 1881-5) about the economic conditions and crime in Sicily.

Since 1872, the structure of organized crime organisations in Sicily and in other parts of Italy have changed considerably. The organization which almost nobody knew about has become famous throughout the world. In terms of revenues, Mafia S.P.A.[6] can be considered as one of the largest and most successful business in Italy. In one of the latest reports from the Italian Minister of Home Affairs, it has been estimated that revenues from the only informal sector related to mafia amount to almost 180 billion of euro (Ruffolo et al., 2010)[7]. In terms of GDP, revenues from mafia-related businesses represent almost 12 percent of the total Italian GDP and equal to the sum of Estonia's, Croatia's, Romania's, and Slovenia's total GDPs. If we consider the four Southern Italian regions with the highest incidence

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

[6] S.P.A. is a form of limited liability company and Mafia S.P.A. is normally used to refer to mafia-business not related to criminal activity (i.e. not related to drugs).

[7] Unofficial estimates which also try to consider revenues from criminal activity put the estimates to 750 billion of euro, i.e. almost half of the Italian GDP.

of mafia (Sicilia, Calabria, Campania, and Puglia) then the different criminal organizations (Sicilian mafia, Ndrangheta, Camorra, and Sacra Corona Unita) operate in almost 610 towns enrolling almost 13 millions of people across businesses accounting for almost 22 percent of the total Italian population and 77 percent of the population in these four regions (Ruffolo et al., 2010). So far the Italian mafia is the most successful form of organized crime in Europe and only comparable to the Chinese, Japanese, Russian and South American crime organizations in terms of business.[8] It is not surprising therefore that the Italian mafia represents one of the most worldwide debated issues which has attracted the interest of social scientists, politicians, journalists, and movie makers.

Given the economic and social relevance of the issue, it is natural to wonder why these forms of organized crime emerged only in a small part of the country and what factors explain the cross-regional presence of mafia. Most of the economic analysis on organized crime focuses on weak institutions, predation, and enforcement of property rights (Fiorentini 1999, Grossman 1995, Anderson, 1995, Skaperdas and Syropoulus, 1995, Skaperdas, 2001). Grossman (1995) considers mafia as an alternative enforcer of property rights and he models the emergence of mafia using a contest success function in which the state faces a competition from the mafia in providing such a public good. Skaperdas (2001) also considers protection of property rights in presence of a vacuum of power as a main factor of mafia development. Using a model with two actors (a self-governing community and mafia) and potential robbers he shows that in absence of an enforcer of property rights mafia can represent a sort of second best. Skaperdas and Syropoulous (1995), on the other hand, use a simple predation model where the agent with the lower marginal productivity in military technology invests less in military expenditure and then the rent is shared accordingly.

The idea of a weak state and private protection is well illustrated by Don Calo Vizzini, one of the historical bosses of the Villalba mafia. In an interview with Indro Montanelli he said that *"...the fact is that in every society there has to be a category of people who straighten things out when situations get complicated. Usually they are functionaries of the state. Where the state is not present, or where it does not have sufficient force, this is done by private individuals"* (Montanelli, 1949).

Related to the weak institutions-hypothesis there is also a loss of social capital and public trust which may determine the development of a private provider of protection. Putnam (1993) for example analyses the loss of social capital in Southern Italy due to the several foreign dominations experienced by the region. Gambetta (1996) also considers the private trust rather than the public trust important for the development of mafia in Southern Italy. Social capital and a loss of public trust may also affect the development of organized crime because of kinship relations, corruption, etc. (see Fukuyama 2000; Gambetta, 2009; Levi, 2006; Hardin, 1999; Newton, 2001).

Besides the weak state hypothesis, there is also a part of the literature which looks at regulatory regimes imposed on legal firms. However this second part of the literature is more

[8] Senator John Kerry (1997) argues that the five most influential mafia organizations (the Italian, the Chinese, the Japanese, the Russian and the South American) represent the third largest business in the world representing a huge threat to common market rules and democracy.

likely to explain the evolution of organized crime rather than the origin, even though it may contribute in some way to the appearance of mafia. For example, Anderson (1995) argues that a high regulatory cost may induce firms to switch activities to irregular markets where contracts and property rights are enforced by mafia. Tanzi (1995) and Smith (1976) also focus on the regulation burden.

Regarding the economic costs of organized crime, Reuter (1987) and Gambetta and Reuter (1995) consider the effect of organized crime on the enforcement of cartel agreements in legal markets. By enforcing a cartel, mafia has a direct effect on individuals' choices and efficient allocation of resources. Anderson (1979) considers scale effects of developing business in legal markets in order to increase profits in illegal markets, which then tend to distort a competitive market. The distortional effect of mafia-business in legal market is made clear by the President of the Commission on Law Enforcement and Administration of Justice (1967) who focuses on the competition disruptive effect of organized crime reached through the use of predatory practices toward legal business.

Even though the above literature provides plausible explanations for the origin of mafia it is still difficult to understand why we observe a huge variation across regions experiencing very similar conditions. If a weak state, a high regulation burden, and a lack of public trust are the factors which matter for the development of mafia, then we should not observe any local variation within the territory at hand. However this is not true at all. Across counties and villages exposed to these same conditions there is a huge variation. Actually, organized forms of crime normally appear only in a small number of localities and then they expand over the entire region. It is therefore important to understand what is specific to these few localities where mafia appears. With relation to Sicily, Gambetta (1996) and Bandiera (2003) focus on land fractionalization policies and the emergence of a private market of protection. Villari (1875) focuses on hierarchical social relations and the emergence of a greedy middle class (*gabelloti*).

2.2 Historical Origins of the Mafia in Sicily

The Sicilian mafia represents so far the most passionately debated and represented form of organized crime. However, the local origins are still not well understood. The heritage of the Spanish domination, the feudalism, the development of a "greedy" middle class (*gabelloti*), 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 (*gabelloti*), 3) peasants which are normally exploited by the *gabelloti*. The *gabelloti* used to lease the land from landlords and then they rented small pieces of this land to peasants. Peasants worked the land and then they gave back to the *gabelloti* a share of the harvest depending on the kind of contract

stipulated. These contracts were relatively short and the *gabelloti* 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 *gabelloti* at interest rates which made it impossible to pay back the debt. 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 Inquiry 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* (large scale plantations almost similar to feudal systems) 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 are developed by Doria (1710) when he considers the Bourbon domination as detrimental 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 (following Damiani, 1886) 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 sulphur mines. Given that the province of Girgenti 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 sulphur mines as conditions for the development of mafia.

Coming to recent years the origin of mafia has also been discussed in Gambetta (1996), Dickie (2004), 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).

Compared to the existing literature we focus on a market structure-hypothesis which should explain the cross-regional variation in the appearance of mafia in Sicily. Our hypothesis is related to the huge profits that in the second half of the 19th century were associated

with the production of lemons. This sector was characterized by huge initial fixed costs and barriers to entry represented by the particular climatic conditions needed by this plant. This sectorial fixed cost provided to Sicily a natural dominant position in international markets making the business extremely lucrative. As a consequence, mafia could extort part of these profits in order to provide protection. This would have not been possible in a competitive market with free entry where profits are quite low and therefore with nothing to extort.

We believe our market structure-hypothesis in important ways complement existing theories of mafia emergence, for instance those focusing on institutional factors. In addition, our hypothesis is also extremely consistent in terms of the timing of the origin of mafia. The lemon production in Sicily started booming in 1840s-50s (when the international demand started increasing) and by 1880 (the period for which we have data on Mafia) Sicily became the largest supplier of lemons and lemon by-product in the world covering more than 78 percent of the total US import lemons which at the time was the largest importer. This timing consistence reassures us about the identification of profits in the sector as a main driver of the cross-regional variation in the appearance of mafia in Sicily.

2.3 The Sicilian Economy

Sicily is the largest island in the Mediterranean and 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 continuous foreign dominations. After having been colonized by Greeks, it was 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 agriculture 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 by 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. Table 1 reports the distribution of lemon trees in the South of Italy in 1898. Palermo and Messina are the two provinces with the largest absolute number of lemon trees, accounting for almost 59.5 percent of the total trees in the South of Italy. The number of lemon trees is also quite large in the province of Catania, accounting for an approximate 12 percent of the total. Outside Sicily, Reggio Calabria is also a large producer of lemons with an absolute number of trees equal to 1,232,675 (almost 18 percent). Few trees were also planted in the centre (almost 798,214 trees) and in Northern Italy (almost 564,559), making a total of almost 8,287,758 trees all over the peninsula. The total number of trees in Sicily amounts to almost 70 percent of all trees in Italy.

Table 1: Production of Lemons in Italy

The dominant position was consolidated throughout the 19th 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) [9]. The expansion was the result of the large returns associated with the production of citrus which Monroe (1909) estimates to be almost $200 (at current 1908 US dollars) per acre providing a net profit of more than $150 per acre (Monroe, 1909). The importance of these figures is made clear by Dickie (2004) when he argues that *"citrus cultivation yielded more than sixty times the average profit per hectare for the rest of the island"* (Dickie, 2004, p 39)

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 the US which represented one of the largest importer of Sicilian citrus.

Table 2 provides a preliminary picture of the importance of the USA for the export of oranges and lemons. The total number of boxes of oranges and lemons exported into the USA in 1893 is 1,061,624 and 2,595,702 respectively. Given that the total production of oranges and lemons in 1893 was 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 1893 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 lemon was exported to the USA.

Table 2: Export to the USA

[9] The international demand of lemons and oranges started increasing since the end of the 19 century after Lind, an officer and naval surgeon in the British Royal Navy, established the fact that oranges and lemons were effective in curing scurvy

Table 3 shows a more accurate picture of the trade of lemons between Italy and the US over the period 1898-1903. To the left in the table, we show the total Italian export of lemons and the relative percentage exported to the US. To the right in the table, we show the total import of lemons into the USA and the estimated percentage coming from Italy. This data needs to be evaluated with some caution given that the total export of lemons from Italy refers to the calendar year while the total import into the US refers to the fiscal year (and the two do not coincide). However, the table clearly shows the importance of the Italian production in international markets. The average quantity of lemons exported from Italy over this period (and therefore from Sicily mainly) is equal to 389 million pounds and the average share of fruits exported to the US is equal to almost 34 percent of the total Italian production. On the other hand, the vast majority of lemons imported into the US in this period come from Italy. Calculating the total Italian export to the US, using percentages to the right of the table, we can estimate that almost 78.4 percent of the total import of lemons into the US over the period 1898-1903 comes from Italy. Besides the US, the UK and Austria were also two large importers of lemons. Over the decade 1898-1908 the UK imported a quantity of lemons between 17.7 and 25 percent of the total Italian export, while the Austro-Hungary imported a share between 14.4-22.8 percent (Powell, 1908).

Table 3: Lemon exports and imports

On the top of Table 4 we show the total Italian export of citrate of lime while at the bottom of the table we show the total import into the USA over the 1898-1903 period. The USA is again the most important market for citrate. On the other hand, Italy is the most important trading partner for the US (with regard to citrate of lime). Besides the US, France and the UK also used to import a large share of citrate from Italy and according to Powell (1908) the quantity imported by these two countries was at least as large as the American one. A similar pattern can also be shown for the export of essential oils from lemons and oranges.

Table 4: Citrate of lime exports and imports

Given the extent of the production and the international demand of lemons the sector was of strategic importance for the local Sicilian economy. This is shown in Table 5 where we report 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) citruses accounted for more than 50 percent of the total export in 1873. 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 caused a deterioration in 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 5: Export from the Harbor of Messina

If we consider the USA, the UK, and France as the three largest markets in the 19th century then it is clear that Italy (and Sicily mainly) had a dominant position in the international lemon market. There are several reasons which can explain such a dominant position[10]. However, the one which matters for our analysis is the barrier to entry in the market represented by the poor tolerance of the plant to extreme climates. Lemon is a very demanding plant to grow with particular climatic requirements. The average temperature for lemon trees to grow and vegetate should be between 13° and 30° Celsius given that the plant is totally intolerant to frost and to extreme heat. Flowers and fruits are totally destroyed after few minutes of exposition to temperatures below 1-2 Celsius degrees. The high intolerance to frost also produces a local variation in places where the plant can vegetate. Places slightly above the coastline are more suitable to the plantation given the relatively low variation in the daily and annual temperature, while places over the mountains with a larger daily and annual variation in the temperature are less suitable to the development of the sector.

Given this insurmountable barrier to entry represented by the climate, which tended to provide a large variation in the production of citrus across countries and across villages, we argue that the large export revenues from citrus associated with its dominant position in international markets 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.

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

[10] Other reasons why Sicily may have had a dominant position are historical (related to the fact that the plant developed in the Mediterranean since Roman times) and geographically (the importance of the Mediterranean in international trade).

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.[11] For simplicity, we assume that the island of Sicily has a monopoly in the production of lemon.[12] The representative household might be thought of as the average Western household in the last decades of the 1800s. The individual household'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

[11] We will only refer to lemon in the model below, but as indicated in the section above, what we really have in mind is the market for lemon, orange, lime, and other citrus products.

[12] This is a simplification. However, Table 3 shows that in the dominant US market, Sicilian lemon accounted for 100 percent of all imports during certain years in the period 1897-1903.

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

Since marginal cost ψ and inverse demand $p\left(C\right)$ 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 Cournot equilibrium supply of lemon from town i gives us

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

Not surprisingly, equilibrium supply will increase with the typical 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 $\bar{F}=a+\left(I+1\right)b/2$.

With these assumptions, the last producer who will choose to produce lemon $(i=n)$ will

be the one where[13]

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

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.[14] 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.[15] In general, for a given n, profits fall with i. Profits always increase with household demand αY. We can therefore express $\pi_i^* = \pi(\alpha Y, a, b, i)$.

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

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

[15] 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.

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. An implicit assumption in this section is that the "predation technology" in the lemon business was particularly favorable for thieves. Compared to other agricultural goods like grapes or wheat, lemon are very easy to collect quickly by a prospective thief. The price per stolen bucket is further very high. These factors contributed to the circumstance that lemon plantations were in particular need of protection.

Let us assume that in each community, there are $d > 0$ thieves.[16] 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 nature of the original organization of local mafia groups (*cosca*) remains largely a mystery. What we know about such groups is that they formed a secret society of sworn-in men who managed to overcome the collective action problem through various measures (like brutal punishments in the case of defection). Mafioso were recruited among men with very diverse occupations in society, including peasants, sheep-herders, doctors, and politicians. In these early days, mafioso typically performed their daily jobs as an integrated part of society while also undertaking mafia activities on the side. The key mafia activity was the protection of businesses (Gambetta, 1996).

[16] In a richer model, the number of thieves might be endogenized so that individuals self-selected into being a mafioso, a thief, or a normal peasant in a process where marginal returns were the same in equilibrium. The number of thieves in Sicily in the 1880s was reportedly very high due to a general release of prisoners after the Italian unification and the breakup of feudal estates which made many workers redundant.

We assume that the local mafia organization in i has no influence over n (there was no central coordinating mafia authority in the 1880s) and that a representative mafioso 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

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

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). This type of production is one option available to mafioso and is the only available option for the majority of ordinary people. $\omega \in (0,1)$ 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 as given. Note that ω must be somewhere within the interval $(0,1)$ for any interaction to occur between the two.

The mafia maximizes the utility function

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

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

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

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 $\omega\pi_i^* = \omega\left(\frac{\alpha Y}{n(a,b)^2} - a - bi\right) > d\left(1-\theta\right)A$.*

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. If the offer from the producers ω is very low, the mafioso will not find protection worthwhile.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 is the level of profits in lemon production π_i^*. 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 due to 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 (3).

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 and the data discussed above, 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 was assumed to be exogenously given. In this section, we will extend the analysis and endogenize the offer ω_i 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:

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

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 $\omega_i = 1$ 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.[17] The examples also illustrate a situation in which thieves always steal a certain fraction of profits and where the mafia appropriates another substantial fraction. The individual producer has no alternative but to let the mafia protect him/her. Many producers, like Dr Galati referred to above, were surely dismayed at this state of affairs and considered mafia offers of "protection" to be more like criminal extortion.

[17] 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 estimated can be written as:

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

where

$$\begin{aligned} Mafia_i &= 1 \text{ if } M_i^\star \geq 0 \\ Mafia_i &= 0 \text{ if } M_i^\star < 0. \end{aligned}$$

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. 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 costs 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 mafia activity. Even though we do not have data on profits, we can consider the dominant position in the market of citrus (73 percent of the total Italian production and almost 78 percent of the total US lemon import) 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.

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 incumbent state, but they should provide an idea of the efficiency of the state in enforcing property rights. Finally η_i represents provincial fixed effects which may be correlated with the error term.

4.2 Data

Data at town level for the entire island are collected from the Damiani Inquiry (1886).[18] This investigation is part of a larger inquiry, approved in March 1877 and proposed by Stefano Jacini, that aimed at assessing the conditions of the agricultural sector and the conditions of peasantry in every region of Italy. Abele Damiani was an MP for the region Sicily. The Damiani Inquiry represents one of the earliest and most important primary sources about the economic and social conditions of Sicily in the 1880s.[19]

The section of the Inquiry which matters for our analysis is divided into two parts. The first part regards the condition of agriculture with reference to the kind of crops produced, tax burden, wages, and relations between peasants and landlord (i.e. tenancy contract, fractionalization of land, etc.). Questionnaires relative to this first part were sent out to almost 357 mayors but less than half of them provided complete information.

The second part of this section regards the moral and social conditions of peasants. In this case questionnaires were sent to 179 pretori (lower court judges)[20] and the information delivered by them is summarized in tables which provide a unique picture about the moral and social conditions of Sicilian peasants at the time. The survey sent to *pretori* asks questions regarding the lewdness and religiousness of people, corruption of the clergy, the rule of law, and the effect of introducing a compulsory military service. However the part of this survey which matters the most to us is the one regarding the form and level of crime in the island. The question asked to pretori in the Inquiry is: *"What is the most common form of crime in the town? What are their causes?"* There are a range of possible crimes that pretori considered. Some of these crimes are related to rustling, robbery, murders, but the alternative that forms our dependent variable is "mafia". [21]

There are some potential concerns with the data on mafia presence. Firstly, could mafia still be present in a town even though the pretore did not list it as the most common form of crime? Because of the structure of the question in the Inquiry, it is indeed possible that some towns had mafia activity even though the pretore does not reckon it as the main source of crime. This problem may slightly affect our results.

Second, were pretori themselves mafioso and hence likely to understate the presence of mafia? The answer to this question is most likely no, although it is quite difficult to give a definite answer to this question. Pretori were directly appointed from the Minister of Justice and their appointment was ratified with *Regio decreto* (Royal order). Their appointment and any other aspect concerning their career was subject to the evaluation made by a local committee of experts of the local Court of Appeal. For the first 10 years of their career, pretori used to change town very frequently which may have restricted their connections

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

[19] The Inquiry is still available from the Archive of State in Rome, even though the condition of manuscripts is not perfect and some pages are very hard to read (see figures in the appendix).

[20] There are much fewer *pretori* than mayors since the office of *pretura* is only present in larger provinces so that one pretore often serves several towns.

[21] Samples of these surveys are provided in Appendix 2. Figure A1 shows the table summarizing information provided by pretori. Figure A2 shows a sample of the survey completed by the mayor of Cefalu.

with the environment. From another question of the Inquiry it emerges also that many experienced difficulties to administer justice without the cooperation of local people because in several trials witnesses did not say the truth because afraid of mafiosi or because of previous agreement with mafia.[22]

Third, did the pretori have a common understanding of what the term "mafia" implied? Yes, this appears to have been the case. In 1880, the term "mafia" already meant a criminal organization. The term appears to have been used to identify this typical sort of organized crime in Sicily at least since 1863 when in Palermo a comedy titled "I Mafiusi di la Vicaria" was shown. In 1865, the prefect of Palermo (Filippo Gualterio) used the term mafia in a private document to identify the criminal organization. In addition, since 1871 mafia membership has been a public law offence. We therefore regard it as highly unlikely that the term was misinterpreted.

These sort of problems are common to most of the empirical analysis which uses survey data causing a sort of measurement error which will be part of the error term. However as long as the error term is not correlated with independent variables there is no reason to believe that these problems will affect estimates. This is important for our analysis given that the possible misenterpretation of the question as well as the collusion between pretori and mafia (if this was possible) are likely to be distributed randomly across towns with mafia. Because of that it appears fair to assume that our main independent variable (whether the city produces citrus) should not be correlated with such an error providing unbiased estimates[23].

Table 6 reports descriptive statistics for some of our key variables. The dependent variable, *Mafia*, is thus binary a dummy variable for whether the pretore of the town reckons mafia as the most important source of crime in the town.[24] 35 percent of all towns were strongly affected by mafia which means that almost 44 out of the 127 towns in our sample had mafia listed as the most common form of crime. Girgenti is the province with the highest incidence of mafia with almost 14 out of 17 towns having a strong mafia presence. In Trapani, the 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 infested with 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) where he divides the island in three macro-regions considering Girgenti as the one with the highest rate of murders and convictions and therefore the one with the highest level of Mafia.

Table 6: Distribution of mafia and of agricultural production

[22] According to Pezzino (1990), the pretore in Bagheria said "There is a tendency to deny the truth. Not only people does not answer truthfully, but they deliberately lie either because of mafia or because of money or because they are afraid".

[23] Assume that the dependent variable is measured with an error and that $y_i = y_i + \psi_i$. Then we can write the composed error term in (5) as $\epsilon_i = u_i + \psi_i$ and if ψ_i is random it should be uncorrelated with independent variables.

[24] Data on mafia is available for 162 cities but when merged with independent variables the largest sample covers 127 cities.

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), as well as our model, consider the profitable production of goods like citrus and sulphur as important determinants of mafia. Because of that, the first set of independent variables in table 6 are related to production. *Citrus, Wheat, Olives, Grape*, and *Sulphur* are the commodities we consider. In order to assess what dominant crops that were produced in each town, we use dummy variables which are coded one in case the town is a dominant producer of these crops. The relevant question in the Damiani Inquiry is: "Which is the dominant crops produced in the city?" Pretori 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.

Given the hypothesis of this paper, the data for citrus production is of particular relevance. After also having compared with the data in Di Vita (1906), we can confirm that the Damiani Inquiry appears to give an accurate description of the local distribution of citrus production. The production of citrus is the highest in the province of Messina and the lowest in the province of Siracusa. Data on sulphur mines are also provided by Di Vita (1906). As argued by Colajanni (1885), sulphur 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. 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).

The second set of explanatory variables is related to the political status of towns and other policies aimed at increasing the small-scale ownership of land (i.e. "enfiteusi").[25] In Table 7, we show 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 the 13th century, Sicilian towns could have three different sorts 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 a subservient role. According to Sonnino and Franchetti (1877), and Doria (1710), feudal cities were likely to experience a larger loss of "social capital".

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 62 percent of our sample which means that 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

[25] "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.

(church-ruled).

Table 7: Political organization

The third set of variables is related to the distribution of land and to the length of the tenancy contract. Damiani (1886) is the source for most of our variables except for a few cases in which we use data from Di Vita (1906). With the end of the feudalism and the unification of Italy in 1860, the land in crown- and church-ruled cities were 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, as described in our model.

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", shown in the last column of table 7.[26] The average effectiveness of this policy is 45 percent which means that according to pretori 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 8 provides descriptive statistics for the scale of the plantation and the fractionalization of land. Damiani (1886) is the source for these data. The question asked for the scale of plantation and fractionalization is: "What is the dominant scale of the plantation? And what is the fractionalization of land?" Most of the time pretori 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 least frequent. Regarding the fractionalization of land, this is highly fractionalized in almost 44 towns, and relatively low fractionalized in almost 29 towns. The small scale plantation is relatively frequent in the province of Messina which on 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 8: Land fractionalization and scale of plantations

Finally, in table 9, we show the pairwise correlation among a selected number of variables. *Mafia* seems to be positively correlated with *Citrus* (0.39 correlation), with the *Large scale*

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

plantation (0.25 correlation), and with the effectiveness of the fractionalization-policy (0.26 correlation). The presence of sulphur mines is also positively correlated with *Mafia* (0.19 correlation). A feudal origin and the high fractionalization of land, which also have been considered important for the diffusion of organized crime, are weakly correlated with *Mafia* (0.05 and 0.04 correlation respectively). Finally, *Population density,* capturing the wealth of a locality, is weakly correlated with *Mafia*. All these variables are weakly cross-correlated, preventing problems of multicollinearity.

Table 9: Pairwise Correlations

5 Empirical Analysis

Table 10 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 for observables. In column, 1 the diffusion of the mafia only significantly depends on production of citrus and sulphur. At the mean, the production of citrus increases the probability of mafia by 45 percent, while the production of sulphur increases the probability of mafia by 24 percent. In column 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 sulphur-mines dummy is now insignificant, while the grape dummy becomes marginally significant at a 10 percent level.

In column 3 we enter some 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 column 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.[27] The dummy for whether the land is highly fractionalized in column 4 is not statistically significant which in some sense is more consistent with our hypothesis.

In fact, given the fixed costs that farmer had to incur 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 column 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

[27] The fractionalization policy dummy could also capture an increase in the use of the "gabella" given that existing landowners bought most of the available land. Therefore, even though mayors consider these policies effective in increasing the fractionalization of land, this still remained quite concentrated in few hands preventing peasants from acquiring any rights on the land.

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. The set of covariates in column 5 is our preferred specification and in this model mafia is 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 10: Mafia Probit Model

In table 11, we add to our preferred specification additional controls which are suggested to have an important effect on mafia. In column 1, we enter controls for the distance from Palermo and from Mazzara del Vallo. The first variable should capture the distance from a well-known mafia-base center and the distance to a key port. 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 Sicily from Mazzaro del Vallo. Both variables are statistically insignificant. In column 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 column 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 (1886). 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 column 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 11 still increases the probability of mafia by a 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 11: Mafia Probit Model: Additional Controls

Finally, in table 12, we control for the robustness of our preferred model to alternative estimators. In column 1, we use a Linear Probability Model (LPM) and all variables in our baseline model are statistically significant at least at a 5 percent-level. Also the grape dummy which was marginally significant in table 10 is now significant at a 5 percent-level. Citrus increases the probability of mafia by almost 30 percent, grape by 17 percent, fractionalization policies by almost 23 percent, and large scale plantations by almost 24 percent.

In column 2 we use an OLS-IV estimator. *Altitude* is the instrument we choose for *Citrus*. This instrument is chosen because of the the particular climatic conditions required by this plant and its influence on fixed costs as spelled out in the theoretical model. We can represent the causality using the simple flow chart below:

Altitude → Climate → Fixed Cost → Profits → Mafia

where altitude affects the climate and its daily and annual variation. The higher variation and the higher probability of frost represent a sort of fixed cost which is not sustainable for the production of lemons given that the plant is totally intolerant of frost.[28] Because of that, the development of the lemon production will occur in few cities characterized by a mild climate with low variation. The production of lemons then affects profits and therefore the level of mafia activity. The choice of altitude is also consistent with the division of the fruit industry made by Monroe (1909) who argues that the fruit industry in 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 feets"* (Monroe, 1909, pg 190-91). Therefore we should expect to have a larger concentration of lemons below fifteen hundred feet.

Of course there is always a potential risk that the exclusion restriction may be violated. For example it can be argued that the enforcement of law is less efficient in towns over the mountains because these towns are relatively more difficult to be reached by public forces. However, in this case we are likely to under-estimate the effect of lemons on mafia.[29] Furthermore, the mountains of Sicily do not appear to be high enough to provide a reliable shelter to outlaws.

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 or lower. In column 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 column 4, we use a Spatial Linear Probability Model to control for spatial autocorrelation in the error term.[30] 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 12: Robustness Check – Alternative Estimators

[28] Of course, a huge investment can be made in order to protect the plant from the frost.

[29] 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.

[30] The idea is that mafia is presence in one town could positively influence the probability of mafia presence in a neighboring town as a local spillover effect.

6 Conclusions

In this paper, we have developed a market structure-hypothesis for understanding 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 were associated with a strong international demand as well as substantial fixed costs during the late 1800s. This profitability, combined with a general lack of rule of law at them time, provided an ideal breeding-ground for a mafia providing private protection to lemon producers.

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. We argue that these results are consistent with a market structure-hypothesis as outlined in this paper.

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Figure 1: Equilibrium number of lemon producing towns

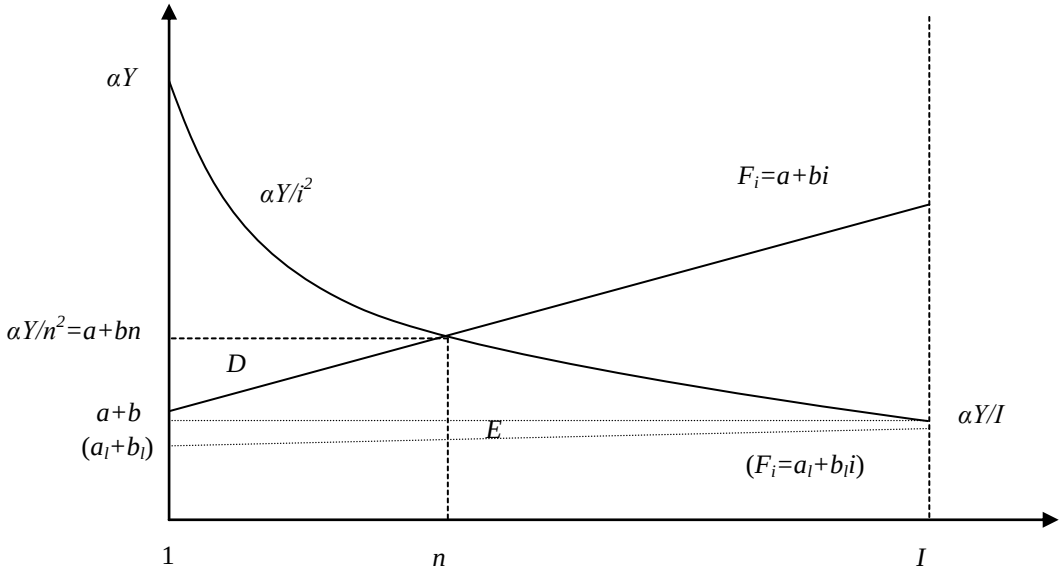
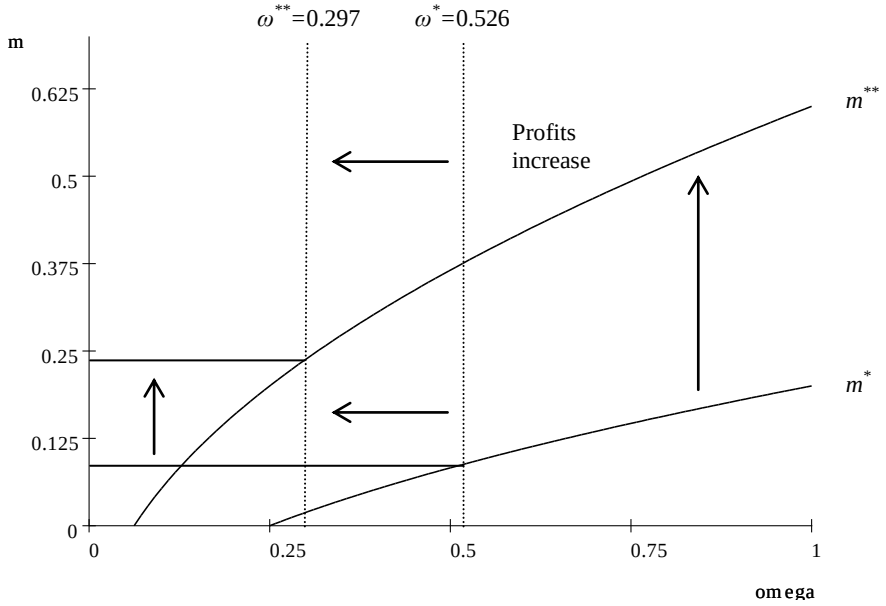


Figure 2: Optimal mafia effort m^* at varying level of profits π^*



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.

Table 1: Distribution of lemon trees in Southern Italy in 1898

Region	Number of trees
Reggio Calabria	1,232,675
Messina	1,634,231
Palermo	2,488,475
Catania	828,640
Syracuse	460,125
Calatanissetta	8,210
Girgenti (Agrigento)	56,379
Trapani	216,610
Total	6,924,985

Source: Powell (1909)

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: Total Italian exports of lemons and total United States imports

Year	Total Italian Exports			Total US Imports		
	Quantity (pounds)	Value (US $)	Exports to the US (%)*	Quantity (pounds)	Value (US $)	Imports from Italy (%)**
1898	325,504,061	3,419,486	41.3	133,374,95	2,521,985	100^
1899	359,473,041	3,234,489	36.7	298,634,448	4,399,160	44.1
1900	331,563,577	3,000,286	29	159,384,389	3,655,926	60.3
1901	368,801,294	3,328,610	29.2	148,334,112	3,516,877	72.5
1902	490,033,260	3,432,677	35.3	162,962,091	3,318,909	100^
1903	459,622,020	3,218,948	31.2	152,775,867	3,087,244	93.8

*Percentages provided by Powell (1909)
** Percentages estimated using percentages on quantity exported from Italy above. For example for the year 1900 the quantity exported to the US is 331,563,577*0.29=96,153,473 which divided by 159,384,389 provides a percentage equal to 60.32 percent.
^ In 1898 and 1902 the percentage exported from Italy to the US exceeds the total import into the US. This is because Italian figures refer to the calendar year, while USA figures refer to the fiscal year.
Source: Powell (1909)

Table 4: Total Italian export of citrate of lime and total United States imports

Year	Total Italian Export			Total US Imports		
	Quantity (pounds)	Value (US $)	Exports to the US (%)*	Quantity (pounds)	Value (US $)	Imports from Italy (%)**
1899	3,142,248	151,295	32.8	1,577,804	157,482	65.3
1900	3,743,448	196,826	37.6	1,944,803	204,243	72.4
1901	3,120,202	147,502	35.3	2,416,658	209,583	45.6
1902	7,517,541	329,965	32.5	3,056,904	293,293	79.9
1903	7,229,647	632,905	38	2,657,110	240,486	100^

*Percentages provided by Powell (1909)
** Percentages estimated using percentages on quantity exported from Italy above. For example for the year 1901 the quantity exported to the US is 3,120,202*0.353=1,101,431 which divided by 2,416,658 provides a percentage equal to 45.57 percent.
^ In 1903 the percentage exported from Italy to the US exceeds the total import into the US. This is because Italian figures refer to the calendar year, while USA figures refer to the fiscal year

Source: Powell (1909)

Table 5: Exports 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	
Sulphur	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 6: Distribution of mafia and agricultural production across provinces in 1881-86

			Dominant production of:				
Province	Towns	Mafia	Citrus	Grape	Olive	Wheat	Sulphur
Catania	22	0.318	0.478	0.826	0.347	0.782	0.227
Girgenti	17	0.823	0.5	0.611	0.388	1	0.705
Messina	25	0.24	0.608	0.739	0.521	0.478	.04
Palermo	27	0.296	0.370	0.777	0.444	0.740	0.111
Siracusa	21	0.142	0.35	0.85	0.35	0.75	0
Trapani	15	0.4	0.4	0.8	0.6	0.8	0.066
Total	127	0.346	0.452	0.769	0.436	0.746	0.14

Numbers in the table refer to the percentage of towns within each province with mafia presence and/or with dominant production of each commodity. Each variable in the table is a binary dummy. *Mafia*=1 if mafia is perceived to be the most common form of crime in the town and 0 otherwise, as explained in the text. *Citrus, Grape, Olive, Wheat* and *Sulphur* are also binary dummies taking on the value of 1 if the commodity is listed by the pretore as one of the key agricultural goods produced in the town, as explained in the text.
Source: Damiani (1886)

Table 7: Descriptive statistics for political organization across provinces before the Italian unification in 1860

		Political organization:			
Province	Towns	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 refer to the percentage of towns within each province that were characterized by feudal organization, was crown- or church-ruled, or had a substantial degree of fractionalization polices. Each of the variables of Political organization is a binary dummy.
Source: Damiani (1886)

Table 8: Land fractionalization and scale of plantations by province in 1881-86

		Fractionalization of ownership		Scale of plantation	
Province	Towns	High	Low	Large	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 refer to the percentage of towns within each province that were characterized by high or low fractionalization in land ownership and large or small plantations.
Source: Damiani (1886)

Table 9: Pairwise correlations

	Mafia	Citrus	Wheat	Olive	Grape	Sulphur	Feudal	Frac. policy	Pop. density	High frac.	Large scale plant.
Mafia	1.0000										
Citrus	0.3863	1.0000									
Wheat	0.0946	-0.2390	1.0000								
Olive	0.0014	0.2289	-0.1850	1.0000							
Grape	0.0680	0.0424	-0.0158	0.1391	1.0000						
Sulphur	0.1914	-0.0124	0.2903	-0.0366	-0.0589	1.0000					
Feudal	0.0556	-0.1212	0.0598	-0.0119	-0.1321	0.0519	1.0000				
Frac. policies	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 10: Mafia probit model

	Dependent variable: Mafia				
	(1)	(2)	(3)	(4)	(5)
Citrus	1.277***	1.491***	1.504***	1.556***	1.388**
	(0.28)	(0.30)	(0.37)	(0.33)	(0.68)
Grape	0.295	0.612*	1.125**	1.041**	0.953*
	(0.28)	(0.34)	(0.48)	(0.47)	(0.50)
Olive	-0.192	-0.324	-0.377		
	(0.27)	(0.29)	(0.34)		
Wheat	0.534	0.337	0.176		
	(0.33)	(0.36)	(0.38)		
Sulphur	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

Notes: The estimator is binomial probit in all specifications. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Probit regressions with additional controls

	Dependent variable: Mafia			
	(1)	(2)	(3)	(4)
Citrus	1.382***	1.301***	1.795***	1.469***
	(0.34)	(0.36)	(0.44)	(0.37)
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 station (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

Notes: The estimator is binomial probit in all specifications. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

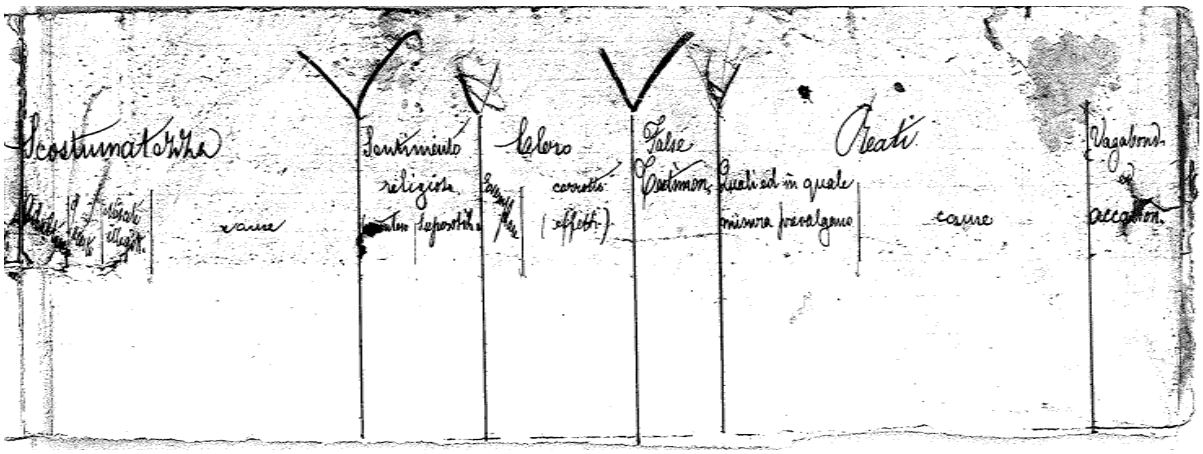
Table 12: Robustness checks with alternative estimators

	Panel A			
	Dependent variable: Mafia			
	2nd stage estimates			
	(1)	(2)	(3)	(4)
Estimator	LPM	IV	IVPROBIT	SPATIAL LPM
Citrus	0.305***	0.430**	1.764***	0.320***
	(0.08)	(0.21)	(0.62)	(0.08)
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)
Constant	0.0560	0.0145	-2.205***	0.0815
	(0.14)	(0.15)	(0.68)	(0.11)
Predicted probability	0.377	0.376	0.319	0.379
Province dummies	Yes	Yes	Yes	Yes
Observations	109	108	108	108
R-Squared	0.44	0.42	0.902	0.44.
	Panel B			
	1st stage estimates for Citrus			
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	25.54			
Endogeneity Test (p-values)	0.5186			

Notes: The estimator is a Linear Probability Model (LPM) in column 1, IV in column 2, IVPROBIT in column 3, and Spatial LPM in column 4. In columns 3-4, we run two-stage estimations with *Citrus* as the endogenous variable and with *Altitude* as the excludable instrument. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

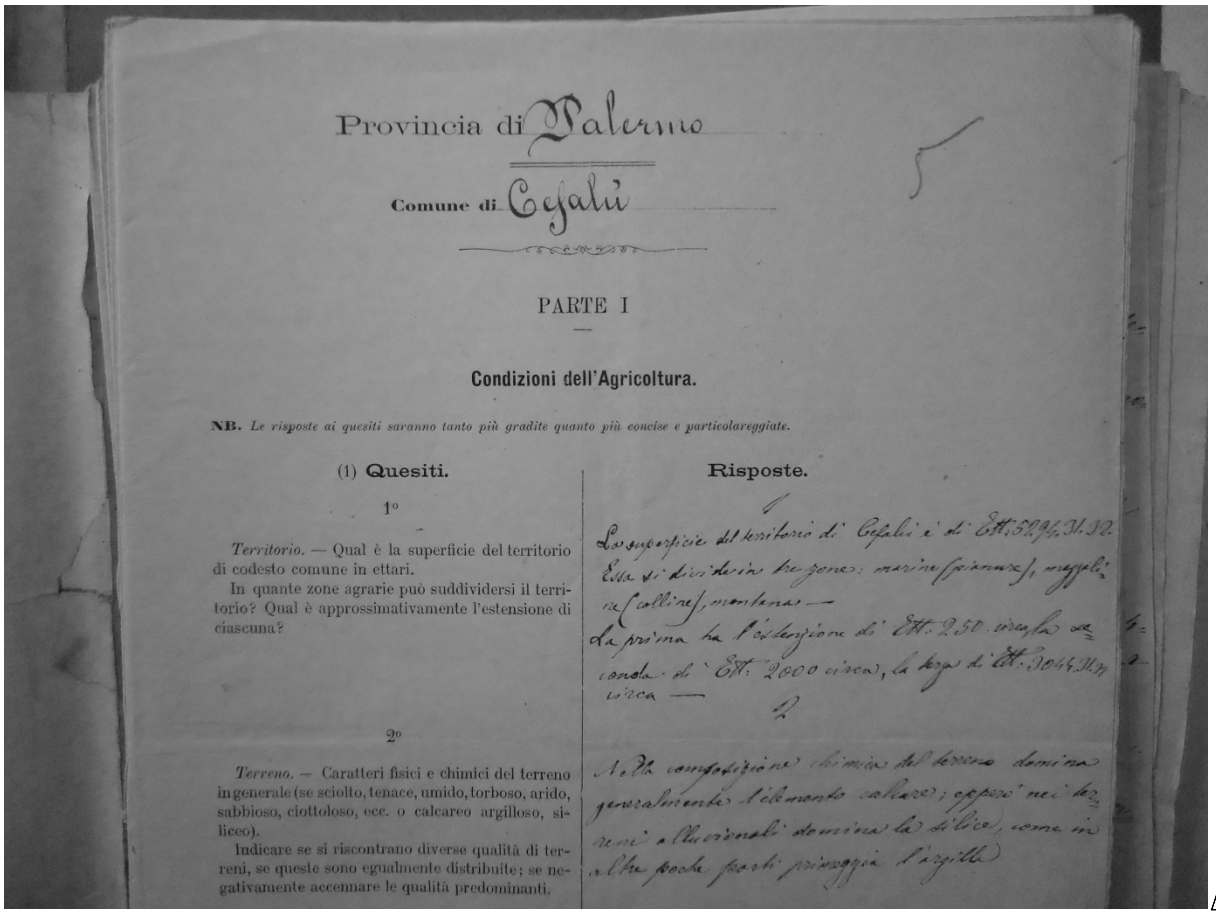
Appendix

Figure A1: Variables in the table related to mafia



Note: Figure A1 shows a picture of the second part of the table from which we got data on mafia. The first row reports variables. Starting from the left, the first variable is Scostumatezza (lewdness). There are three possible causes among which the prefect can choose. The first one is Adulterio (adultery), the second Incesto (incest), the third is Nascite Illegali (illegally born child), and the last one is Varie (various). The second variable relates to the religiousness of people in the town, the third one relates to the clergy (corrupt or exemplary), and the fourth variable regards perjury. The last variable is Vagabondaggio accattonaggio (vagrancy and begging). The fifth variable is the one we use to get information on mafia. The variable is labelled Reati (crimes) and then it is asked what the most common crimes are and the extent of these crimes. Most of the time, pretori only answered providing information on the sort of crime committed. The most common forms of crime were rustling, mafia, bloody crimes, and bloody crimes for passion. In addition poverty was described as the most common cause of crime.

Figure A2: Inchiesta Agricola (Agricultural Inquiry)



Provincia di Palermo

Comune di Cefalù

PARTE I

Condizioni dell'Agricoltura.

NB. *Le risposte ai quesiti saranno tanto più gradite quanto più concise e particolareggiate.*

(1) **Quesiti.**	**Risposte.**
1°	
Territorio. — Qual è la superficie del territorio di codesto comune in ettari. In quante zone agrarie può suddividersi il territorio? Qual è approssimativamente l'estensione di ciascuna?	La superficie del territorio di Cefalù è di Ett. 5294,31.92. Essa si divide in tre zone: marina, pianura, e collina, montana — La prima ha l'estensione di Ett. 250 circa, la seconda di Ett. 2000 circa, la terza di Ett. 3044,31.92 circa —
2°	
Terreno. — Caratteri fisici e chimici del terreno in generale (se sciolto, tenace, umido, torboso, arido, sabbioso, ciottoloso, ecc. o calcareo argilloso, silicco). Indicare se si riscontrano diverse qualità di terreni, se queste sono egualmente distribuite; se negativamente accennare le qualità predominanti.	Nella composizione chimica del terreno domina generalmente il elemento calcareo; oppure nei terreni collinari domina la silice, come in alcune poche parti prevaglia l'argilla

Note: Figure A2 shows the first page of the Agricultural Inquiry for the city of Cefalu. The column on the left reports the question (Quesiti). The column on the right reports the answer of the mayor. For example the first question asks "What is the surface area of the city", "In how many areas the territory can be divided?" and "What is the extent of each area?" The mayor answers that the surface land of Cefalu is 52,943,492 sq.mt. and the territory is divided in three zones: 1) plain; 2) hills; 3) mountains. The first zone extends for almost 2,500,000 sq.mt.; the second for almost 20,000,000 sq.mt.; and the third for almost 30,443,492 sq.mt. The second question relates to the physical and chemical characteristics of the territory. This first part of the inquiry which is titled the Condition of Agriculture also reports information on the kind of crops produced, the sort of manufactures developed in the city, and so on. The second part of the Inquiry relates to the relationship between peasants and landlords, while the third part regards the moral conditions of peasants.

0.1 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 response function m_i^* given by (**??**).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

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

The key derivatives of this function are

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

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

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

The second-order condition shows that

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

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 $1 - \rho\left(m_i^*\right)/\frac{\partial \rho(m_i^*)}{\partial \omega} - \omega$, we can express a function

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

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 $\omega_i^* = \omega\left(x_i\right)$ where $\omega'\left(x_i\right) < 0$.