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Abstract

This paper explores the historical roots of land inequality in Sicily and its relationship with the Mafia presence. Using earthquake intensity as an instrumental variable to address endogeneity concerns, we find that greater land inequality in the past leads to a higher incidence of Mafia activity. Moreover, we show that contemporaneous socio-economic conditions did not drive the effect but reflected persistent historical inequality patterns. Our results suggest that policies to reduce land inequality and promote land reform could have effectively curbed organized crime in Eastern Sicily and other areas with a similar history of inequality.

Keywords: organized crime, mafia, land inequality

JEL Classification Codes: K42, H11, H75.

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1 Introduction

Organized crime is a heavily debated topic in the social sciences due to its significant impact on individuals, businesses, and entire countries. With activities such as violence, corruption, extortion, and drug trafficking, organized crime has been shown to disrupt development and prosperity worldwide (e.g., Acemoglu et al. (2013); Pinotti (2015); De Feo and De Luca (2017); Alesina and Piccolo (2018)). The Sicilian mafia is one of the oldest criminal organizations tracing back to when the government's ability to provide security was limited and banditry was widespread. The Sicilian mafia, according to Gambetta (2017), operates a protection business that defends the landlords from predatory attacks, while nowadays, it offers several other forms of protection (Varese, 2014).

This paper aims to provide evidence of the role of land inequality in the emergence of the mafia using new data on crop diversification. We hypothesize that the different land ownership patterns between the East and West of Sicily, as highlighted by Sylos Labini (2014), can explain the emergence of the mafia. In particular, to identify the causal effect of land inequality on the mafia, we exploit the exogenous variation in the seismic events in eastern Sicily during the 17th and 18th centuries and the island's land distribution. We argue that the difference in land inequality between the East and West of Sicily in the 19th century was due to certain policies following earlier earthquakes.

As argued by Puleo (2010) the Val di Noto earthquake in 1693 resulted in significant social changes in eastern Sicily, claiming the lives of 60,000 people, destroying over 45 towns and villages, and affecting around 5600 km^2 of land. After the earthquake, the Viceroy of Sicily allocated funds to reconstruct devastated towns and introduced measures to facilitate property distribution, such as emphyteusis and the concession of agricultural land. The government introduced these measures to discourage protests and encourage people to remain in the affected areas. Similar measures were taken after the Messina earthquake of 1783. Therefore, the Eastern part of the island underwent a transformation in the 19th century with the partial abolition of monocultural specialization and the spread of intensive agriculture and various crops, resulting in a more diversified economy. In contrast, the Western part continued to be dominated by extensive agriculture and latifundium, requiring effective property control to protect against raids and resist the increasing wage demands of peasant classes. To fulfill this role, the mafia took charge (e.g., Renda (1997)).

We contribute to the existing literature on the emergence of mafia by providing a complementary perspective on the causes of the Sicilian mafia. Previous work has attributed the emergence of mafia to land fragmentation (Bandiera (2003)), sulphur mines (Buonanno et al. (2015)), and citrus groves (Dimico et al. (2017)). More recently, Acemoglu and De Feo (2020) produced evidence that the Mafia's growth at the end of the 19th century was due to a severe drought that increased worker wage demands. In response, landowners turned to the Mafia to quell peasant revolts. Moreover, our paper contributes to the literature on the socio-economic impacts of natural disasters (Barone and Mocetti, 2014; Belloc et al., 2016).

The rest of the paper is organized as follows. Section 2 presents the econometric methodology. Section 3 describes the dataset. Section 4 describes our results, and Section 5 concludes.

2 Methodology

Our main econometric model takes the form of an ordered probit model. For each municipality $i = 1, ..., n$, the latent continuous variable of Mafia presence, M_i^*, is assumed to be given by

$$M_i^* = L_i \beta_L + X_i' \beta_X + \epsilon_i, \tag{1}$$

where M_i^* determines the observed values of mafia, $M_i \in 1, 2, ..., J$, by partitioning the real line using a series of ordered thresholds $a_1 < a_2 < ... < a_{J-1}$, $M_j = j$ if $a_{j-1} < M_i^* \leq a_j$ with $a_0 = \infty$ and $a_J = \infty$.[1] The coefficient of interest is β_L, which measures the effect of land inequality, L_i on the Mafia. X_i denotes other determinants and initial heterogeneity across municipalities. The error term has a zero mean and follows a normal distribution, $\epsilon_i \sim N(0, \sigma_\varepsilon^2)$. Using the earthquake intensity as an instrument, we allow for the endogeneity of land inequality. Inference is based on

[1] Using the linear IV model we obtained qualitatively similar results, which are available upon request.

bootstrap standard errors clustered at the district level using 1000 bootstrap replications.

3 Data

The dependent variable is given by Mafia and measured as an ordinal variable ranging from 0 to 3, (from no presence to high Mafia). This measure is based on the work of Cutrera (1900) and reflects the degree of Mafia presence. Our key regressor is the land inequality measured by Latifundia, defined as the proportion of arable land cultivated by cereals not irrigated and grasslands, based on a municipality-wide dataset containing the extent of cultivated land under 23 different crops (Mortillaro, 1854). This measure captures the degree of concentration of land ownership. As a robustness check, we also consider the degree of agricultural diversity defined by normalized Gini index, which ranges from 0 (minimal heterogeneity) to 1 (maximal heterogeneity).

Our instrumental variable is given by the maximum intensity of earthquake intensity between the 17th and 18th centuries. Comparing the Sicilian maps of Mafia presence against the map of the maximum intensity of earthquakes in Figure 1, it appears that the Mafia is less prevalent in the part of Sicily that has experienced the most significant number of seismic events and the most severe intensity. We also consider an alternative instrument based on the intensity of the Val di Noto earthquake in 1693 (from 4 to 11 Mercalli points).

Finally, we account for various controls that have been proposed in the literature (e.g., Lupo (1988),Bandiera (2003), Nunn and Puga (2012), Buonanno et al. (2015), Dimico et al. (2017), Acemoglu and De Feo (2020)). In particular, we include population density, distance from the five largest cities in Sicily (Urban), the ruggedness of the terrain, the maximum difference in altitude within a municipality, vineyards, olive groves, and the distribution of sulfur caves. Furthermore, we account for the direct connectivity of the municipality to the largest cities by post roads, distance from rivers and ports, the presence of malaria, and the quantity of drinking water.

Tables A.1 and A.2 of the Appendix give detailed variable descriptions and summary statistics, respectively.

4 Econometric Results

Table 1 displays the study's key findings, which document the impact of Latifundia on the Mafia from Equation (1). In addition to Latifundia, columns (1) and (3) include confounding factors representing possible alternative channels for the Mafia presence, while (2) and (4) contain additional controls. The first two columns provide reduced form estimates, whereas the last two use maximum intensity as an instrumental variable. In Panel A, we report the coefficient estimates, while in B, we provide the marginal effects of Latifundia. The results provide compelling evidence for the positive role of Latifundia in the Mafia. Across all specifications, Latifundia is statistically significant at the 1% level. Regarding the other controls, we find statistically significant evidence at the 1% that urban, olive, vineyards, and altitude are positively related to Mafia.

In particular, focusing on column (1), an increase in Latifundia by 1 unit decreases the probability of being in the no mafia state by 6.9 percentage points. In contrast, it increases the probability of being in the highest mafia state by 6.1 percentage points. Interestingly, ignoring the endogeneity of Latifundia implies substantial negative bias. Notably, the proposed instrumental variables appear to be a strong instrument as implied by weak IV tests reported in Panel C. Focusing on (3), an increase in Latifundia by 1 unit decreases the probability of being in the no mafia state by 43 percentage points. In contrast, it increases the probability of being in the highest mafia state by 42 percentage points. Both Cragg-Donald and Kleibergen-Paap tests statistics for the linear reduced form models are well above critical values. These findings suggest that latifundium play a crucial role in supporting the emergence of the Mafia.

Our results survive several sensitivity investigations, summarized in Table 2. We focus on the models that account for the endogeneity of land inequality without additional controls in column (1) and with additional controls in column (2). In Panel A, we replace Maximum Intensity with Earthquake in 1963, with minor differences in the reported coefficients of latifundia. In Panel B, we replace land inequality with agricultural diversity. As expected, the coefficient of agriculture diversity is negative and statistically significant at the 1% level. With lower agricultural diversity, the province is more likely to be in the higher mafia categories. Finally, in Panel C, we report estimates from a Spatial Durbin model with spatially lagged error to account for potential spillovers among adjacent municipalities using a non-normalised contiguity matrix following Buonanno et al. (2015). While the spatial lag coefficient appears statistically significant at the 1% level, the statistical significance of latifundia is retained.

5 Conclusions

Our study demonstrates that areas with higher levels of land inequality were more likely to have a presence of organized crime. Our instrumental variable approach indicates that areas that experienced severe earthquakes in the past had lower levels of land inequality, suggesting that these natural disasters may have led to more equitable land distribution. These findings underscore the significance of addressing structural factors such as land inequality to combat organized crime in Sicily and other regions facing similar socio-economic challenges. By illuminating the historical roots of these issues, our study offers insight for policymakers and communities striving to promote social and economic development in these areas.

Table 1: Estimating the Role of Latifundia in Mafia

This table presents estimation results from the ordered probit model of Mafia in panels A and B. Columns (1)-(2) of Panel A and IV ordered probit while allowing for the endogeneity of latifundia using maximum intensity as an instrumental variable. Bootstrap standard errors clustered at the district level based on 1,000 replication are reported in parentheses. ***, **, and * denote significance at 1%, 5%, and 10%, respectively. Panel C summarizes the corresponding first-stage estimation results, including weak-iv tests.

Panel A:	Ordered Probit		IV Ordered Probit	
Dependent Variable: Mafia	(1)	(2)	(3)	(4)
Latifundia	2.275***	2.141***	7.827***	7.951***
	(0.515)	(0.633)	(0.753)	(0.764)
Population Density	0.001	0.002*	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Urban	1.022**	1.054***	0.852**	0.671*
	(0.422)	(0.402)	(0.430)	(0.399)
Ruggedness	0.000	0.001	0.000	0.000
	(0.002)	(0.002)	(0.001)	(0.001)
Caves	0.042	0.044	0.004	0.005
	(0.087)	(0.098)	(0.046)	(0.042)
Citrus	-5.872	-2.494	-1.097	-2.054
	(14.243)	(10.308)	(7.764)	(7.460)
Olives	0.549	0.776	6.184***	6.406***
	(2.038)	(2.762)	(2.271)	(2.184)
Vineyards	2.295**	2.346**	8.015***	8.141***
	(1.041)	(1.097)	(1.051)	(1.038)
Altitude	0.001**	0.001	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Roads		0.165		-0.078
		(0.148)		(0.131)
Rivers		-0.055**		-0.014
		(0.022)		(0.022)
Ports		-0.002		-0.009
		(0.007)		(0.006)
Malaria		0.316		0.077
		(0.202)		(0.221)
Drinking water		0.111		0.218
		(0.155)		(0.149)
Observations	264	264	264	264
Panel B: Marginal effects of Latifundia				
Mafia = 0	-0.685***	-0.595***	-4.311***	-4.586***
	(.173)	(.193)	(.136)	(.137)
Mafia = 1	-0.110	-0.107	-0.922	-.866
	(0.095)	(0.081)	(0.565)	(0.670)
Mafia = 2	0.191**	0.162**	1.103**	1.176**
	(0.074)	(0.076)	(0.438)	(0.495)
Mafia = 3	0.604***	0.540***	4.220***	4.276***
	(0.150)	(0.168)	(0.130)	(0.135)
Panel C: Dependent variable: Latifundia			First-stage	
Maximum Intensity			-0.024***	-0.023***
			(0.006)	(0.006)
Controls			YES	YES
Cragg-Donald Wald F			22.189	20.382
Kleibergen-Paap Wald rk F			20.701	17.929
Stock-Yogo weak ID test 15% maximal IV size			8.96	8.96

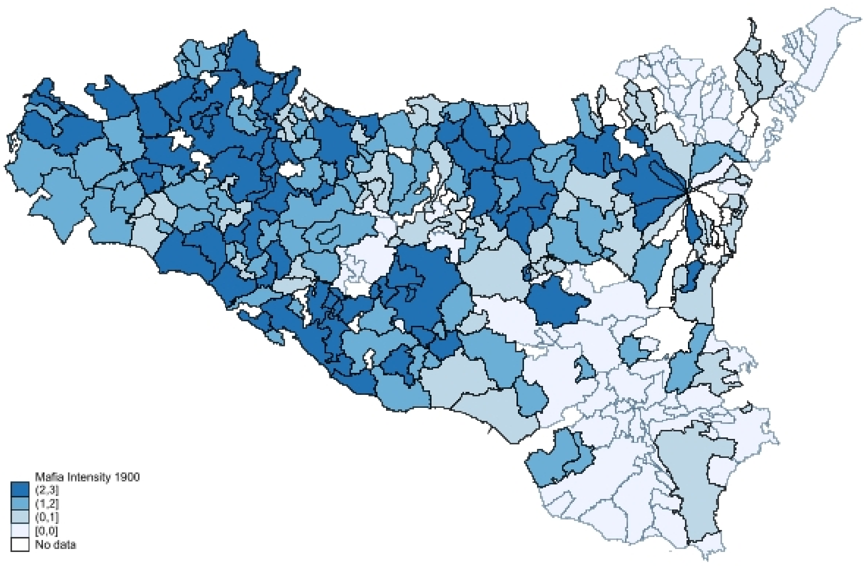
Table 2: Robustness

This table presents three panels that provide sensitivity analysis to the baseline specifications in Table 1. Full results are provided in Table A1 of the Online Appendix. Panel A replaces the instrumental variable Maximum Intensity with Earthquake in 1963. Panel B replaces the measure of land inequality with Agriculture Diversity. Panel C reports estimates from a Spatial Durbin Error model.

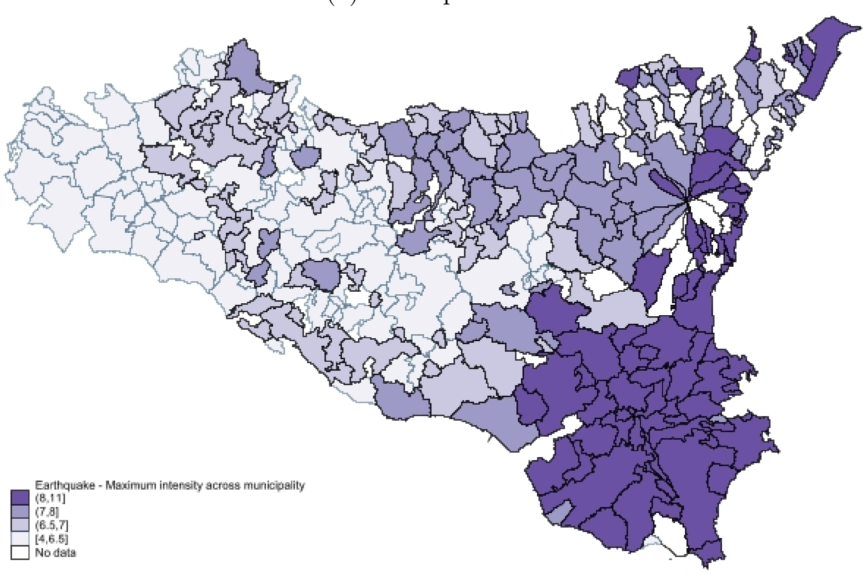
Panel A: IV Ordered Probit - IV: Earthquake in 1693		
Dependent Variable: Mafia	(1)	(2)
Latifundia	7.838***	7.970***
	(0.919)	(1.090)
Additional Controls	NO	YES
Dependent variable: Latifundia	First-stage	
Earthquake in 1693	-0.028***	-0.027***
	(0.008)	(0.008)
Controls	YES	YES
Cragg-Donald Wald F	20.184	22.149
Kleibergen-Paap Wald rk F	15.838	15.933
Stock-Yogo weak ID test 15% maximal IV size	8.96	8.96

Panel B: IV Ordered Probit - IV: Maximum Intensity		
Dependent variable: Mafia	(1)	(2)
Agriculture Diversity	-8.140***	-8.186***
	(1.027)	(1.267)
Additional Controls	NO	YES
Dependent Variable: Agriculture Diversity	First-stage	
Maximum Intensity	0.019***	0.019***
	(0.006)	(0.006)
Controls	YES	YES
Cragg-Donald Wald F	15,691	14,491
Kleibergen-Paap Wald rk F	12,353	11,808
Stock-Yogo weak ID test 15% maximal IV size	8.96	8.96

Panel C: G2SLS Spatial Durbin Error - IV: Maximum Intensity		
Dependent Variable: Mafia	(1)	(2)
Latifundia	4.590***	3.415***
	(1.210)	(1.049)
Spatial Lag Coefficient	0.069***	0.065***
	(0.016)	(0.016)
Spatial Error Coefficient	0.038	0.036
	(0.030)	(0.029)
Additional Controls	NO	YES



(a) Mafia presence



(b) Intensity of earthquake

Figure 1: Spatial distribution of Mafia intensity in 1900 and maximum intensity of earthquake from 1600 to 1900

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A Appendix

Table A1: Variables description

Acronym	Variable	Source
	Main Variables	
Latifundia	Cereal and pasture land grows (share in 1830s)	Mortillaro (1854)
Agricultural diversity	Degree of agricultural diversity which ranges from 0 (minimal heterogeneity)[2] to 1 (maximal heterogeneity)	Mortillaro (1854)
Mafia	Intensity of mafia activity on a four-point scale ranging from none, to low, intermediate and high (0-3)	Cutrera (1900)
Maximum Intensity	Maximum intensity of earthquake (1600-1900)	Rovida et al. (2017)
Earthquake 1693	Intensity of Valdinoto earthquake	Rovida et al. (2017)
	Determinants of Mafia	
Altitude	Maximum difference in altitude	FAO-GAEZ (collected by Buonanno et al. (2015))
Caves	Number of sulphur caves	Collected by Buonanno et al. (2015))
Citrus	Citrus groves (share in 1830s)	Mortillaro (1854)
Olives	Olives groves (share in 1830s)	Mortillaro (1854)
Population Density	Municipal population	ISTAT (collected by Buonanno et al. (2015))
Ruggedness	Roughness of the terrain	GLOBE (collected by Buonanno et al. (2015))
Urban	Distance of municipality respect to the five largest cities in Sicily	ISTAT (collected by Buonanno et al. (2015))
Vineyards	Vineyards groves (share in 1830s)	Mortillaro (1854)
	Other controls	
Ports	Distan from port	ISTAT (collected by Buonanno et al. (2015))
Rivers	Distance from rivers	ISTAT (collected by Buonanno et al. (2015))
Drinking water	The quantity of drinking water on a three-point scale ranging low, intermediate and high (1-3)	Direzione Generale della Statistica (1864) (collected by Acemoglu and De Feo (2020))
Malaria	Dummy variable for malaria areas in a municipality in Sicily	Direzione Generale della Statistica (1864) (collected by Acemoglu and De Feo (2020))
Roads1799	Connection with post roads	Cary (1799) (collected by Buonanno et al. (2015))

[2] Agricultural diversity (AD_m) at municipal level m is defined as a Gini index $AD_m = (1 - \sum_{i=1}^{k}(f_i)^2) * \frac{k}{1-k}$ where f_i is the relative frequency for each type crops i. The crops are: Almonds groves, ashes groves, carob groves, cereal, chestnut groves, citrus groves, cotton crops, fine vegetable gardens, grassland, mixed crops, mulberry groves, olives groves, paddies, pistachios, poplar groves, prickly pears, reedbed, sumac, vineyard groves, vegetable gardens, walnuts groves, wooded.

Table A2: Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Altitude	265	809.72	526.00	48.00	3232.00
Agricultural diversity	265	.59	.16	.006	.88
Caves	265	2.09	7.30	0.00	61.00
Citrus	265	0.01	0.01	0.00	0.16
Drinking water	265	1.66	0.52	1.00	3.00
Latifundia	265	0.73	0.21	0.00	1.00
Mafia	265	1.46	1.14	0.00	3.00
Malaria	265	1.79	0.46	0.00	2.00
Maximum Intensity	265	7.40	1.61	4.00	11.00
Olives	265	0.09	0.12	0.00	0.73
Population Density	265	131.69	128.52	4.86	1177.99
Ports	265	38.54	19.43	0.13	83.92
Rivers	265	9.29	7.20	0.99	42.07
Roads	265	0.56	0.50	0.00	1.00
Ruggedness	265	219.23	104.71	31.87	578.29
Urban	265	0.12	0.33	0.00	1.00
Vineyards	265	0.03	0.05	0.00	0.32