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ABSTRACT

This research attempts to explain the large differences in the early diffusion of the mafia across different areas of Sicily. We advance the hypothesis that, after the demise of Sicilian feudalism, the lack of publicly provided property-right protection from widespread banditry favored the development of a florid market for private protection and the emergence of a cartel of protection providers: the mafia. This would especially be the case in those areas (prevalently concentrated in the Western part of the island) characterized by the production and commercialization of sulphur and citrus fruits, Sicily's most valuable export goods whose international demand was soaring at the time. We test this hypothesis combining data on the early incidence of mafia across Sicilian municipalities and on the distribution of sulphur reserves, land suitability for the cultivation of citrus fruits, distance from the main commercial ports, and a variety of other geographical controls. Our empirical findings provide support for the proposed hypothesis documenting, in particular, a significant impact of sulphur extraction, terrain ruggedness, and distance from Palermo's port on mafia's early diffusion.

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I. Introduction and motivation

There is growing interest among social scientists in understanding the workings of organized crime and its profound socio-economic consequences (Jennings, 1984; Fiorentini and Peltzman, 1997; Skaperdas, 2001). Much of this research has focused on the study of mafia-type criminal organizations in various parts of the world including southern Italy, Russia, USA and Japan (Gambetta, 1996, 2009; Varese, 2005, 2011; Mastrobuoni and Patacchini, 2011; Pinotti, 2011). Despite the increasing number of theoretical and empirical contributions on the nature and structure of these organizations (Gambetta, 1996; Skaperdas, 2001), the economic origins of the mafia(s) remain relatively unexplored, limiting our understanding of the phenomenon and of the large differences in the presence of the mafia(s) across and within countries.

This paper attempts to fill this gap by empirically investigating the determinants of the emergence of the Sicilian mafia, the oldest and most notorious example of this sort of organizations, which dates back to the nineteenth century and which has had a considerable and long-lasting effect on the socio-economic development of Sicily[1]. In particular, this research aims at shedding light on one of the most puzzling questions about the history of the Sicilian mafia: why did the mafia emerge in the western part of Sicily but not in the eastern part of the island, where, in fact, it remained virtually absent until the second part of the twentieth century[2].

The hypothesis advanced and tested in this paper is that the mafia - which following Gambetta (1996) we intend as an industry of private protection - emerged after the demise of Sicilian feudalism, in a context characterized by a severe lack of state property-right enforcement and low interpersonal trust, in response to the rising demand for the protection of goods and economic transactions. In particular, the mafia would thrive in areas prone to the production and commercialization of sulphur and citrus fruits, Sicily's most valuable export commodities which, both in the production and transportation stages, were especially vulnerable to predatory attacks. In fact, the steady rise in the demand for these goods on the international markets over the course of the nineteenth century, determined a large and durable positive shock to the value of protection in these areas. In sum, we argue, the geographic fitness for sulphur extraction and citrus fruits cultivation, combined with the exogenous rise in the value of these commodities, favored the development in certain areas (prevalently con-

[1] Lupo (1993)and Dickie (2005) provide an excellent account of the history of the Sicilian mafia and of its expansion to other regions of Italy and to the United States.With regard to the economic and non-economic costs of the mafia, Pinotti (2011) examines the case of the diffusion of the mafia in the southern Italian regions of Apulia and Basilicata over the last thirty years; he estimates that, over this period, the presence of the mafia determined a 16% decrease in GDP per capita and a parallel sharp increase in murder rates.

[2] This aspect has been discussed by historians, sociologists and economists alike. Some examples include Lupo (1993); Gambetta (1996) and Sylos Labini (2003).

centrated in the Western part of the island) of a florid market for private protection and the emergence of the mafia, a cartel of providers who took control of that market.

Based on this argument one would expect higher incidence of mafia activities in : i) areas characterized by greater sulphur reserves; ii) in areas with more suitable agro-climatic conditions for the cultivation citrus fruits (or similarly valuable crops such as olive). Furthermore, the presence of the mafia would be more marked in: iii) communities situated in strategic locations on the routes connecting production sites to commercial ports (as protection intervened in the transportation stage as well); and in iv) communities located in more remote and mountainous locations where the presence of state police forces, and the protection offered by them, was more limited.

To empirically test these predictions we combine historical data on the presence of the mafia over the second half of the nineteenth century in Sicilian municipalities with high-resolution data on geomorphological and climatic conditions, crop-specific soil suitability, presence of sulphur reserves, proximity to the main roads, distance from the main commercial ports, and a variety of other geographical and demographic controls including terrain ruggedness, proximity to rivers and other waterways, population density, etc.. The use of such a unique dataset at the municipality level is especially useful to to investigate within-region variation in the diffusion of the mafia.

Our empirical findings provide support for our main hypothesis: exogenous variations in the demand for protection - as predicted by the geographical fitness for high-value mining and agricultural productions - contribute to explain geographical differences in the early incidence of the mafia, especially between east and west of Sicily. In particular, the existence of sulphur reserves, terrain ruggedness, and proximity to Palermo (by far the most important Sicilian commercial port at the time) are good predictors of the intensity in mafia's activity in the period under consideration.

This research relates, *in primis*, to the relatively small but growing body of literature on the socio-economic foundations of organized crime and mafia-type organizations. In particular, it integrates the only two empirical studies that have looked at the historical emergence of the Sicilian mafia. The first one is by Bandiera (2003) whom, like us, subscribe to Gambetta's original view of the mafia as an industry for private protection. Within this framework, Bandiera uses a common agency model to formalize the idea that the mafia's should have been historically more active in towns were land was more fragmented[3], and finds support for this hypothesis using qualitative data from a 1881 parliamentary survey on

[3] The argument is based on the idea that the purchase of protection from a single landowner imposes a negative externality on the other ones (since it deflects thieves on their properties), and that, hence, landlords will be competing with each other to acquire protection and to exclude others from it. By increasing the number of competing landlords, land fragmentation should increase mafia's potential profits.

77 municipalities in western Sicily. The second contribution is by Pazzona (2010), who, in line with the view of historians such as Lupo (1993) and Pezzino (1995), examines the role of the mafia in the socio-economic struggles between emerging classes which followed the demise of Sicilian feudalism. His empirical analysis, performed on a somewhat larger sample than that used by Bandiera, documents that the mafia was more likely to emerge where the competition by new social actors was harsher, particularly in areas where land value was higher, land holdings larger, population smaller, and fewer peasants owned the land. Although these studies certainly contribute to a better understanding of the various factors involved in the emergence of the mafia, the data and the scope of the empirical analysis are, in both cases, limited to the West of Sicily, and hence less than ideal for the study of difference in the incidence of the mafia between eastern and western part of the island, which our analysis focuses on.

More in general, the results of this research complements the literature on the emergence of persistent social institutions as the consequence of some kind of "historical accident" (Acemoglu et al., 2001), which in this case, we argue, would be represented by the sudden rise in the trade of Sicilian commodities whose impact on the emergence of the mafia would play through the interaction with the island's natural endowements.

Finally, although geographical characteristics *per se* are not the focus of our study, the findings we present can also be interpreted in the context of the debate on the long-term impact of geography on socio-economic development. Previous research has documented that the environment can influence economic performance directly, through its effect on health and agricultural productivity (Landes, 1998; Sachs and Malaney, 2002), and indirectly, by setting the conditions in which social norms and political institutions have formed (Sokoloff and Engerman, 2000; Easterly and Levine, 2003; Durante, 2009; Nunn and Puga, 2009; Michalopoulos et al., 2010) or by defining environmental constraints to population growth (Galor and Weil, 2000). The evidence presented here suggests that, under given economic circumstances, geographic characteristics may have contributed to the emergence of particular forms of social organizations (criminal ones in this case) which have persisted overtime and continue to have non-neglibile socio-economic effects.

The remainder of the paper is organized as follows. In section 2 we provide some historical background on nineteenth century Sicily and discuss the issue of protection in that context. In section 3 we describe the data and discuss our emprical strategy. In section 4 we present our empirical findings before concluding in Section 5.

II. Protection in historical perspective

In his seminal contribution, Gambetta (1996) conceptualizes the Sicilian mafia as an industry of private protection, and argues that its emergence was associated with an increase in the demand for protection over the period comprised between the demise of feudalism (1812) and Italy's unification (1861).[4] In particular, the rising demand for protection was centered around the production and commercialization of three main categories of commoddities: cattle, valuable crops, and sulphur.

I. Protection of cattle and rich cultivations

Over the period under examination, the large majority of Sicilian former feudal lords lived in the capital city, Palermo, hence at a distance from their properties. These were generally rented out to local administrators (*gabelloti*) who were in charge of managing the landholding's productive activities and who invested their own capital in it. Given the relatively short duration of their contracts, the *gabelloti* had little incentive to make long term investments to improve land productivity; rather they invested in livestock, particularly cattle, which, however, had to be protected from local bandits (*briganti*).[5] The demand for protection against cattle-stealing was particularly high in areas characterized by important differences in altitude, and hence prone to transhumance.[6]The most profitable agricultural land was that suitable for the cultivation of citrus fruits, mostly concentrated in the northern and western coastal areas. Over the course of the nineteenth century, a sharp increase in international demand for citrus fruits determined an impressive increase in the production and commercialization of these products, which were generally shipped from Palermo's port - Sicily most important one - to both European and non-European markets.[7] As a consequence, investments in the cultivation of citrus fruits were extremely profitable but also rather risky. In fact, if on the one hand large initial investments were required for purpose of land preparation and the installation of adequate irrigation infrastructure, on the other hand

[4] Both Gambetta (1996) and Lupo (1993) strongly oppose the view that the mafia would be related to some distinctive traits of Sicilian "culture" (see Cutrera (1900) for an early account of some of these rather peculiar theories).

[5] *Briganti* had been present in southern Italy since the XVI-XVII century and had often been used by feudal landlords to protect their holdings (see Candeloro, 1956).

[6] Lupo (2004) emphasizes the importance of the availability of pastures at different altitudes for non stabling cattle-breeding.

[7] As Dickie (2004) points out: "Sicilian oranges and lemons were shipped to New York and London when they were still virtually unknown in the mountains of the Sicilian interior. In 1834, over 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. In 1860, the year of Garibaldi's expedition, it was calculated that Sicily's lemon groves were the most profitable agricultural land in Europe, out-earning even the fruit orchards around Paris. In 1876, citrus cultivation yielded more than sixty times the average profit per hectare for the rest of the island." (p. 39).

a long time would pass between the trees' initial plantation and the commercialization of the first harvest. Furthermore, due to their high commercial value, citrus fruits were particularly exposed to attacks from *briganti* both at the production and the commercialization stage. The combination of potentially high and vulnerable yields in those areas were citruis fruits could be successfully grown resulted in high demand for protection of these commodities and, consequently, in high potential profits for those who could offer it.

II. Protection of sulphur

The demand for private protection also arised from the need to protect monopoly power, enforce cartels and restrict competition. This was especially the case for the sulfur industry. In fact, sulfur mine galleries were rented out and, not unusually, the right to exploit them had to be defended from violent attacks. Furthermore, once extracted, sulfur minerals - largely produce for export purposes - had to be transported to Palermo's port, so cargoes safety along the way had to be ensured as well. Starting in the first decades of the nineteenth century, international demand for sulphur soared as this represented an important intermediary input for the industrial and chemical productions which were quickly expanding both in Britain and France.[8] For all of the nineteenth century and until the beginning of the twenthieth, Sicily represented the largest producer of sulfur in the world with ever increasing export levels[9]: in volume, Sicilian sulfur exports grew at a yearly average rate of 8.8%, from 25,000 tons in 1832 to 180,000 in 1859 (Gatto, 1925).[10]The high commercial value of sulfur did not translate into higher wages or better living conditions for miners, who had to compete with low-wage agrictultural workers.[11] Each miner had to protect his earnings from other miners, as raw material extracted by miners was usually paid only once a week and no public law

[8] In 1855 over 70% of Sicilian sulphur was exported to France and Great Britain (Squarzina, 1963). Sulphur is the base of oil of vitriol, and of almost all the acids and alkalis which are extensively used in various manufacturing processes. It is also required for the manufacture of gunpowder as well as for the production of various medicines(Rawson, 1840). Even if industrial substitutes for sulfur have been discovered and developed since the late '40s, the use of sulfur gained again momentum because of its use in the grape cultivation as a fungicide. Sulphur accounted for 20% of total export value in 1940(Pescosolido, 2010).

[9] Figures for 1893 reveals that Sicily supplied the 83% of sulphur used worldwide; an additional 10% was produced in other regions of Italy and the remaining 7% was produced in the rest of the world, particularly in Japan (source: French Ministery of Public Works).

[10] We estimate that sulphur production represented about 2.5% of Sicilian GDP in 1861. To compute this estimate we refer to data available from the Italian National Institute of Statistics (ISTAT) according to which Italian GDP in 1861 could be estimated to about 7,774 million liras, and the Sicilian population represented about 10% of the total national population. From this information, since Sicilian per-capita GDP was at the time very similar to the Italian one (Daniele and Malanima, 2007) we derive an estimate of Sicily's aggregate GDP. Finally we compute the total GDP attributable to sulphur production as the product of the total quantity sold in 1861 (160,000 tons) and its average price over that year (120 liras/ton; source: Squarzina, 1963).

[11] In 1860, the average daily wage was around 2 liras, while the value of the sulphus extracted by a miner in one day was between two and three times higher.

enforcement was provided in the mines. Labor costs and transportation costs accounted for around 56% and 27% of total costs respectively.[12] Transportation costs were extremely high in this environment: mules caravanes - the most common way of transporting sulphur to destination - were extremely slow and costly and the routes generally very insecure due to risk of predation on the part of bandits. All these factors contributed to increase sulphur producers' demand for protection both around the mines and along the routes connecting these to the main ports.

III. Supply of protection

In Gambetta's view, in the absence of publicly provided property-right protection, the business of private protection prospered in the interior of the island, in localities contiguous to the most prosperous areas: those surrounding Palermo as well as those where citrus cultivation and sulphur extraction were more widepread. In these areas protection services were greatly demanded, the supply of individuals specialized in the use of violence was abundant, and information about potential customers as well as suppliers' reputation flew quickly.[13] As the violent threats used to protect thir "clients" could also be used to intimidate them as well , early *mafiosi* were in a position to create their own demand; hence the distinction between offered protection and threatened extortion was genereally unclear. Indeed, various forms of agreements linked *briganti* and *mafiosi*, as the latter used the threat of the former to justify the services they offered.

On a related note, Lupo (1993) emphasizes the relevance of riots and insurrections for the supply of potential *mafiosi*'s skills and organization. Indeed, *mafiosi* played an active role in the various insurrections that took place in Sicily, and especially in Palermo, over

[12] The data are available from the Italian Ministery of Agriculture, Industry and Commerce (1894) and refer to the year 1893. Nevertheles, as reported by several scholars, sulfur production technology did not change much over the course of the nineteenth century and, most likely, factors' shares remained relatively stable as well. Physical capital and energy consumption accounted altogheter for less than 7% of total cost, consistent with the extremely low technology intensity of the sulfur production process (even in the late part of the century).

[13] In the countryside, *gabelloti* were surrounded by a number of guards, former soldiers and former convicts, all trained in the use of violence whom, formerly employed by feudal lords, were now looking for new job opportunities. Local networks of such individuals quickly emerged: extremely well informed about the local context, of both potential victims of violent predation and potential perpetrators, they were in the position to establish a credible reputation as effective protectors. This process led, following Franchetti's expression, to the "democratization of violence".

the course of the nineteenth century.[14] Secret societies, such as the Freemasonry, provided *mafiosi* with some of their rituals and organizational style.[15] Nevertheless, the *mafiosi* favored whoever could best grant the continuation and expansion of their business - be it the rioters or the State - and in several instancs the new Italian State used their local power to police and control the territory.

As to why the mafia emerged in western but not in eastern Sicily, Gambetta (1996) argues that in the east former feudal landlords were more present on their lands and less divided than in the west and, as consequence, were better equipped to maintain a monopsonistic control of violence and enforcement. However, Gambetta does not develop this argument further and does not spell out the historical determinants of this difference. Lupo (1993) suggests that in the areas around Agrigento and Caltanissetta the emergence of the mafia was more related to the sulfur industry (sulfur mines were concentrated in the western and central parts of Sicily), with a lower social class characterization of the mafiosi, whereas around Palermo, where landlords and merchants concentrated, the connection between aristocrats and the protagonists of insurrections played a major role.[16]

III. Data

I. Mafia measures

Mafia data come from several historical sources and allow us to provide a very detailed picture on the presence of mafia activity in the second half of the 19th century, when most of historians trace back the birth of the Sicilian mafia. Our data are based on the historical and sociological research conducted by Cutrera (1900) on the Sicilian mafia. In his book he draws a map with the intensity of mafia activity (on a four level scale) in 253 municipalities, according to his own judgement, which followed from his previous direct experience as an officer of public security and from his detailed study of the mafia phenomenon. We call this variable *mafia_c*. This qualitative measure assume values equal to 0, 1, 2 or 3 if mafia is not

[14] The demise of feudalism in 1812 already reflected a great tension between barons and the Bourbons (although barons lost their feudal rights, they maintained their properties and gained, at least for a few years, legislative power and control over the king through the Parliament). Until 1860, there was a constant alternation of periods of order, insurrections (such as those of 1821 and 1848) and restorations, until the insurrection triggered by Garibaldi led to the end of the Bourbons' domination. This situation did not change after Italy's reunification, with another insurrection in 1866 and with several intents by the new State to impose order through repression.

[15] Together with its popular variant, the 'Carboneria', the Masonry played a relevant role in the various revolts and fights for local power.

[16] "Da Palermo l'aristocrazia ottocentesca più o meno nuova domina la proprietà fondiaria della Sicilia occidentale e controlla il mercato degli affitti, però nei paesi e nei dintorni della stessa capitale essa deve venire a confronto con il vasto mondo dei facinorosi. [...] Il rapposto tra facinorosi e grande possidenza palermitana è l'elemento decisivo nel caratterizzare storicamente l'origine della mafia, nel localizzare quest'ultima nella sezione occidentale dell'isola." (Lupo, 1996, p. 63)

present, if mafia presence is very limited, if there is some mafia activity or if mafia presence is very high. Map presented in figure 1 shows in greater detail the geographical distribution of our measure of mafia activity at the municipality level.

Cutrera (1900) is a well established source in the criminological and sociological literature. Nevertheless, to the best of our knowledge, it has not been exploited in any previous economic study. The only two empirical studies that have looked at the historical emergence of the Sicilian mafia (Bandiera, 2003; Pazzona, 2010) exploit two different datasets that with respect to Cutrera (1900) have several drawbacks and limitations. The first is the parliamentary enquiry on the conditions of the agricultural class, which took place between 1881 and 1885 and which was directed by Damiani for Sicily (by Jacini at the national level). This source contains qualitative information for 149 towns, obtained from chief prosecutors, who were asked to report whether mafia was active in their town and to what extent. The second source is the parliamentary enquiry on the conditions of Sicily, which took place between 1874 and 1876, directed by Borsani and with Bonfadini as speaker. Its qualitative information on mafia activity for 160 towns, obtained from interrogations to several local authorities, was combined by Pazzona (2010) with that from the previous source to obtain a more accurate picture of mafia intensity. These two measures present three main problems. First, they cover less that 45% of Sicilian municipalities (357 at the time). Second, they are likely to underestimate the intensity of mafia activity. This is especially true for Damiani inquiry, as extensively discussed by Pazzona (2010). The reason is that a combination of *omertà*, real unawareness, fear of retaliation and contiguity with the mafia would all bias the interviewed local authorities towards understatement. If such factors are not simply randomly distributed across municipalities, but are correlated to the intensity of mafia activity or to its determinants, this can be a serious problem for empirical analysis. Third, since these variables code qualitative information reported by different individuals, there is no guarantee that the interviewd authorities adopted the same scale in their answers.

Cutrera (1900), obviously differs from the previous ones in that it is drawn at a later point in time, but it presents important advantages. First, it substantially improves the coverage to more than 70% of all municipalities. Second, it solves the problem of heterogeneous evaluation scales. Third, it reduces the risk that measurement errors are correlated to actual mafia activity (or to its determinants). This is because, unlike local authorities, Cutrera was not responsive to different local incentives to understate the presence of mafia activity. Notice that we do not claim that the risk that measurement errors are correlated with the true values of mafia intensity (or to its determinants) disappears, since it is still possible that information available to Cutrera was influenced itself by local conditions and in particular by mafia presence, but we do claim that relying on a scholar's evaluation rather than on reports

from local authorities reduces such risk. For all these reasons we will rely only on Cutrera's data for our analysis.

II. Geomorphological and historical variables

As widely discussed in the previous section, the demand for protection was particularly high in areas characterized by cattle breeding and by the production and commercialization of sulfur and citrus fruits. We thus construct and use a variety of geomorphological variables and land quality indicators at municipalities level. Geomorphological variables include different measure of ruggedness and difference in municipalities elevation. Ruggedness, as proposed by Nunn and Puga (2009), reflects the possibility for people to hide, something that was very useful for out-of-law people involved in criminal activity, as Lupo (2004) stresses in describing Gangi, a small town where mafia was very active because of its position difficult to reach and control by police forces. Differences in altitude are known to impose limits on the extent of agriculture, on cattle-breeding (Lupo, 1993) and on the choice of cultivated crops Grigg (1995). In particular, the difference in altitude should be a good proxy for the existence of transhumance (i.e. the seasonal move of cattle between pastures at different altitudes), and during moves the cattle were more vulnerable. This vulnerability should be associated with the need for protection and therefore to mafia presence. Thus, we use both the maximum ruggedness (*rugged*) (calculated over observations available on a grid of 30 by 30 seconds, from RIX Ruggedness Index) and the difference between maximum and minimum altitude in the municipal area (*diff. altitude*) in kilometers, from ISTAT. With regard to land suitability, high-resolution data on soil suitability for specific crops are available from the Food and Agriculture Organization Global Agro-Ecological Zones project (FAO-GAEZ)[17] The FAO-GAEZ database include a variety of measures of soil suitability constructed under different assumptions regarding possible irrigation conditions (rain-fed, irrigation, gravity irrigation, etc.). The FAO measures take into account the impact of both soil composition[18] and climatic varables. The data are in grid format, have very high resolution (1'), and assign to each grid cell a score from 0 (totally unsuitable), to 7 (very suitable). As municipal measures of soil suitability for citrus fruits we use the mean of the suitability index over all cells comprised in the territory of a given municipality. As an alternative for land suitability, we construct a dummy equal to one for those municipalities that are characterized by lau-

[17] More information on the FAO-GAEZ project can be found at http://www.gaez.iiasa.ac.at/w/ctrl?_flow=Vwr&_view=Welcome&idAS=0&idFS=0&fieldmain=main_&idPS=0. Data from FAO-GAEZ have been used extensively by economists in recent years to investigate a variety of topics. Examples include Michalopoulos (2011), Nunn and Qian (2008) and Durante (2009).

[18] The following factors are considered: slope constraints, terrain fertility constraints, drainage constraints, texture constraints, and chemical constraints.

retum phyto-climatic zone (*lauretum*), the one that better accommodates citrus cultivation. Alternatively, we also use a dummy for predominance of intensive cultivations (*intensive*) (citrus and olives, in particular) over extensive cultivations (wheat, faves, etc.) in 1930, according to Basile (1941). Cutrera (1900), based on the Damiani enquiry, defines areas with different level of land productivity (low, medium or high) that we use as a further alternative measure for productivity (*product*). We take into account the availability of water in large supply (*water*), since water is a necessary and crucial input for agriculture and in particular for citrus cultivation. As presented above the 19th century, especially the first half, was characterized by a dramatic increase in the international demand of both sulfur and citrus fruits. The former represented a key component in the manufacturing, medical and agronomy industry. In this international context, the existence of a large commercial port located in Palermo had represented an advantage for that area. We obtained from Squarzina (1963) the number of sulfur mines operating in 1886. Unfortunately we do not know the production of each of these mines, so we construct a dummy for the presences of at least a mine (*sulfur*). From the map by Cary (1799) we construct a dummy variable indicating whether a postal road passed through the municipality (*roads*). Having roads from 18th Century allows to have their exogenous distribution with respect to the discovery of sulfur, since its intensive excavation and trade only began at the beginning of 19th Century, according to Squarzina (1963). Since Palermo was already the main port of Sicily during the first half of 19th century, we include among the controls the great-circle distance from Palermo (*distance*), in kilometers.[19] Finally, we collect population data (*pop*) from the 1853 census by Marzolla (1856) for 323 municipalities. We calculate population density (*density*) by using today's municipalities' extension in squared kilometers. At that time total Sicilian population was 2.1 million, more than one tenth of Italian population at that time, and population density was more than 81 inhabitants per square kilometer, similar to today's Spain. The historical demographic pattern is quite homogeneous across municipalities, resulting in a correlation between population in 2001 and in 1853 above 0.95. Palermo was the largest and denser city at that time with a population of 185,000 inhabitants and more than one thousand inhabitants per square kilometer, comparable with today's medium-sized Italian cities. The usual expected effect of population density is a positive one on economic activity, as urban and agglomeration economics suggests, however we are mainly interested in the positive effect of density on criminal activity, as many authors point out (Glaeser et al., 1996; Glaeser and Sacerdote, 1999; Buonanno et al., 2012). The 1853 census allows us to define two different

[19] In 1838, 240 out of 450 merchant vessels left Palermo for foreign ports, while only 65 left Messina, the second in order of importance (Petino, 1958).

layers of regional fixed effects: 7 provinces and 24 districts.[20] The geographical distribution of some of the control variables are available in the Appendix.

IV. Empirical Analysis

Our basic empirical model is one in which the dependent variable is one of the measures of mafia activity described above and historico-geographic determinants as regressors. Before moving to the multivariate analysis, it is worth looking at some simple but interesting pairwise correlations, to have a grasp of the underlying mechanisms at play. We start by looking at the variable built from Cutrera (1900), *mafia_c*, and then we highlight the similarities that arise once we use other variables as proxies for mafia activity. First, as well established in the literature, mafia activity tents to be higher in Western areas of Sicily, the correlation between *mafia_c* and longitude being -0.60. The same large and negative correlation (-0.61) exists between *mafia_c* and distance from Palermo, since historically the origin of mafia activity can be found, according to Cutrera (1900) and Lupo (2004), among others, in the "Conca D'Oro", the area surrounding the city of Palermo. Correlation between *mafia_c* and the dummy indicating the presence of a river turns out to be positive (0.34), contrary to what Sylos Labini (2003) claims. In this respect, it is fair to note that Sylos Labini describes a Western Sicily with scarce water, while we find a larger concentration of municipalities through which a river passes precisely in the Western part.[21] We do not find important correlations (all below 0.05 in absolute terms) between *mafia_c* and density in 1853, the presence of roads in 1799 and the presence of lauretum phyto-climatic zone. There is a positive correlation of *mafia_c* with the presence of sulfur mines in 1886, around 0.19. As expected from considerations above, the correlation between the presence of roads in 1799 and the presence of sulfur mines in 1886 is negligible (below 0.03 in absolute value).

In the first set of OLS regressions, collected in Table 2, we use *mafia_c* as dependent variable and regress it against some variables that will not change across specifications plus some variables that proxy for the difference in elevation and land suitability for agriculture that will be varied across specifications.[22] We run different specifications using different proxies for the same variables (two variables for ruggedness, *rugged* and *diff.altitude*, and three for land productivity, *intensive*, *lauretum* and *product*) because we want to assess the robustness of these different measures. The set of variables always in the regressions of Table 2 are the presence of sulfur mines (*sulfur*) and rivers (*water*), roads (in 1799, *roads*), a dummy for coastal municipalities (*coast*) and population density (in 1853, *density*). *sulfur*

[20] The provinces at that time were Girgenti (today's Agrigento) with 40 municipalities, Caltanissetta with 29, Catania with 55, Messina with 82, Noto with 30, Palermo with 69 and Trapani with 18.

[21] This can be due to our definition of rivers, or to the focus of Sylos Labini on the inner parts of Sicily.

[22] In all specifications, standard errors are robust to heteroscedasticity.

is always positive and significant, in most cases at 1% level, confirming our hypothesis of a positive association between presence of sulfur and mafia activity. *river* is always positive and significant at 1% level in all specifications, included (7) and (8) that allows for province fixed effects. Depending on the specification, *rugged* and *diff.altitude*, together with population density are positively associated with the intensity of mafia activity. Note that, according to Bentley (1987), both population density and ruggedness are predictors of land fragmentation, so that the findings in Bandiera (2003) indicating land fragmentation as determinant of mafia activity could simply reflect the omission of these variables. The coastal dummy has a negative coefficient as expected (Cutrera, 1900) claims that among workers in the sailing activity mafia was absent), significant in some of the specifications. It turns out that among the variables measuring land productivity the one always significant and with more explanatory power is *product*. Our preferred specification is the one in column (8), one with *product* and *diff.altitude* among the regressors, together with province-level dummies.[23] The adjusted R^2 is larger than 0.48 and the coefficints of all the relevant explanatory variables have the expected sign and are strongly significant.

After having defined our baseline specification, we address its robusness to further modifications and to the use of different variables measuring mafia activity, with results being reported in Table 3. In column 1 we add (to specification 8 of Table 2) distance from Palermo as another explanatory variable: as expected, it is negative and significant. Specification 2 uses 24 district dummies instead of the 7 province dummies: some of the explanatory variables are less precisely estimated but significance remains, while only *distance* and *product* are no more significant. Specification 3 replicate specification 6 of Table 2 using different LHS variables. In column 3 the dependent variable used is *mafia_cdb*, the maximum of our original mafia variable and information coming from Damiani and Bonfadini inquiries. Results are similar to those obtained using *mafia_c*.

In the following, we split the sample according to different dimensions, so to explore whether different forces are at play across heterogeneous groups of municipalities. The first split we perform is the East vs West one: historically, as already debated, mafia were more active in the Western part of Sicily, but still some mafia activity was in place in the Eastern part. We arbitrarily split the sample at 14.2E longitude in order to have a balance in the number of observations, the average *mafia_c* being 0.9 in the East and 2.1 in the West, and we run the same regression as in specification 8 of Table 2. Results are reported in columns 1 and 2 of Table 4. In the West the main drivers seem to be *sulfur* and *density*, nicely picking the drivers specific to the mining and urban environment, respectively. In the East

[23] Given the discrete nature of *mafia_c* we performed also ordered probit estimations, whose results are in line with those obtained here.

river and *product* are the variables more related to mafia activity, suggesting a prominent role for rich cultivations in the mafia business. The larger presence of mafia in the West is captured by the large, and precisely estimated, constant term. Next, we split the sample according to population in 1853 (*pop*), the threshold being 5000. The difference in average *mafia_c* between small and large municipalities is not very large (1.2 and 1.7, respectively) and results indicate a role for *sulfur* and *product* in small municipalities, while the variance in large municipality is mostly captured by provincial fixed effects: among the explanatory variables, only *river* is weakly significant. A better way of splitting the sample could be based not on dimension, but rather on geographical proximity to large cities versus rural areas, since the literature proposes different drivers for the existence of mafia, as stressed in the previous sections. We discriminate between municipalities within a distance of 40 kilometers from Palermo, Catania, Messina, Trapani or Girgenti (the "Urban" sample, in column 5) against the other municipalities, those far away from large cities (the "Rural" sample, in column 6). The first group of municipalities includes, for example, Palermo and all the Conca D'Oro region, while the latter includes those municipalities characterized by large estates with absent owners, most of sulfur mines and harsher lands. As for the case of population, the difference in average *mafia_c* between the two groups of municipalities is not very large: 1.2 in Rural regions and 1.7 in Urban regions. As expected, *sulfur* turns out to be positive and significant only in Rural regions, together with *product*. *river* and *diff.altitude* are weakly significant while interestingly roads is positive and significant in the Urban sample: this backs the hypothesis that the transit of valuable goods (such as sulfur and citrus) toward the ports should attract the attention of mafia, on the side of both extortion and protection.

V. Conclusions

We presented an empirical analysis of the historical origin of the Sicilian mafia and of its economic determinants. The mafia spread in western Sicily in the second half of the 19th century, with a much slower penetration in the eastern part of the island. We collected a new dataset with detailed information at the municipality level and used it to test the perspective that an initial shock to the demand for protection, in a context characterized by poor enforcement of law by the state, led to the emergence of mafia as a supplier of private protection. Once the mafia emerges, its monopoly of violence allows it to further increase the demand for its services through extortion. We identify the major changes in the demand for protection, and therefore in the potential profitability of mafia activity, in the impressive increase in the price of the most important Sicilian exported commodities at the time, namely sulphur and citric fruits. By using data on land suitability for the extraction of sulphur and the culti-

vation of citrus, we establish their significant impact on the early diffusion of mafia activity. We also assess that the early presence of the mafia is positively and significantly correlated to population density, since this naturally leads to higher demand, and to terrain ruggedness, which makes state enforcement more difficult, offers hiding possibilities to mafiosi and is also related to the demand for protection of cattle during the transhumance. Our results may be interesting from different points of view: historically, they shed light on the origins of an important and persistence criminal organization; more broadly, they illustrate how the blessing of an increase in demand may turn, when state enforcement is weak, in the curse of private protection offered by a criminal organization; finally, they show how geographical and historical contingencies may lead to the emergence of particular human institutions (in this case the mafia), which then become self-sustaining and thus persist over time.

Figure 1: Mafia density according to Cutrera

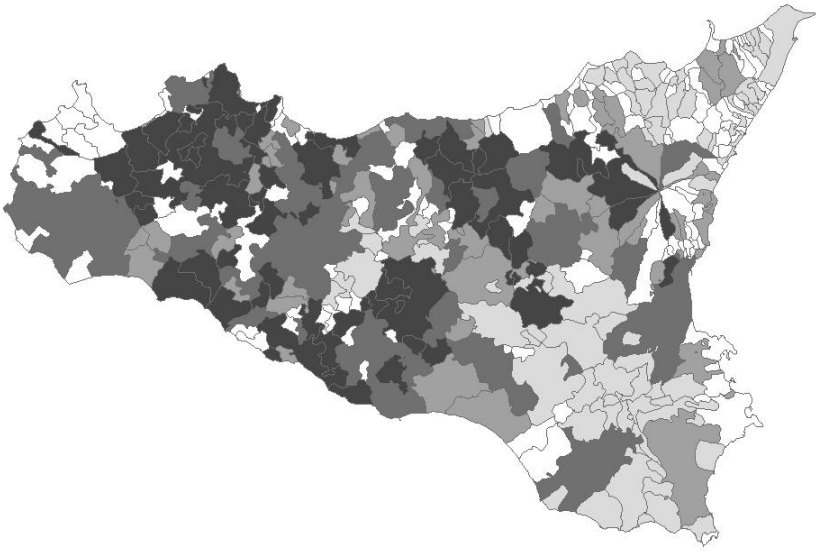

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
mafia_c	253	1.45	1.14	0	3
mafia_d	145	0.65	1.02	0	3
mafia_b	157	1.18	1.31	0	3
mafia_db	160	1.16	1.31	0	3
mafia_cdb	274	1.55	1.21	0	3
sulfur	382	0.13	0.33	0	1
river	382	0.34	0.47	0	1
rugged	382	427.5	199.8	53.7	1149.3
diff.altitude	380	0.77	0.53	0.04	3.28
lauretum	382	0.43	0.50	0	1
intensive	382	0.52	0.50	0	1
product	382	1.61	0.74	1	3
pop (X1000)	323	6.27	12.43	0.3	185
dens	323	129.6	134.4	4.4	1164.3
roads	382	0.49	0.50	0	1
coast	382	0.30	0.46	0	1
distance	382	110.9	54.8	0.1	223.3

Table 2

VARIABLES	(1) mafia_c	(2) mafia_c	(3) mafia_c	(4) mafia_c	(5) mafia_c	(6) mafia_c	(7) mafia_c	(8) mafia_c
sulfur	0.6228***	0.6099***	0.5142**	0.4725**	0.5106***	0.5214***	0.5151**	0.5765***
	[0.1924]	[0.1950]	[0.2029]	[0.2070]	[0.1928]	[0.1948]	[0.2200]	[0.2201]
river	0.7861***	0.7841***	0.7940***	0.7964***	0.6945***	0.6784***	0.4043***	0.3632***
	[0.1390]	[0.1407]	[0.1396]	[0.1414]	[0.1337]	[0.1364]	[0.1283]	[0.1299]
rugged	0.0011***		0.0011***		0.0012***		0.0006*	
	[0.0003]		[0.0003]		[0.0003]		[0.0004]	
diff.altitude		0.2708**		0.2059		0.4173***		0.3233**
		[0.1366]		[0.1409]		[0.1314]		[0.1367]
lauretum	0.2241	0.2973**						
	[0.1427]	[0.1443]						
intensive			-0.2418	-0.2466				
			[0.1485]	[0.1535]				
product					0.5702***	0.6160***	0.3543***	0.3416***
					[0.0818]	[0.0857]	[0.0951]	[0.0937]
dens	0.0013**	0.0013**	0.0015***	0.0015***	0.0011**	0.0013***	0.0009**	0.0011**
	[0.0005]	[0.0005]	[0.0005]	[0.0005]	[0.0005]	[0.0005]	[0.0005]	[0.0005]
roads	0.0761	0.1046	0.0710	0.1045	0.0738	0.0881	0.0797	0.0741
	[0.1476]	[0.1494]	[0.1468]	[0.1492]	[0.1352]	[0.1358]	[0.1168]	[0.1181]
coast	-0.3129*	-0.3449**	-0.1255	-0.1395	-0.3378**	-0.3084**	-0.2358*	-0.1856
	[0.1697]	[0.1717]	[0.1637]	[0.1720]	[0.1405]	[0.1458]	[0.1230]	[0.1267]
Constant	0.3596*	0.5661***	0.5085**	0.7922***	-0.4896**	-0.4106**	0.9121***	-0.0754
	[0.1894]	[0.1835]	[0.2036]	[0.1969]	[0.2008]	[0.2057]	[0.3253]	[0.3305]
Dummies	NO	NO	NO	NO	NO	NO	Province	Province
Observations	236	235	236	235	236	235	236	235
Adjusted R^2	0.199	0.179	0.200	0.176	0.326	0.317	0.475	0.484

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

Robust standard errors in brackets

Table 3

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	mafia_c	mafia_c	mafia_d	mafia_b	mafia_db	mafia_cdb
sulfur	0.6191***	0.4137*	0.7849***	0.4203	0.4479*	0.6406***
	[0.2306]	[0.2433]	[0.2712]	[0.2568]	[0.2562]	[0.1745]
river	0.3380**	0.2114*	0.1358	0.2160	0.2525	0.4224***
	[0.1310]	[0.1258]	[0.1778]	[0.2109]	[0.2054]	[0.1248]
diff.altitude	0.3257**	0.3896***	-0.0287	-0.1478	-0.1275	0.3138**
	[0.1368]	[0.1418]	[0.1077]	[0.1372]	[0.1348]	[0.1278]
product	0.2525***	0.2677	0.0683	0.0387	0.0886	0.2632***
	[0.0969]	[0.2445]	[0.1076]	[0.1507]	[0.1478]	[0.0840]
dens	0.0012**	0.0014**	0.0015***	0.0000	0.0002	0.0009*
	[0.0005]	[0.0005]	[0.0004]	[0.0004]	[0.0004]	[0.0005]
roads	0.0927	0.1662	0.0614	0.0835	0.0878	0.1848
	[0.1182]	[0.1176]	[0.1854]	[0.2215]	[0.2144]	[0.1220]
coast	-0.1258	-0.1573	0.0583	0.3467	0.3109	-0.0747
	[0.1276]	[0.1320]	[0.2196]	[0.2565]	[0.2450]	[0.1335]
dist_palermo	-0.0067**	0.0063	-0.0058***	-0.0137***	-0.0131***	-0.0111***
	[0.0027]	[0.0054]	[0.0017]	[0.0021]	[0.0020]	[0.0011]
Constant	0.7723	-1.9283	0.7215*	2.3511***	2.1357***	1.5489***
	[0.5808]	[1.3232]	[0.3691]	[0.5414]	[0.5283]	[0.2972]
Dummies	Province	District	NO	NO	NO	NO
Observations	235	235	136	147	150	254
Adjusted R^2	0.497	0.558	0.226	0.356	0.354	0.498

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

Robust standard errors in brackets

Table 4

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	West	East	pop<5000	pop>5000	Urban	Rural
VARIABLES	mafia_c	mafia_c	mafia_c	mafia_c	mafia_c	mafia_c
sulfur	0.7914***	-0.2406	1.0544**	0.2186	0.3280	0.7648**
	[0.2339]	[0.4096]	[0.4839]	[0.2778]	[0.3045]	[0.3723]
river	0.1291	0.8528***	0.3158	0.3529*	0.3110*	0.3169*
	[0.1501]	[0.2355]	[0.2017]	[0.1846]	[0.1734]	[0.1858]
diff.altitude	0.3375	0.1500	0.2120	0.3391	0.2842*	0.4479*
	[0.2275]	[0.1765]	[0.1934]	[0.2100]	[0.1685]	[0.2262]
product	0.2126**	0.4444***	0.3958***	0.1533	0.1777	0.4663***
	[0.1002]	[0.1683]	[0.1462]	[0.1345]	[0.1285]	[0.1456]
dens	0.0017**	0.0003	0.0007	0.0008	0.0011**	0.0021*
	[0.0008]	[0.0007]	[0.0009]	[0.0005]	[0.0005]	[0.0011]
roads	0.0842	-0.0473	-0.0150	0.0945	0.3477**	-0.1163
	[0.1639]	[0.1721]	[0.1575]	[0.2125]	[0.1651]	[0.1671]
coast	-0.1133	-0.1930	-0.1535	-0.1967	-0.1964	-0.1020
	[0.1746]	[0.1827]	[0.1795]	[0.1817]	[0.1644]	[0.2033]
Constant	1.4058***	0.3900	1.1491*	0.0302	0.2401	0.3923
	[0.3555]	[0.5665]	[0.6049]	[0.4278]	[0.3883]	[0.5150]
Dummies	Province	Province	Province	Province	Province	Province
Observations	118	117	122	109	115	120
Adjusted R^2	0.208	0.347	0.433	0.446	0.508	0.430

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

Robust standard errors in brackets

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