

Origins of the Sicilian Mafia: The Market for Lemons

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In this article, we study the emergence of an extractive institution that hampered economic development in Italy for more than a century: the Sicilian mafia. Since its first appearance in the late 1800s, the reasons behind the rise of the Sicilian mafia have remained a puzzle. In this article, we argue that the mafia arose as a response to an exogenous shock in the demand for oranges and lemons, following Lind's discovery in the late eighteenth century that citrus fruits cured scurvy. More specifically, we claim that mafia appeared in locations where producers made high profits from citrus production for overseas export. Operating in an environment with a weak rule of law, the mafia protected citrus production from predation and acted as intermediaries between producers and exporters. Using original data from a parliamentary inquiry in 1881–1886 on Sicilian towns, the Damiani Inquiry, we show that mafia presence is strongly related to the production of oranges and lemons. The results hold when different data sources and several controls are employed.

The Sicilian mafia is arguably one of the most infamous institutions in the Western world. After its first appearance in Sicily in the 1870s it soon infiltrated the economic and political spheres of Italy and of 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 murders, bombings, and embezzlement of public money have been observed during the last 140 years, the reasons behind its emergence are still obscure.

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In this article, we study the rise of the Sicilian mafia using a unique dataset from the end of the nineteenth century. The main hypothesis is that the growth and consolidation of the Sicilian mafia is strongly associated with an exogenous shock in the demand for lemons after 1800, driven by James Lind's discovery on the effective use of citrus fruits in curing scurvy. Given Sicily's already dominant position in the international market for citrus fruits, the increase in demand resulted in a very large inflow of revenues to citrus-producing towns during the 1800s. Citrus trees can be cultivated only in areas that meet specific requirements (such as mild and constant temperature throughout the year and abundance of water) guaranteeing substantial profits to relatively few local producers.¹ The combination of high profits, a weak rule of law, a low level of interpersonal trust, and a high level of local poverty made lemon producers a suitable target for predation. Neither the Bourbon regime (1816–1860), nor the newly formed government after Italian independence in 1861 had the strength or the means to effectively enforce private property rights. Lemon producers, therefore, resorted to hiring mafia affiliates for private protection and to act as intermediaries between the retailers and exporters in the harbors.

Our article presents a conceptual framework that links the institutional setting of Sicily in the early 1800s with the specific characteristics of the market and production of lemons following the international boom in export demand. The main implications of our conceptual framework are tested using two data sets from Sicilian towns and districts gathered from a parliamentary inquiry conducted between 1881–1886 (Damiani 1886) and an additional one from 1900 (Cutrera 1900). Our results indicate that mafia presence in the 1880s is strongly associated with the prevalence of citrus cultivation. No other crop or industry has a robust impact on mafia activity. The results continue to hold when we include several control variables, address a possible endogeneity issue using data on climatic conditions, and adopt two alternative dependent variables collected and coded from a later source.

Our article relates to several different strands of literature.² First, is the literature on the historical emergence of an “extractive” institution that hampers economic development and that can appear, at critical junctures, in a country's history (Acemoglu, Verdier, and Robinson 2004; Acemoglu and Robinson 2012). The mafia is undoubtedly an example of this, emerging during a critical period in the Italian history (i.e., Italian

¹ The high fixed costs were given by the sum of the cost of planting trees and waiting several years for them to grow, the need to build protective walls to keep thieves out, the system of irrigation, etc. Due to a large regional variation in the climate and soil suitability for growing lemons, the fixed costs of starting up a cultivation were very different across towns.

² Please see the working paper version for a more extensive review.

unification). Our analysis though, departs from this strand, since we emphasize the economic or *market structure*-related factors behind mafia organization rather than its political origins (such as the role played by a weak and oppressive Bourbon state in Sicily with substantial social inequalities, as discussed further later).

Our results are also strongly associated with research on the “curse of natural resources” (see van der Ploeg 2011 for a recent overview). We claim that the economic boom in international citrus demand, and the subsequent rise of Sicilian exports during the nineteenth century, are key factors behind the rise of mafia. This is also consistent with the more recent finding that windfall gains from natural resources are often associated with intense rent seeking and patronage politics. For instance, Xavier Sala-i-Martin and Arvind Subramanian (2003) argue that political corruption related to oil revenues hampered Nigeria’s growth for decades. Daron Acemoglu, Thierry Verdier, and James A. Robinson (2004) show how mineral wealth in Zaire allowed President Mobutu to buy off political challengers. A recurrent theme in this tradition is that resource windfalls might actually destabilize and deteriorate institutions, if key groups in the society believe that predation is more profitable than production (Mehlum, Moene, and Torvik 2006; Congdon Fors and Olsson 2007).

Another literature that our analysis connects with is the economic analysis of organized crime, which focuses on weak institutions, predation, and enforcement of property rights (Fiorentini 1999; Grossman 1995; Anderson 1995; Skaperdas and Syropoulou 1995; Skaperdas 2001). Herschel I. Grossman (1995) and Stergios Skaperdas (2001) both consider mafia as an alternative enforcer of property rights. Using a model with two actors (a self-governing community and mafia) and potential robbers, Skaperdas (2001) shows that in the absence of an enforcer of property rights, mafia can represent a sort of second best solution.³ Regarding the economic costs of organized crime, Peter Reuter (1987) and Diego Gambetta and Reuter (1995) analyze the effect of organized crime on the enforcement of cartel agreements in legal markets. Giuseppe De Feo and Giacomo Davide De Luca (2017) study how the mafia influenced the rise of the Christian Democratic Party.

Our article is most closely related to Oriana Bandiera (2003). Bandiera’s main hypothesis is that the increase in land fragmentation following the

³ The idea of a weak state and private protection is well illustrated by Don Calo’ Vizzini, one of the historical bosses of the mafia in Villalba. 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 strength, this is done by private individuals” (Montanelli 1949).

Bourbon-era land reforms (1816–1860) provided the breeding ground for mafia protection: a higher number of land owners increased the need for private protection. In Bandiera’s model, a key feature is that protection of one producer generates a negative externality on other producers, since it makes them more likely to become objects of predation. In an empirical section where she uses information from the Summary Report presented to the Italian parliament by A. Damiani (1886), Bandiera (2003) concludes that land fragmentation is a significant determinant of mafia presence.⁴

While our analysis also identifies landowners’ demand for private protection as the main process through which the mafia was mobilized, we explicitly focus on the role of revenues from citrus production rather than on land fragmentation. We improve on Bandiera (2003) by using the original Damiani survey (1883) where *pretori* (lower court judges) provided answers on the causes of crime. This allows us to extend the analysis from the 70 towns located in the western part of the island (Bandiera 2003) to almost all available Sicilian towns (143 in total) for which *pretori* provided answers. With this more complete sample, we find that *Land Fragmentation* indeed explains some of the variation in mafia presence. However, we also find that the most robust determinant of mafia activity is the production of citrus fruits.

Paolo Buonanno, Ruben Durante, Giovanni Prarolo, et al. (2015) also studies the importance of export markets (sulphur production) for mafia appearance using data from Antonino Cutrera (1900), a police officer in Palermo. Cutrera uses as sources Napoleone Colajanni (1900), Giuseppe Alongi (1886) and other data from local police offices to create a map of Sicily where the intensity of mafia activity is outlined for every city.⁵ Even though the data show figures on the level of mafia for most of the Sicilian cities at the beginning of the twentieth century, they refer to a period of almost 20 years later than the Damiani Inquiry. In the meantime, mafia extended its activity to cities that initially were unaffected and hence, we believe that data from Cutrera are more appropriate for understanding the evolution of the mafia phenomenon over time.⁶ Buonanno, Durante,

⁴ The information available in the Damiani Inquiry (see Footnote 1) has previously been used also by other scholars studying the origins of the Sicilian mafia. See for instance Colajanni (1885, 1895), Hess (1973), Arlacchi (1986), Catanzaro (1992), Gambetta (1996), Dickie (2004), and Lupo (2011).

⁵ Alongi (1886) and Colajanni (1900) themselves use the information available from the original inquiry. Therefore, their books represent a further elaboration of the results collected by the Damiani Inquiry, which could potentially add a bias in the data provided by Cutrera (1900).

⁶ This is supported by Gambetta (1996), who argues that in the period between the late 1870s and late 1890s, the mafia evolved quite markedly as a result of “economic and political conflicts among local groups, in connection with the institutional change that affected Italy between 1869–1890” (Gambetta 1996, p. 83).

Prarolo, et al. (2015) find that sulphur production has a strong association with mafia presence in 1900. Our results show that citrus production explained the presence of mafia holds even when we use Cutrera's data. In summary, we believe our focus on the importance of citrus production complements (rather than competes with) the findings in previous studies on the key roles played by land fragmentation and sulphur exports.

Our analysis is also related to a long tradition in anthropology, sociology, and history on the Sicilian mafia. The classical contributions include early investigations from Pasquale Villari (1875), Sidney Sonnino and Leopoldo Franchetti (1877), and Colajanni (1885, 1895). In recent years, the origin of Sicilian mafia has also been discussed in Gambetta (1996), John Dickie (2004), and Salvatore Lupo (2011).⁷ While Lupo (2011) and Dickie (2004) consider profits from the lemon industry in the Western part of the island as a pre-condition for the development of mafia, Gambetta (1996) focuses on the division of land resulting from the abolition of feudalism and other policies introduced by the Italian government after 1860 (i.e., the sale of land owned by the church and the crown before the unification). These policies opened a market for private protection, where the mafia acted as an incumbent.

The extensive literature discussed earlier provides plausible explanations for the rise of the Sicilian mafia. Yet, with the exception of Bandiera (2003) and Buonanno, Durante, Prarolo, et al. (2015), it is still difficult to understand why we observe a substantial variation in mafia activity across provinces experiencing very similar social, economic, and political conditions. If a weak state, a high regulatory burden, and a lack of public trust are the factors that matter for the development of mafia, then we should not observe any province variation. However, this is not the case. Across counties and villages exposed to the same environment there is a notable difference in mafia presence: organized forms of crime initially appeared only in a small number of localities and then spread all over the region. The combined hypothesis of a resource boom under a weak rule of law advanced here not only complements existing theories of mafia emergence (for instance those focusing on political factors), but is also consistent with the timing of the rise of the mafia. It also allows us to explain the cross-regional variation across Sicily.

⁷ See Lupo (2011) for a general history and Monroe (1909) for a description of the agricultural practices in Sicily at the time.

BACKGROUND

Historical and Institutional Setting

Sicily is the largest island in the Mediterranean and, given its central position within the Mediterranean trade routes, has always been considered a strategic location. Its history is marked by continuous foreign domination. Having been colonized by Greeks during early antiquity, it was subsequently controlled by Romans, Byzantine, Arabs, Normans, Spanish, and French. This long period of different foreign domination strongly shaped its social development. In fact, from the economic and institutional point of view, Sicily has been a lagging region in Italy.

The death of Fredrick II represents a turning point. In his effort to establish a modern and centralized state in Sicily, Fredrick II promulgated the Constitution of Melfi in 1231 which limited the jurisdictional power of princes and barons and empowered local magistrates who were responsible only to the king. As a result, princes and barons were responsible for civil justice only, while the king, through the appointment of local magistrates who remained in charge for one year, was responsible for criminal justice.

However, with the death of Fredrick II, a period of political instability followed which led to an increasing decentralization of power to feudal lords who *de facto* established a *mero et mixto imperio* in which the king delegated the political, administrative, fiscal, military, and judicial power to the feudal lord. Between 1583 and 1748 the Sicilian population under the direct jurisdiction of feudal lords increased from 44 to 58 percent (Benigno and Pharum 2001). The weak and distant governance of the Bourbons only increased the prevalence of insecurity, providing the barons with unrivaled domination over local affairs (Blok 1975). As a result, they took into their own hands the business of protection appointing their own militia to maintain law and order and to supervise other employees, such as stewards, field guards, tax collectors, etc. (Blok 1975).

The French, who reigned over the island from 1805 to 1815, tried to modernize this archaic system by introducing, in 1812, a new constitution which abolished the feudal privileges and the primogeniture. However, the reform did not achieve the desired results given the financial inability of small scale owners to invest in land, which was auctioned by parishes. As a result, the feudal structure was perpetuated and barons retained their power. Indeed, the reform may have made the situation worse. Beside feudal privileges, the reform also abolished civic, social, and judicial

duties of feudal lords, transforming the feud in a simple allodial land (Colajanni 1900).

The period 1812–1860 was marked by popular revolts and the spread of brigandage, during which several feudal lords fled, delegating the responsibility for the large estates to the *gabellotti*, who acted as mediators between landowners and the proletariat. From having been simple tenants (renting the land from landowners and subletting it to peasants), many *gabellotti* became landowners following the auctioning of feudal land after 1812. To maintain order and to avoid being plundered by brigands, they hired their own private guards, referred to as *campieri*. According to Colajanni (1900) the easiest way to hire a *campiere* was to recruit him from the *brigands*. Such an arrangement secured the estate against attacks from the *campiere*'s former companions. The coalition between *gabellotti*, *campiere* members of the *compagnia d'armi* (a private militia hired by the Bourbon government to maintain order in the countryside), and *brigands* triggered a system of corruption and intimidation such that landowners who could not afford to hire a *campiere* became the target of brigands and they had to pay (*componende*) to get back stolen goods and livestock. We argue that this adverse institutional environment provided the breeding ground for the organization which would become known as the *mafia*.

The Production of Lemons

According to available historical evidence, the bitter orange⁸ (*Citrus higaradia*) was introduced in Sicily by the Arabs in the tenth century. Because of favorable weather conditions, the plant spread quite quickly and bitter orange started growing wild almost all over the island. The island's hot coastal plains, together with the exceptionally fertile soil, containing a limestone base with heavy coatings of lava, were well-suited for growing citrus fruits. Lemon trees, however, have a very poor tolerance for extreme climatic conditions. In order to grow and develop they require temperatures between 13–30°C where the average temperature in Sicily is between 10–22°C. Flowers (and fruits) may die after few minutes of exposure to temperatures below 1–2°C. The intolerance to frost explains the geographic concentration and location of the trees on the island. Areas slightly above the coastline are more suitable because of the relatively low variation in daily (and annual) temperature than locations in the mountains, where the variation in temperature is greater.

⁸ The bitter orange is the wild plant which is normally used as a rootstock in groves of lemons and sweet orange.

In the absence of a strong national and international demand before the nineteenth century, lemons were mainly used for decorative purposes and for extracting essences. It was an aristocratic symbol of wealth. According to the detailed description of lemon production in Harold G. Powell (1908), the production of lemons in nineteenth century Sicily started with the sowing of bitter orange seeds in spring in small seed beds under the bearing lemon trees. After one year from the seeding, the small trees were transplanted in small clumps at a distance of about 60 cm from each other. When the plant reached a height of almost a meter, the tree was transplanted to the groves at 3–4 meters of distance from each other. The quality of the lemons largely depended on the quality of the soil. “The lemons produced on the lighter soils are rougher in texture and poorer in quality than the lemons from the heavier lands. They ripen earlier and are said to have poorer keeping qualities” (Powell 1908, p. 21). Because of the lower quality, lemons planted on lighter soils were generally used for citrates (a soft drink) and essences, whereas lemons produced on heavier soils were exported.

Every one to two years dead branches were pruned. In order to keep the soil moisturized, the land was generally turned over with a short, heavy hoe twice a year. At the same time, land was fertilized either with natural or, in some cases, with chemical fertilizers. Because of water needs (plants need to be watered at least once every week) irrigation was practiced in almost all groves using the *noria*, a sort of horse powered mill which pumps water from the well into terracotta tile channels where the water was carried to the heads of the rows. Because flowering trees are extremely sensitive to frost, in the regions where the temperature dropped below zero, a system of trellises were built over the grove. Walls and fences were also used to protect the plant against the hot wind from Africa (*sciocco*).

Despite being seasonal, efforts by producers made it possible to harvest lemons at least twice a year. Products were therefore able to stay on the market for the entire year: in October, fruit that had an early maturation were collected, whereas fruit that matured in February were left on the trees as long as possible in order to extend their supply. The last fruit to go on the market were those maturing in summer time, though they were considered of a lower quality. Lemons were harvested from the trees when they were still green. In winter time, the fruits were placed in boxes and kept in underground storage rooms, where the lemons could complete the maturation process (Lupo 1990).⁹

⁹ When an upcoming harvest of lemon promised to become particularly valuable, it would frequently attract thieves. Usually, very high walls were built around the groves and dogs were often employed to discourage potential bandits (Lupo 1990).

The type of contracts signed between landlord and tenant/gabellotto represented variations of the sharecropping contract. Sonnino (Lupo 1990) documents a quite advanced type of contract proposed by the baron Turrisi to his tenants, where the tenant was allowed to keep one-fourth of the total output. However, this share could go up or down depending on the quality of the groves. When groves were of particularly high quality, the tenant's share was around one-eighth of the final output and it would go up to one-half in case of lower quality. The landlord provided the trees, the water, and the fertilizers, and the tenant was responsible for farming the land and for soil preparation. Usually, the contract lasted between 6–8 years, which is the minimum number of years for a lemon grove to become fully productive.

Given the uncertainty associated with the sharecropping agreement, it was, overtime, replaced by simple employment contracts according to which the landlord hired an employee (*castaldo*) on a fixed wage. The *castaldo* was in charge of the lemon grove and of the workforce that permanently worked on the land. Besides the wage, the *castaldo* could sometimes be allowed to live in a small house close to the landlord, having wood and access to the vegetables and cereals cultivated on the land. In some cases, mainly after some years of experience, he could even attain the role of legal representative of the landlord when citrus fruits were brought to the market.

The workforce supervised by the *castaldo* was typically a squad of about 15 people (Lupo 1990). Their main responsibility was to pick fruits and then with extreme care, putting the fruits in baskets covered with blankets. Each basket, weighing around 8 kg (Lupo 1990), was then moved into a larger area where (usually) a woman cut the stalks and started a preliminary selection of the fruits. Later, these baskets were again carried to storage rooms from where they would be transported to the closest harbor. The essence industry was somewhat similar. However, the procedure to extract the essence and the oil from the fruits was more complex and required extremely skilled workers. Usually, the warehouses where this sort of processing took place were situated very close to the harbor, giving rise to a whole new neighborhood where employees organized their lives around the industry (Lupo 1990).

The key agents in the negotiations were the *sensali* (i.e., a broker that connected the lemon producers with the exporters in the harbor). Direct transactions between the producer and the retailer were infrequent. *Sensali* and landlords could negotiate price and quantity at harvest time when the quality of fruits could be evaluated (i.e., spot contract). Otherwise they could negotiate the entire yield of the grove before the ripening season (i.e., future contract). This type of contract provided more guarantees and

certainty to the producer. The spot contract was usually more popular among those producers who were in control of the market, who could rely on existing financial assets and who aimed at a higher price (Sonnino and Franchetti 1877).

When an agreement was reached, a fruit was placed on top of the gate leading to the grove to signal the end of the deal and that such a grove was protected by the *mafia* which supposedly guaranteed that the property and its fruits were free of damage (Lupo 1990). The *mafia* often also provided different forms of contract enforcement. In fact, because of the weak rule of law and the pervasive uncertainty associated with an environment dominated by informal relationships, *mafiosi* were often involved in the negotiations between brokers and producers, filling the legal vacuum and the lack of trust between different actors (Lupo 1990). According to Sonnino and Franchetti (1877), the power of mafia in the area of Palermo became particularly strong in the decade after the unification of Italy with the *mafia* being involved in all the aspects of productions from the simple appointment of the *castaldo* (generally associated to the mafia) to the choice of workforce, the negotiations and enforcement of contracts.

The Role of Citrus in the Sicilian Economy

Despite its underdeveloped economy, Sicily in the nineteenth century was a leading producer of wheat, olive oil, wine, and above all, citrus fruits. International demand for lemons started to increase from the late 1700s when lemons and, in particular, lemon juice became a standard preventive treatment against scurvy. Scientific support for the theory that consumption of citrus fruits cured scurvy was established by James Lind, a British naval officer and surgeon, in the latter part of the eighteenth century. Although Lind performed, according to many, the first controlled therapeutic trial of his time, it took time for his results to be publicly recognized and for his suggestions to be adopted by the Royal Navy. In the words of Jeremy H. Baron (2009): “The Sick and Hurt Commission agreed to supply all naval ships on foreign service with lemon juice, extended in 1799 to all the ships on the British coast. Between 1795 and 1814 the admiralty issued 1.6 million gallons of lemon juice. Sweet lemons were imported, especially from the Mediterranean region turning Sicily into a vast lemon juice factory.”¹⁰

When peace was restored in 1814, international trade began to grow again and the international demand for Sicilian lemons boomed. Table 1

¹⁰ For more insights on this see Baron (2009).

TABLE 1
EXPORTS OF LEMON JUICE AND FRAGRANCES FROM THE HARBOUR OF MESSINA

	1834		1837		1839		1840		1850	
	Lemons (Barrels)	Fragrances (Pounds)	Lemons (Barrels)	Fragrances (Pounds)	Lemons (Barrels)	Fragrances (Pounds)	Lemons (Barrels)	Fragrances (Pounds)	Lemons (Barrels)	Fragrances (Pounds)
Austria	158	27,452	24	14,068	282	54,902	72	57,416		67,720
Belgium	121	6,680	4	600	8	6,810	39	7,700		
Denmark	102	2,200	10	130	25	715	27	1,650	102	4,700
France	164	9,744	139	6,452	110	34,604	373	33,968	1,472	355,187
Germany	120	10,685	20	2,800	2	11,550	37	4,530	384	12,400
Great Britain	210	24,795	385	28,108	504	31,216	640	47,217	8,626	84,450
Italy	409	21,150								
Malta			84				55			
Netherland		2,200		1,720			6	10,200	268	17,470
Prussia				250						
Russia		13,453	64	2,000	128	5,750	210	15,720	9,190	12,400
Sardinian State	157	9,132		1,390	14	7,408	4	6,950		
Sweden	114					800				3,000
Turkey	180	1,001	10		31		203			
Tuscany	12	1,300				864	16			
United States	3	6,080		400	1	5,250	15	13,134	256	46,700
Total	1,341	114,722	740	57,918	1,105	159,914	1,967	198,485	20,707	624,977

Source: Battaglia (2003).

shows exports of barrels of lemon juice and lemon fragrances from the harbor of Messina throughout the nineteenth century.¹¹ Over the period 1837–1850, the total exports of lemon juice increased from 740 barrels to almost 20,707 barrels. The exports of lemon fragrances (in pounds) went from 57,918 pounds in 1837 to almost 624,977 pounds in 1850.

Production increased in the following years and the total surface area devoted to the citrus production went from 7,695 hectares in 1853 to 26,840 hectares in 1880 (Pescosolido 2010). The expansion was a direct result of the large returns associated with the demand for lemons. Will S. Monroe (1909) estimates that revenues were almost \$200 per acre (in 1908 U.S. dollars), providing a net profit of more than \$150 per acre.¹² Dickie (2004) describes the evolution of citrus production: “In 1834, more than 400,000 cases of lemons were exported. By 1850, it was 750,000. In the mid-1880s an astonishing 2.5 million cases of Italian citrus fruit arrived in New York every year, most of them from Palermo”. . . . “citrus cultivation yielded more than 60 times the average profit per hectare for the rest of the island” (Dickie 2004, p. 39).

From 1881–1885, the quantity of citrus exported went up to almost 949,000 quintals (2.5 million cases approximately),¹³ compared to 250,000 quintals in 1850 (Pescosolido 2010). In this period, a large share of production went to the United States. A combination of factors contributed to this outcome: a favorable international context, elimination of exports duties, and a considerable improvement in transportation. Table 2 shows figures on the lemon trade between Italy and the United States in 1898–1903. The left-hand side of the table shows the total Italian lemons exports and the relative percentage exported to the United States. The right-hand side shows the total U.S. lemons imports and the estimated percentage coming from Italy.¹⁴ The average quantity of lemons exported from Italy (and therefore mainly from Sicily) over this period amounts to 389 million pounds and the average share of fruit imported by the United States is almost 34 percent of the total Italian production.¹⁵ Calculating

¹¹ According to Sestini (1779–1784) the harbor of Messina was the leading port in Sicily for citrus fruits (Bottari 2006).

¹² Table A1 in the Online Appendix reports the change in the distribution of land devoted to lemon trees in the South of Italy between 1853 and 1885.

¹³ Quintals are converted in cases using the information from Powell (1908) according to whom 1,040 lemons weigh almost 120 kg (p. 29) and in a case there are almost 330 fruits (p. 10). As a result the average weight per case should be around 38 kg.

¹⁴ These data should be evaluated with some caution given that the total Italian lemons exports refer to the calendar year, while the total U.S. imports refer to the fiscal year (and the two do not coincide).

¹⁵ The leading role of Sicily for the U.S. lemons market continued until the end of the nineteenth century, when the production in Florida became substantial.

TABLE 2
TOTAL ITALIAN EXPORTS OF LEMON AND TOTAL U.S. IMPORTS

Year	Total Italian Exports			Total U.S. Imports		
	Quantity (Pounds)	Value (U.S. \$)	Exports to the U.S. (Percent)*	Quantity (Pounds)	Value (U.S. \$)	Imports from Italy (Percent)**
1898	325,504,061	3,419,486	41.3	133,374,950	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

Notes: *Percentages provided by Powell (1908).

** Percentages estimated using percentages on quantity exported from Italy above. For example, for the year 1900 the quantity exported to the United States 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 United States exceeds the total import into the United States. This is because Italian figures refer to the calendar year, while U.S. figures refer to the fiscal year.

Source: Powell (1908).

the total Italian exports to the United States, we estimate that almost 78.4 percent of the total U.S. lemons imports between 1898–1903 came from Italy. Besides the United States, the United Kingdom and Austria were two others large importers of lemons. Over the decade 1898–1908, the United Kingdom imported between 17.7 to 25 percent of the total Italian lemons exports, and Austro-Hungary imported between 14.4 and 22.8 percent (Powell 1908).

Powell (1908) provides a quite detailed account of the costs and profits associated to the production of lemons. He suggests that “*a fair estimate of the cost of producing a crop on a bearing grove, including cultivation, irrigation, fertilization, pruning, and other operations up to the time of picking, is from \$25 to \$60 per acre (that is, between 130 and 300 Italian lire per acre)*” (Powell 1908, p 33). The average wage of men during the picking season was equal to about 1.5 lire per day. Powell (1908) estimates that an average man could pick almost 5,000 fruits per day. The average price of 1,000 lemons in 1908 was around 17 Italian lire, providing a revenue per worker of almost 85 lire per day against a marginal cost in terms of wage payment of 1.5 lire.

Compared to lemons, the costs for olive trees and for grapes were much lower. According to the Damiani Inquiry (1886) olive trees in the nineteenth century were generally grafted trees and besides pruning and tilling, there were no other substantial costs related to irrigation or

protection from frost and wind. The situation was similar for grapes which developed from branches of grapevines that did not bring fruit in the previous year.

Estimates of the profit and costs associated with different crops are provided in the Damiani Inquiry by the mayor of Bisacquino according to whom the average annual cost for a hectare of wheat is lire 88 producing a profit of lire 200. The cost of 1,000 grape plants is 60 lire, providing a profit of lire 50. Finally, the cost of 1,000 lemon plants is 2,000 lire for a profit of lire 14,000. The profit from a hectare of land cultivated with olives is almost lire 400 (lire 98 per hectoliter), but no costs are reported. Therefore, the annual cost for a thousand plants of lemons is almost 33 times larger than the cost for a thousand plant of grapes, but the profit is almost 35 times higher than the profit from olives (the second most profitable crop). In summary, the fixed and marginal costs of lemon production were so much higher for lemon than for any other crop, but so was profitability.

The Rise of the Mafia

The origin of the word *mafioso* (and consequently *mafia*) is found in the Arab language where the word *marfud* used to mean *swindler* or *cheater* (Lupo 2011). In Italian, the original meaning of the word did not have a negative connotation, but simply characterized somebody who had *proud/courageous behaviour*. In fact, in the period before the unification of Italy—when the *proto-mafia* developed¹⁶ (Lupo 2011)—a *mafioso* was a man who had gained the respect of the local population by standing up against the brigands and the malicious crimes of the *campieri* and *compagnia d'armi* (Colajanni 1900). This respect from the local population contributed to a legitimization of the *mafioso*, who received the support of the population given that their crimes were justified when committed against delinquents who were even worse than he (Colajanni 1900). For this reason, almost everybody became directly or indirectly involved with the *mafia*, either by taking part in mafia activities or by covering and protecting those who committed such illegal acts (i.e., *omerta*). It became a general practice to define men who showed courage and resolution as *mafiosi*.

The institutional setting on Sicily, based on corruption, crime, and private protection continued after unification in 1860. The Italian government was unable to take effective control of the island or to enforce the rule of law. As a result, the pre-unification system persisted. Actually, the situation became even worse as the discontent of the people increased due

¹⁶ The proto-mafia refers to the perverse association between *gabellotti*, *campieri* and *compagnia d'armi* described in the section devoted to the Institutional Context.

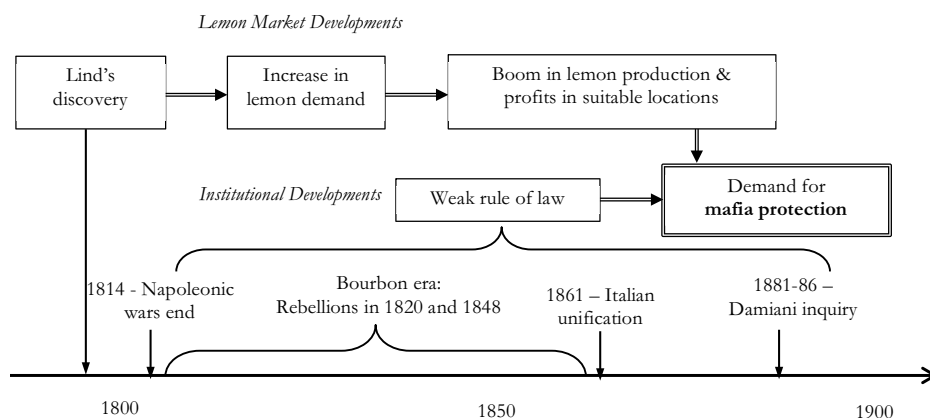


FIGURE 1
MODEL OF MAFIA EMERGENCE

Source: Authors' calculation.

to the policies promoted by the new government which led to the uprising of Palermo in 1863. According to Lupo (2011), this is the period during which the *proto-mafia* turned into the new kind of *mafia* that would play an important role in the subsequent history of Sicily.

At the same time, there is no perfect account of its appearance. 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.¹⁷ Mafiosi were recruited from very diverse occupations in society, including gabellotti, peasants, doctors, and politicians, and typically performed their daily jobs as an integrated part of society while also undertaking mafia activities. In the latter half of the nineteenth century, it is known that the key mafia activity was the protection of businesses, but we do not know if this was their original purpose (Gambetta 1996).

We argue that the combination of a generally weak rule of law, the boom in international demand for citrus fruits, and the risky and sensitive nature of lemon production together provided the breeding ground for the growth and consolidation of a mafia-type organization that could meet the challenges from producers, workers, and exporters in the lemon industry. Our schematic framework is shown in Figure 1 which features

¹⁷ The first evidence of the presence of a secret sect (referred to as *cosca*) we are aware of is a note in 1872 by Dr. Galati, a landlord owning a lemons grove just outside Palermo, who wrote about a "man of honor" who made increasing use of violence and extortion to force him to sell his lemon grove (Dickie 2004). When the Minister of Home Affairs learned about Galati's situation, he asked immediately for a written report from the chief of police in Palermo, and then ordered two parliamentary inquiries (the Bonfadini Inquiry in 1876 and later the Damiani Inquiry in 1881–1885) to better understand the economic conditions and the level of crime in Sicily.

two major types of developments relevant for understanding the rise of the mafia: one political and one specific to the citrus sector.

Despite the fact that the exact circumstances under which the mafia arose are not completely clear, we know that they thrived from offering protection to lemon and orange producers, from manipulating market prices, and from acting as intermediaries between producers and exporters. The protection services easily slipped into extortion where producers faced a direct threat of violence from the mafia if they refused to pay protection money. In line with standard models on the “hold-up problem,” it is natural to assume that in equilibrium, the mafia managed to extract rents for protection to an extent such that producers were almost indifferent about continuing their business or abandoning cultivation altogether.¹⁸

Why would the mafia focus on citrus production and not, for example, on the cultivation of wheat or wine? There are three basic reasons for the special importance of citrus fruit. First, the market value and profitability of citrus fruits was unusually high at the time, certainly much higher than for basic food crops like wheat. Second, the large fixed costs associated with irrigation and the long time before trees matured, made producers sensitive to predation. Third, the technology of predation on citrus fruits was relatively easy and cheap. According to Lupo (2011), a harvest of lemon fruits is very difficult to protect when the fruits are still on the trees. Picking a few hundred ripe lemons from a grove during a dark night should have been much easier for a thief than harvesting olives or grapes, not to mention wheat. As a consequence, lemon groves were more vulnerable to predation, despite the frequent construction of walls and the use of dogs and guards.

The straightforward hypothesis that arises from this framework is the following: In the period of the Damiani Inquiry in the 1880s, after several decades of a gradually growing production and exports of oranges and lemons in Sicily, the mafia should mainly be observed in local communities with citrus cultivation. More specifically, there should be a positive relationship between the dependent variable (mafia presence) and the main independent variable (citrus cultivation) in a cross-section of Sicilian local communities. Our framework suggests that natural control variables that might confound the analysis of a causal effect from citrus production to mafia presence are land ownership patterns and the production of other crops.

¹⁸ For a general analysis of the hold-up problem, see for instance Hart and Moore (1988).

DATA

Data from Damiani (1886)

The data used come from the Damiani Inquiry (1886),¹⁹ which was 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 (Member of Parliament) 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.²⁰

Data both at town and district level (*mandamento*)²¹ are collected for the seven provinces in which Sicily was split at the time of analysis (Caltanissetta, Catania, Girgenti, Messina, Palermo, Syracuse, and Trapani) for a total of 143 observations.²²

The section of the Inquiry that matters to our analysis is comprised of two parts. The first discusses the situation of the agricultural sector, with particular reference to tax burden, wages, the kind of crops produced, and the relations between peasants and landlords (i.e., tenancy contracts, fractionalization of land, etc.). Questionnaires were sent out to almost 357 mayors of whom less than half provided complete information.²³

The second part of the Inquiry provides information on the moral and social conditions of peasants. Questionnaires were sent to 179 *pretori* (lower court judges).²⁴ In this section, we focus on the type/level of crime in the region. The question asked was: “*What is the most common form of crime in the district? What are their causes?*” We coded as the

¹⁹ Caltanissetta is the only province missing in our sample because files for this province were no longer available in the archives.

²⁰ 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.

²¹ A *mandamento* is a judicial district of competence of the *pretore*, a lower court judge.

²² Syracuse became province in 1865 replacing Noto, which was a province at the time of the unification in 1861. Except for mafia activity, all the information regarding Caltanissetta comes from the Summary Report that Abele Damiani presented to the Parliament because the original handwritten copy of the Inquiry has never been catalogued in the Archive of State in Rome.

²³ For unknown reasons, differently from the other provinces, the folder for this section on the province of Caltanissetta never reached the Archive of State in Rome and therefore, it was never catalogued there. In order to get data for the agricultural conditions for this province, we use the information available from the Summary Report that Damiani presented to the Parliament, which has also been used by Bandiera (2003) and Buonanno, Durante, Prarolo, et al. (2015).

²⁴ There are much fewer *pretori* than mayors since the *pretura* is only present in larger provinces and one *pretore* often serves several towns.

dependent variable a binary dummy, *Mafia*, for whether the *pretore* of the town recognizes mafia as the most important source of crime in the district.²⁵

Bandiera (2003) and Buonanno, Durante, Prarolo, et al. (2015) opted for a different dependent variable: an ordinal variable for the intensity of mafia collected from the Summary Report that Abele Damiani sent to the Italian parliament on the basis of the original Inquiry. However, in the original Inquiry it emerges that very few *pretori* mention the intensity of mafia (less than one-tenth). Since the origin of the additional information is unclear, we prefer to use to the original document, which appears to be more accurate.²⁶

There are potential concerns with the data on mafia presence. First, the mafia could still be present in a district even though the *pretore* did not list it as the most common form of crime. It is indeed possible that some districts had mafia activity, even though the *pretore* did not report it as being a major crime. This problem may slightly affect our results.

Second, if *pretori* were themselves mafiosi and they were likely to understate the presence of mafia. The answer to this question is most likely to be no although there is no conclusive evidence in either direction. *Pretori* were directly appointed by the Minister of Justice by a *Regio decreto* (royal order) and any other aspect concerning their career was subject to an evaluation made by a committee of experts belonging to the local Court of Appeal. For the first ten years of their career, *pretori* changed district (*mandamento*) very often, which may have restricted their possibilities of connecting with the local environment.²⁷

Third, did the *pretori* have a general understanding of what the term *mafia* implies? This indeed appears to have been the case. In the 1880s, the word *mafia* was already used to indicate a criminal organization, at least since 1863, when a comedy titled “*I Mafiusi di la Vicaria*” was shown in Palermo. Also, in 1865, the prefect of Palermo (Filippo Gualterio) used the word *mafia* in a private document to identify the criminal organization and later, in 1871, mafia membership became a

²⁵ Data on mafia are available for 162 districts, but when merged with the independent variables the largest sample covers 143 districts.

²⁶ *Pretori* were lower court magistrates. Because of their role, their information on criminal activity can be considered the most indicative.

²⁷ From another question of the survey it emerges that many *pretori* complained about administering justice without the cooperation of locals, since in several trials witnesses did not testify because of mafia’s retaliation or collusion with the mafiosi. According to Pezzino (1990), the *pretore* in Bagheria said “*There is a tendency to deny the truth. People does not answer truthfully, they deliberately lie either because of mafia or because of money or because they are scared.*”

public law offence. We, therefore, believe it highly unlikely that there was only misinterpretation.²⁸

In Figure 2 we show the local distribution of mafia in our sample. On average, 36 percent of towns were strongly affected by mafia which means that almost 51 out of the 143 towns had mafia listed as the most common form of crime. Girgenti is the province with the highest presence of mafia, where 14 out of 17 towns have strong mafia presence. In Trapani, the mafia operates in 6 out of 15 towns, and in the Caltanissetta province in 7 districts out of 16. In almost one-third of the districts in Palermo (mainly those in the Conca d'Oro) and Catania provinces there is some form of mafia presence. Messina and Syracuse are the ones with the lowest incidence. These statistics (reported in Table 3) are also consistent with Colajanni (1885).²⁹

The independent variables we employed in the analysis can be divided into three groups. Colajanni (1885), Dickie (2004), and Lupo (2011) identify the profitable production of goods as important determinants of mafia presence. For this reason, the first group of independent variables includes: *Citrus*, *Wheat*, *Olives*, *Grape*, and *Sulphur*.³⁰ Given that the Inquiry does not provide information on hectares per crop for every *mandamento*, we decided to use a dummy variable (only recording whether the crop is predominant or not) in order to minimize the potential measurement error. The question we draw on for data in the Damiani Inquiry is: "*Which is the dominant crop produced in the city?*" Mayors listed more than one crop (for a few cities they also reported quantities) and, because of that, dummies are not mutually exclusive. Whenever possible this information has been double checked with Question 8 which provides a better picture on dominant crops.³¹ For example, for the town

²⁸ 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 misinterpretation of the question is likely to be distributed randomly across towns. It seems reasonable then to assume that the independent variable that we base our analysis on (whether a city/village produces citrus) is not correlated with the measurement error, providing us with unbiased estimates.

²⁹ Using information available in Damiani (1886), Colajanni identifies three macro-regions on the basis of economic and social conditions. The first region includes the province of Catania and Messina, where there were good economic and social conditions. The situation was slightly worse in the provinces of Syracuse, Trapani, Caltanissetta, and Palermo (the second region). The third region includes Girgenti, where both economic and social conditions were very poor, and there was a high level of crime.

³⁰ The full list reported in the Inquiry for all the Sicilian region has many more crops and plants, but we decided to include only three other than citrus on the basis on their relevance.

³¹ The reason we do not use average production (Question 8) as an explanatory variable is because this information is not available for several towns. In addition, the answer is not always comparable. Sometimes mayors report the monetary value of the production, while some others they report number of fruits per tree, or the number of fruits per hectare, or the number of trees per hectare.

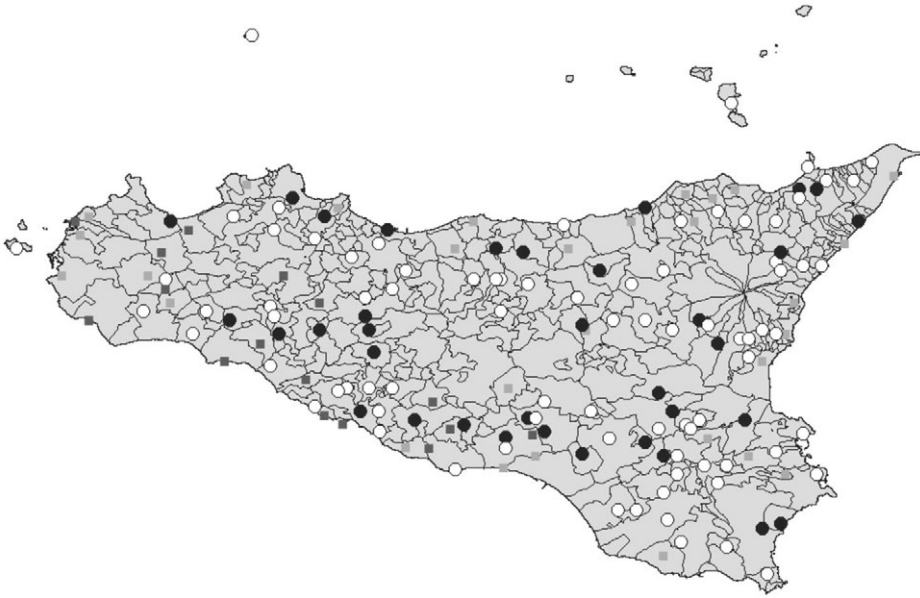


FIGURE 2
MAFIA AND NON-MAFIA TOWNS IN SICILY IN 1880S (DAMIANI SAMPLE)

Notes: Black circles represent municipalities with mafia and lemon production, white circles represent municipalities with no mafia and no lemon production, squares represents municipalities with no mafia and lemon production (light grey) and with mafia and no lemon production (dark grey).

Source: Damiani (1886).

of Agira, the mayor does not list citrus as a dominant crop, but then he argues that the total production of lemons is 400,000 units, providing an average revenue per hectares of about 592 lire.³² Therefore, we decided to recode the variable using this additional information.³³

Because data on citrus production plays a key role in our analysis, in a couple of instances where the Inquiry has ambiguous information (or no information is available), we used the data from Guisepppe Di Vita (1906) to complement the Damiani Inquiry.³⁴ Di Vita (1906) also provided data on sulphur mines, and we used that to code this variable. As argued by Colajanni (1885), sulphur mines are almost exclusively concentrated in the province of Girgenti (12 out of 17 towns). Outside Girgenti, there are five mines in the province of Catania, three in Palermo, and one in

³² To understand the economic relevance of this number, we can compare these revenues with the average revenues per hectare of wheat (which the main crop listed) which is 50 lire.

³³ Controversial cases are reported in the Read-me file.

³⁴ Di Vita (1906) is a geographical dictionary which reports statistical information about Sicilian towns in the nineteenth century. Part of the information reported in Di Vita is based on the Damiani Inquiry itself.

TABLE 3
DISTRIBUTION OF MAFIA AND AGRICULTURAL PRODUCTION ACROSS
PROVINCES IN 1881–1886

Province	Towns	Dominant Production of:					
		Mafia	Citrus	Grape	Olive	Wheat	Sulphur
Caltanissetta	16	0.437	0.368	1	0.471	1	0.684
Catania	22	0.318	0.567	0.913	0.435	0.826	0.226
Girgenti	17	0.823	0.4	0.611	0.388	1	0.458
Messina	25	0.24	0.542	0.869	0.652	0.522	0.036
Palermo	27	0.296	0.517	0.777	0.444	0.74	0.067
Siracusa	21	0.142	0.429	0.9	0.5	0.8	0
Trapani	15	0.4	0.4	0.8	0.6	0.8	0.133
Total	143	0.357	0.474	0.839	0.497	0.797	0.213

Notes: Numbers in the table refer to the share 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 one if the commodity is listed by the *pretore* as one of the key agricultural goods produced in the town, as explained in the text. Towns shows the number of municipalities per province for which we have data on mafia.

Source: Damiani (1886).

the province of Messina and Trapani. Wheat production is high in the entire province of Girgenti, but is low in the province of Messina. Grapes and olives are almost equally distributed across the island. Our summary statistics seem to match the picture provided in Colajanni (1885) quite well.³⁵

The second group of explanatory variables intends to control for the political status of each town and to assess the impact of policies implemented between 1812 and 1870 to increase the small-scale ownership of land. We consider three types of policies: (1) the abolition of feudalism and the auction/allocation of land to smallholders, (2) the *enfiteusi*, a perpetual lease that allowed farmers to use the land as if they were owner, and (3) the seizure of Church-ruled territories and the consequent land auctions, which occurred after Italy's unification. For each city, mayors provided information on the effectiveness of these policies in increasing land fragmentation. We use this information to code a dummy variable which is positive in case of reported effectiveness.³⁶ According to our data, highest effectiveness was reached in the Caltanissetta, Girgenti, and Catania areas, where the *latifund* was dominant. In the provinces

³⁵ Table A3 in the Online Appendix reports Summary Statistics.

³⁶ The dummy is coded one if the mayor argues that the policy has had an effect on the fractionalization of land.

of Palermo and Caltanissetta, the distribution of land appears to have been more fractionalized in relative terms. This was mainly due to the fact that the majority of cities in these provinces were ruled directly by the crown instead of the typical feudal hierarchy dominant in other provinces. As a consequence, fractionalization policies had little effect in increasing private ownership among peasants because land was already fractionalized.³⁷

Regarding land distribution, fractionalization is high in almost 50 towns and relatively low in 45 towns.³⁸ The questions asked were: “*What is the dominant scale of the plantation? And what is the fractionalization of land?*” The scale of plantation tends to be relatively high in Palermo, whereas in the other provinces its percentage is around 33 percent. Small-scale plantations are fairly common in all provinces, but particularly in Trapani, Messina, and Catania. Girgenti and Caltanissetta instead are the provinces with the lowest number of small-scale plantations.³⁹

Data from Cutrera (1900)

Cutrera (1900) is the second source of data on Mafia we use. Using information from police offices and newspapers, Cutrera drew a detailed map of the intensity of mafia in Sicily in 1900. Therefore, for each town, we code the intensity of mafia activity using an ordinal variable ranging from 0 (no mafia) to 3 (high intensity of mafia).⁴⁰ This alternative source presents some issues. First, this data source records the level of mafia in 1900, more than 20 years later than the Damiani’s Inquiry. During these two decades, it is reasonable to assume that the mafia spread for reasons different from the ones that determined its emergence (e.g., internal conflicts).⁴¹

Second, Cutrera’s data covers only towns with and without mafia for East Sicily (provinces of Messina and Syracuse). For the remaining provinces (i.e., Palermo, Girgenti, and Trapani), the author reports only towns with mafia, without providing any information about the ones missing, that is, whether they are not mentioned because there is no mafia or

³⁷ Information on the actual distribution of land, ownership and tenancy contracts are provided in Section 2 of the Inquiry.

³⁸ The Damiani Inquiry (1886) is the source for these data, except for Caltanissetta, whose data come from Damiani’s Summary Report. Table A4 in the Online Appendix shows summary statistics.

³⁹ Most of the time, mayors answered that a large, a medium, and a small scale are dominant, therefore the sum of the three variables is larger than one.

⁴⁰ The dependent variable is coded in the following way: 0 if there is no mafia; 1 if there is low intensity mafia; 2 if there is a medium intensity mafia; 3 if there is a high intensity mafia.

⁴¹ See Gambetta (1996) for a discussion of the diffusion of mafia in the period 1880–1900.

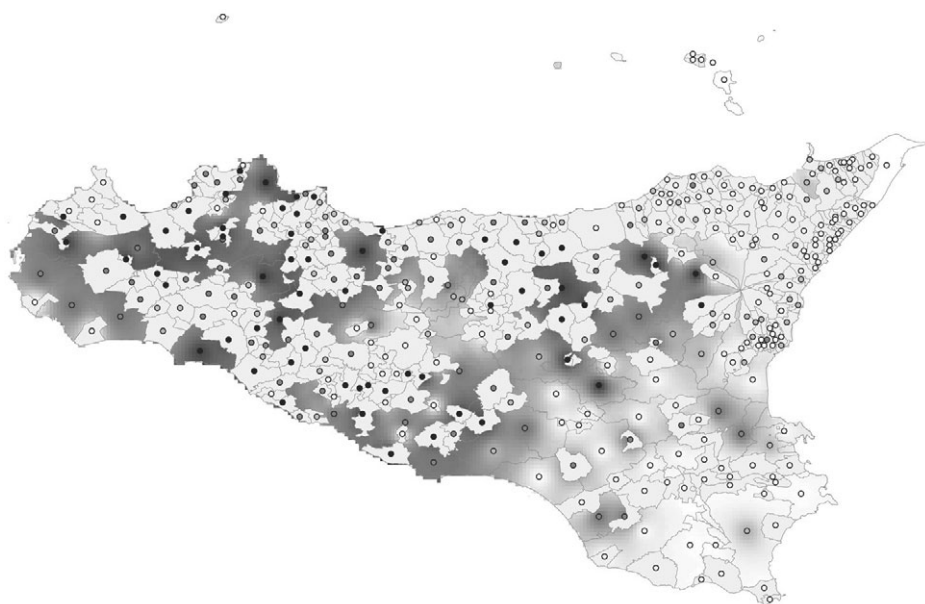


FIGURE 3
MAFIA INTERPOLATED USING AN IDW

Note: Circles denote municipalities with high intensity of mafia (black circles), average intensity (greyish circles), and no mafia (white circles). The intensity of mafia after the interpolation is denoted on a same scale from 0 to 3 with white areas denoting towns with no mafia and black areas denoting regions with high intensity of mafia.

Source: Cutrera (1900).

because there is no information available. Because we cannot disentangle these two motivations, we decided to use two different coding strategies: (1) We code a variable of mafia intensity for towns reported in the map following Cutrera's coding rule, and (2) we use the spatial distribution of mafia in order to interpolate levels of mafia activity for towns where information have not been reported. We assume that towns that are in the neighborhood of others with a high mafia intensity are likely to be also affected by some sort of mafia activity. As a result, we can use an inverse distance weight interpolation technique to interpolate data for those towns for which there is no information on mafia activity. The level of mafia activity depends therefore both on the intensity and on the distance from neighboring cities where mafia is present. The results of this interpolation are shown in Figure 3. White areas denote towns with a low intensity of mafia (between 0 and 0.69), whereas black areas denote towns with a high intensity of mafia (between 2.25 and 3).

We merge this source with data on crop suitability from the FAO GAEZ (Food and Agriculture Organization – Global Agro-Ecological

Zones).⁴² We collect data for the three main crops produced in Sicily (lemon fruits, olive, and wheat). Data on grape suitability and sulphur is not provided by the FAO GAEZ. For this reason we integrate data from the FAO GAEZ with dummies on grape production from Damiani (integrated with data from Di Vita 1906) and sulphur mines from Di Vita (1906).⁴³

To minimize the risk of omitted variable bias, we use a large set of climatic and geographical indices related to factors which may affect agricultural production, and hence mafia. From the FAO GAEZ, we include indices for the median altitude, inland water scarcity, and natural soil fertility (natural soil nutrients). We complete the list of independent variables by adding: (1) spatial data on distance from the coast (NASA Ocean Biology Processing Group)⁴⁴ and (2) data on soil neutrality (pH) from the FAO Geonetwork.⁴⁵

ECONOMETRIC ANALYSIS

Specification

We consider a simple model in which the probability of mafia depends on the prevalence of citrus production and other covariates. The baseline ordinary least square (OLS) model to be estimated can be written as:

$$M_{i,p} = \beta_0 + \beta_1 \text{Citrus}_{i,p} + \beta_2 Z_{i,p} + \eta_p + \mu_{i,p}. \quad (1)$$

The main explanatory variable is an indicator for citrus production in the municipality i and province p , which we denote by $\text{Citrus}_{i,p}$. Our key hypothesis is that $\beta_1 > 0$. $Z_{i,p}$ represents a set of control variables suggested in our theoretical framework that may affect the probability of mafia such as the presence of other crops, land fragmentation, the degree of trust citizens have in the law, or the peripherality of each town. Finally, η_p represents provincial fixed effects that may be correlated with the error term $\mu_{i,p}$.

⁴² Global Agro-Ecological Zones - GAEZ: <http://www.fao.org/nr/gaez/en/>.

⁴³ Table A5 in the Online Appendix provides descriptive statistics for the dependent variable and the most important independent variables.

⁴⁴ <http://oceancolor.gsfc.nasa.gov/DOCS/DistFromCoast/>.

⁴⁵ Geo-Spatial data from the FAO GeoNetwork are available from: <http://www.fao.org/geonetwork/srv/en/main.home>. As expected soil PH is quite largely correlated with soil fertility (correlation = 0.5) given that it captures one of the main factor of soil fecundity.

TABLE 4
MAFIA OLS MODEL

	Dependent Variable: Mafia (in 1880)					
	(1)	(2)	(3)	(4)	(5)	(6)
Citrus	0.201** (0.086)	0.224*** (0.085)	0.225** (0.086)	0.213*** (0.076)	0.200** (0.078)	0.219*** (0.082)
Grape	0.030 (0.105)	0.136 (0.105)	0.124 (0.105)			
Olive	0.006 (0.091)	-0.037 (0.089)	-0.027 (0.092)			
Wheat	0.039 (0.095)	-0.028 (0.094)	-0.012 (0.095)			
Sulphur	0.198 (0.125)	0.022 (0.119)	-0.071 (0.127)			
Fractionalization policies	0.271*** (0.085)	0.262*** (0.087)	0.242*** (0.087)	0.252*** (0.086)	0.247*** (0.088)	0.268*** (0.091)
Large scale plantation	0.251*** (0.090)	0.257*** (0.086)	0.283*** (0.086)	0.255*** (0.083)	0.258*** (0.088)	0.251*** (0.087)
Population density					0.041 (0.079)	
High land fractionalization						0.072 (0.082)
Provinces fixed effects	No	Yes	Yes	Yes	Yes	Yes
R-squared	0.160	0.280	0.311	0.288	0.281	0.261
Observations	119	119	109	120	119	112
Provinces	All	All	Without Caltanissetta	All	All	All

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

Source: Authors' calculation.

Results Using Data from Damiani

We present the OLS estimates with mafia presence in the 1880s as the dependent variable in Table 4. We start by estimating a simple model, where mafia presence in the 1880s depends only on variables capturing the economic activity of the town, the dummy for *fractionalization policies*, and a dummy for large scale production given that large fixed costs related to investment in irrigation (*norie*) were much more likely to be sustained in towns where the scale of the plantation was relatively large (because of the decreasing cost per hectare), making producers more vulnerable to a potential loss due to extortion. We then proceed by introducing additional variables to control for observables.

In Column 1, the diffusion of the mafia significantly depends on citrus production. At the mean, the production of citrus increases the probability of mafia by 20 percent. The *Fractionalization Policy* dummy has also a strong significant effect on the probability of mafia presence, as does the dummy for large scale plantations which increases the probability of mafia presence by 25 percent. The latter reflects the perverse system of corruption and private protection which developed in the latifund as outlined in the institutional setting. In Column 2, we re-estimate the same model, but controlling now for province dummies to capture regional fixed effects: the same results still hold. In Column 3, we drop the observations for the province of Caltanissetta in order to detect any potential bias due to a different source of data. The estimated effects, in Column 3, are almost unchanged as are the coefficients and the t-statistics. In Column 4, we change specification by dropping the non-significant variables (to prevent an excessive reduction of the degrees of freedom) and again the results still hold. In Column 5, we use *population density* which is normally used as a proxy of income per capita and urbanization and the variable is not significant.

Bandiera (2003) argues that the effect of fractionalization policies occurs through the increase in the number of small-owners private property which made them vulnerable. At the same time, it is also possible that the dummy for fractionalization policies captures the absence of public providers of protection (i.e., a landlord) after the abolition of feudalism given that the aim of these policies was to limit the power of landlords by redistributing land to private owners. In fact, even though private ownership did increase, the resulting fractionalization in former feudal cities never exceeded that in crown-ruled cities where land has always been fractionalized. Therefore, to better assess the effects of this control, in Column 6 we also include a dummy variable for the degree of land fractionalization. The dummy variable *high land fractionalization* turns out to be not significant. As argued earlier, though fractionalization policies in former *feudal cities* had some effects in increasing private ownership, the overall effect was not large enough and land distribution was not more fractionalized than in former *crown-ruled cities*. As a result it is possible that the consequence of these fractionalization policies was to release on the open market a new commodity: the armed guards that used to work for the feudal barons (Sonnino and Franchetti 1877).

The set of covariates specified in Column 6 represents our preferred specification. In this model, the presence of mafia is significantly

determined by the citrus production, the effect of policies for private ownership, and by the scale of the plantation.⁴⁶

As discussed earlier, our hypothesis is that the positive shock on the demand for citrus, following Lind's discovery of the beneficial properties of citrus fruits in the treatment of scurvy, together with a comparative advantage in climatic conditions, gave Sicily a dominant position in the market for lemons. This in turn resulted in larger profits for some Sicilian producers in a weakly institutionalized setting, which created a demand for the mafia. Both the historical evidence of exports of citrus from Sicily and of prices of lemons in the nineteenth century, provided in Section 3 and OLS results in Table 4 support this hypothesis.

To provide additional robustness to our results, we re-estimate using an Instrumental Variable estimator (IV).⁴⁷ The instrument for citrus is obtained using data on thermal regimes from FAO GAEZ. Among the several indicators on thermal regimes provided by the FAO GAEZ, we chose a measure of the frost-free period.⁴⁸ GAEZ estimates of climate and agro-climatic analysis are based on mean climatic data for the period 1961–1990. Therefore, we assume that large changes in climatic conditions have not occurred during the last two centuries.

The reason for using data on the risk of frost as an instrument for lemons is related to the minimal tolerance of the lemon tree to frost. The probability of frost, therefore, represents an important fixed cost for the production of lemons, and we assume that lemon production will occur in towns characterized by a mild climate characterized by a shorter frost period and a lower seasonal variation.⁴⁹ High profits generated and

⁴⁶ In Table A6 in the Online Appendix, we perform a series of robustness checks entering to our preferred specification additional controls for: (1) the distance from Palermo and Mazzara del Vallo (to capture the distance from a well-known mafia-base center and the distance from the town where lemon plants were originally introduced by the Arabs), (2) a dummy variable *Feudal* to test whether this political system often associated with patronage and kinship relations matter, (3) the distance from the nearest railway station (collected from Di Vita 1906) as a measure of peripherality, (4) dummies for whether citizens trust, mistrust, or do not care about the law (the excluded group is whether they fear the law) from Damiani (1886), and (5) the length of the tenancy contract which may be correlated with property rights. Among these variables, the length of the tenancy contract is the only one which results to have a statistical significant effect on mafia. However, this effect hardly impacts on the coefficient on *lemons*.

⁴⁷ The IV estimator provides a source of exogeneity to our dummy for citrus fruits dealing with potential issues with the OLS estimator. In addition, an IV estimator, providing more variance, will also allow us to overcome the problem that the independent variable is a dummy, given that the estimator exploits the covariance between the dependent variable and the excluded instrument.

⁴⁸ The frost-free period dataset refers to the number of days during the year with low risk of early and late frosts (days with $T_{mean} > 10^{\circ}C$). This dataset is the result of the calculation procedures of GAEZ Module I (climate data analysis and compilation of general agro-climatic indicators).

⁴⁹ In terms of our model, the risk of frost would imply a relatively high *bi*.

more protection against potential losses required from local producers, play a key role on the level of mafia activity. Support for the use of this instrument is provided by the mayor of Bisacquino, who reports that the production of citrus is almost absent in his town because of adverse climate conditions.

The equations we estimate can be written as follows:

$$Citrus_{i,p} = \pi_p + \gamma_1 Frost_{i,p} + \beta_2 X_{i,p} + \mu_{i,p} \quad (2)$$

$$Mafia_{i,p} = \gamma_p + \beta_1 Citrus_{i,p} + \beta_2 X_{i,p} + \varepsilon_{i,p}. \quad (3)$$

The first stage regression (Equation 2) predicts the probability of lemon production, which then, in the second stage, affects the probability of mafia (Equation 3).

In Table 5, Panel A shows the results for the second stage regression.⁵⁰ The coefficients and levels of significance for the excluded instrument, together with diagnostic tests are also reported. In Column 1, we report estimates for the IV and all variables in the baseline model are statistically significant at least at the 5 percent level. *Citrus* increases the probability of mafia presence by almost 54 percent, *fractionalization policies* by almost 24 percent, and *large-scale plantations* by almost 22 percent. Diagnostic tests confirm the relevance of the instrument. The Cragg Donald F-statistics is well above critical values for weak instruments and the partial F-statistics from the first stage is well above ten, normally considered the threshold value for relevance of instruments with one endogenous variable (Stock and Yogo 2005). We also report estimates from using an IV Probit: results (in Column 2) are consistent with the IV estimates.

Results Using Data from Cutrera (2000)

To test further the robustness of our empirical specification, we run the same regressions but using data on *mafia* from Cutrera (1900), merged with independent variables on crops suitability from the FAO/GAEZ.

⁵⁰ IV results depend on whether the exclusion restrictions is satisfied or not. For example, it may be possible that frost also affects other crops. For this reason we tried a series of falsification tests in order to test whether there is a significant effect of frost on other crops (i.e., olive, grape, almond, wheat, etc.). Overall we do not find any significant effect of frost on these other crops.

TABLE 5
2-SLS ESTIMATES

Panel A		
Dependent Variable: Mafia (in 1880)		
Second Stage Estimates		
Estimator	IV	IVPROBIT
Citrus	0.539** (0.210)	1.836*** (0.394)
Fractionalization policies	0.240*** (0.091)	0.828** (0.336)
Large scale plantation	0.220** (0.087)	0.750** (0.324)
Province dummies	Yes	Yes
Observations	120	120
R-Squared	0.171	
First Stage Estimates for Citrus		
Excluded instrument: Mean free-frost period	0.005*** (0.001)	0.005*** (0.001)
Anderson LR statistics	20.39	
Cragg-Donald F-statistics	20.372	
Stock and Yogo 10 percent critical value	16.38	
Partial F-statistics	22.14	
Endogeneity test (p-values)	0.078	

Notes: The estimator is an IV in Column 1 and IVPROBIT in Column 2. We run a two-stage least square estimations with *Citrus* as the endogenous variable and mean free-frost period as the excludable instrument. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' calculation.

In Table 6 we show the results. The dependent variable used in the first three columns is the mean intensity of mafia using Cutrera's coding rule. Because of that, the sample is confined to the 289 towns for which the author provides data. The first model is estimated using an ordinal probit. The variable proxying the suitability for citrus is significant at 1 percent level. In Column 2, we re-estimate the same model using an OLS estimator, and in Column 3, we control for spatial correlation of the error terms using Timothy Conley, Christian B. Hansen, and Robert E. McCulloch, et al. (2008) spatial HAC estimator. For both models, the variable for suitability for citrus turns out to be significant at 5 percent level at least and its standard error decreases quite significantly, when we control for spatial correlation.

TABLE 6
MAFIA INTENSITY AND CITRUS SUITABILITY

	Dependent Variable:				
	Mafia Intensity (Cutrera)			Mafia Intensity (IDW)	
	Oprobit (1)	OLS (2)	Spatial OLS (3)	OLS (4)	Spatial OLS (5)
Citrus suitability (rain fed)	2.762** (1.137)	1.816** (0.788)	1.816*** (0.357)	1.156*** (0.440)	1.156*** (0.348)
Olive suitability (rain fed)	0.216 (1.252)	0.181 (0.966)	0.181 (0.927)	0.424 (0.538)	0.424 (0.658)
Wheat suitability (rain fed)	1.281 (1.380)	0.808 (1.015)	0.808 (0.927)	-0.442 (0.570)	-0.442 (0.741)
Grape (dummy)	0.077 (0.235)	0.014 (0.173)	0.014 (0.106)	0.000 (0.106)	0.000 (0.058)
Sulphur (dummy)	0.228 (0.235)	0.161 (0.175)	0.161 (0.181)	0.070 (0.107)	0.070 (0.092)
Distance from the coast	-2.521*** (0.483)	-1.721*** (0.351)	-1.721*** (0.505)	-1.214*** (0.194)	-1.214*** (0.257)
Soil productivity	-0.068 (0.595)	0.014 (0.395)	0.014 (0.379)	0.135 (0.212)	0.135 (0.216)
Altitude	0.876 (0.830)	0.566 (0.594)	0.566* (0.293)	0.432 (0.292)	0.432* (0.230)
Precipitation	-3.356** (1.458)	-2.165** (1.040)	-2.165** (0.875)	-1.642*** (0.617)	-1.642** (0.768)
Inland water (basin)	-4.487*** (1.096)	-2.478*** (0.638)	-2.478*** (0.540)	-0.714** (0.316)	-0.714*** (0.245)
Land nutrients	-0.180 (0.804)	-0.107 (0.496)	-0.107 (0.401)	-0.201 (0.239)	-0.201 (0.224)
Land workability	1.209* (0.729)	0.875* (0.524)	0.875*** (0.193)	1.100*** (0.287)	1.100*** (0.149)
Province dummies	Yes	Yes	Yes	Yes	Yes
R-squared		0.420	0.809	0.665	0.906
Observations	235	235	235	280	280

Notes: Robust standard errors in parentheses for Columns (1), (2), and (4). Conley (2008) robust spatial standard errors in parentheses for Columns (3) and (5). Distance cutoff in Columns (3) and (5) equal to 20 km. We tried different cutoff levels and standard errors decreases when we increase the cutoff. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' calculation.

In Columns 4 and 5, we change the dependent variable and use our interpolated measure of mafia intensity, which allows us to expand the sample to the entire population of Sicilian towns. We regress this new measure of mafia intensity against the same independent variables using an OLS (Column 4) and a spatial HAC estimator (Column 5). In both models, citrus suitability has a significant and positive effect on the intensity of mafia. In addition, the coefficient on citrus suitability remains quite

stable (close to 1.2) compared to the other smaller sample. Overall, one standard deviation in suitability to citrus increases the intensity of mafia by almost 1.3 percent.

CONCLUSIONS

Understanding how socially inefficient institutions arise and persist is a key issue in economic history. In this article, we have investigated the origins of the Sicilian mafia. Unlike existing works that emphasize political and historical factors, our analysis identifies the importance of an exogenous shock in the international demand for lemons. The extraordinary revenues that certain producers received, combined with the general political insecurity and weak rule of law, provided an ideal breeding ground for the emergence of a mafia that provided protection and acted as intermediaries.

The empirical analysis, using data from two sources, shows that the presence of mafia is strongly related to the production of citrus fruits. The results continue to hold when we include several control variables, address a possible endogeneity issue and employ two different dependent variables. We believe that our results contribute to shedding light on the emergence of one of the most harmful economic institutions in Europe during the modern era.

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