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Explaining pre-industrial inequality in Navarre and Aragon in the mid-19th century.

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Abstract

This paper uses a highly detailed database with information of more than 155,000 individuals to construct wealth inequality during the mid-19th century for 655 towns in Navarre and Aragon. The compilation of this information, together with agrarian information, census data and Geographic Information System techniques, permits, not only the characterization of inequality through the territory in a pre-industrial and agrarian society, but the understanding of the determinants of it. Measure as the wealth accumulated by the upper percentile, inequality was driven by market dynamics as those towns with higher productivity, easy access to markets and growing demand had higher inequality. Moreover, the results show the resilience of aristocracy, being able to hold economic power while the society transformed around them.

JEL Codes: N33, N53.

Keywords: Wealth inequality, agrarian history, micro-data, 19th century Spain

Análisis de la desigualdad preindustrial a mediados del siglo XIX en el Navarra y Aragón.

Resumen

Este artículo utiliza una base de datos altamente detallada con información de más de 155,000 individuos para construir la desigualdad de la riqueza a mediados del siglo XIX en 655 municipios de Navarra y Aragón. La recopilación de esta información, junto con datos agrarios, datos censales y técnicas de Sistemas de Información Geográfica, permite no solo la caracterización de la desigualdad a través del territorio en una sociedad preindustrial y agraria, sino también la comprensión de sus determinantes. Medidas como la riqueza acumulada por el percentil superior muestran que la desigualdad fue impulsada por dinámicas de mercado, viendo como aquellos pueblos con mayor productividad, fácil acceso a los mercados y creciente demanda, tenían una desigualdad mayor. Además, los resultados muestran la resistencia de la aristocracia, siendo capaz de mantener el poder económico mientras la sociedad se transformaba a su alrededor.

Códigos JEL: N33, N53.

Palabras Clave: Desigualdad en riqueza, historia agrarian, microdatos, España siglo XIX

Inequality on wealth, income, educational opportunities, health outcomes, and access to basic services has a broad impact on individuals, communities, and entire societies (Galor and Zeira 1993; Alesina and Rodrik 1994; Aghion et al. 1999; Berg et al. 2018). Following Kuznets' (1955) seminal work, the evolution of inequality since the 19th century in Western countries has been the focus of intensive academic research (Williamson and Lindert 1980; Williamson 1985; Piketty et al. 2006; Rossi et al. 2001; or Prados de la Escosura 2008). Some scholars argue that inequality is primarily driven by economic factors, such as market forces, capital accumulation, and labour market conditions (Stiglitz 2012; Piketty 2013). Others emphasize the role of political institutions, policies, and power dynamics in shaping inequality (Acemoglu et al. 2005; Hacker and Pierson 2010;). Nevertheless, these arguments interwoven as a key element of capital and wealth accumulation, and therefore inequality, is the capacity of the elites to extract wealth, being higher when their economic and political power is stronger (Milanovic et al. 2011; Acemoglu and Robinson 2012).

Furthermore, as Piketty (2013) has emphasized, understanding the long-term dynamics that have led to modern inequality is crucial. Consequently, the economic history literature has concentrated on the evolution of inequality over the past five centuries (Alfani et al. 2022; Wegge 2021; Alfani and García Montero 2022; Bengtsson et al. 2017; Gelman and Santilli 2013; Llorca-Jaña et al. 2018). In a similar vein to studies conducted for other countries, the literature for Spain has also investigated the determinants of inequality, demonstrating that agriculture played a pivotal role in the distribution of wealth and income during the pre-industrial period (Tello and Badia-Miró 2018; Santiago-Caballero 2011; Nicolini and Ramos-Palencia 2021; Martínez-Galarraga and Prat 2022; Mas-Ferrer 2023).

Hence, this paper aims to contribute to the literature by investigating the factors that shaped inequality in a pre-industrial society. This study involves an examination of wealth inequality, assessed through land and real estate assets, at the municipal level in Navarre and Aragon (Northern Spain) during the mid-19th century. This endeavour holds particular significance for three key reasons. First, as Federico (2005) emphasizes, agriculture was globally dominant until the 20th century, making land the main sources of income, power, and wealth. Similarly, as emphasized by Pinilla (2004), the agricultural sector, particularly its development during the initial phases of modern economic growth in the 19th century, holds particular relevance for its role in economic development. Thus, understanding the evolution of agriculture is crucial, especially for Spain,

where the primary sector employed over half of the population until the mid-20th century.[1] Second, recent literature has highlighted that land access played a crucial role in Spanish history during the 19th and 20th centuries (Simpson and Carmona 2020; Robledo 2022). Thus, it is important to comprehend the determinants that led to specific patterns of land distribution and accumulation. Lastly, following from the late 18th century, Spain's property market transitioned to a capitalist structure (Garcia Sanz 1985; Gallego 1998; Millán 2000; Pan- Montojo 2018). This made regions with significant agricultural focus, population growth, and potential for land expansion attractive for profitable real estate and land investments (Gallego 2001). Consequently, an examination of these determinants will elucidate how the transition to a market economy in the mid-19th century influenced inequality through the accumulation of property.

To achieve this objective, the paper relies on a highly detailed micro-database of land and real estate properties at individual level reported by the *amillaramietos* (wealth cadastres) for more than 155,000 individuals. Then, inequality, measured by the share of wealth owned by the top 10%, is computed for the 655 municipalities in the provinces of Huesca, southern Navarre, and Zaragoza, in Northeastern Spain. The use of *amillaramientos*' data, in conjunction with population census data and GIS information, enables the exploration of the factors that influenced the distribution of land and housing.

The selection of this region is motivated by three factors. Firstly, the comprehensive data available for all municipalities in the region, the *amillaramietos*, allows for a detailed study of inequality in mid-19th century Spain. Secondly, the region represents diverse agrarian systems prevalent in Spain during this period, from evenly distributed communities in the Pyrenees to specialized wine and olive-oil-producing municipalities. Lastly, unlike studies focusing on Catalonia's exceptionality, this paper aligns with Santiago-Caballero (2011) and Nicolini and Ramos-Palencia (2021) in analysing a region more representative of Spain as a whole, considering Catalonia's industrialization could have influenced elite wealth accumulation behaviour as discussed by Garrabou et al. (2001).

The results indicate a significant impact of first-nature characteristics, specifically measured as topography or roughness, on wealth distribution among the top decile (Top 10%). This underscores the crucial role that agricultural productivity plays, and by extension, the returns on land investments in the context of Spain's developing agrarian economy. This is

[1] Nicolau (2005 p. 150).

confirmed with the introduction of high-quality soil, showing that land with higher productivity led to higher wealth accumulation. Moreover, consistent with prior scholarly research, population size surfaces as another significant determinant, with larger populations in municipalities exhibiting increased inequality. Additionally, population growth increased inequality, further underscoring the dynamics of local market expansion and heightened demand on wealth distribution. The study also confirms the nobility's ability to maintain their socioeconomic dominance. Lastly, a rise in wealth per capita is positively correlated with a larger share wealth owned by the Top 10%, implying that affluent municipalities attract investment from the economic elite due to the enhanced returns linked to property accumulation. These findings remain robust when the analysis is extended to include municipalities stratified by population and when district fixed effects are incorporated.

Following the argument by Milanovic et al. (2011), in those towns where elites had a higher extraction capacity, inequality was higher. Furthermore, productivity, as measured by the value produced per hectare, enhanced wealth accumulation, thereby affirming that market dynamics were instrumental in driving property accumulation and consequently, inequality in mid-19th century Spain. The study also found that topographic roughness significantly moderated the interaction of other variables with inequality, particularly constraining the impact of population growth on wealth accumulation. Moreover, as the literature has addressed, propertyless families had a significant impact on inequality, highly affected by the availability of communal resources. Lastly, market access, when considered in conjunction with distances and crops, had a significant bearing on inequality, indicating that cereals and cash crops could influence inequality, but only under specific market access conditions.

The remaining sections of this paper are structured as follows. Section 2 provides an overview of the general context and the case study under analysis. In section 3, it is described the data utilized in this study and its sources. Section 4 presents the methodology used to analyse the data and the resulting findings. Finally, section 5 concludes the paper.

Context

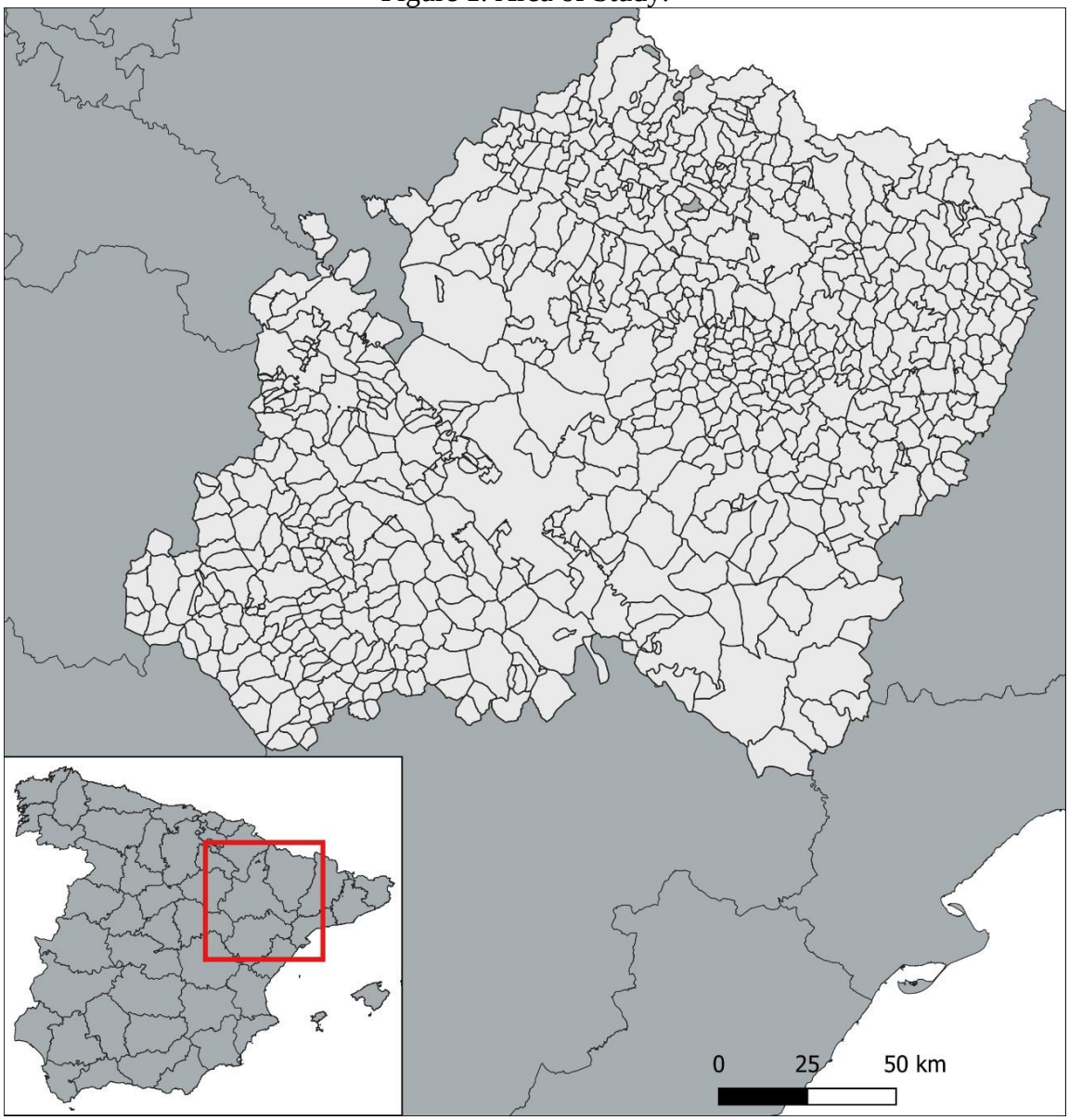
As underscored by García Sanz (1985), Spain initiated a series of structural reforms from the mid-18th century, aimed at transitioning its society from the *Ancien Régime*. By the mid-19th century, the dismantling of feudal structures and institutions, along with the disentailment of properties from the Church, religious entities, commonly and publicly owned properties, and entailed estates, facilitated the emergence of market-driven and capitalist

relationships, replacing feudal ones (Robledo 2004; Pan-Montojo 2018). As articulated by Gallego (2001), this transformation created a context where areas with superior connectivity, productivity and higher urbanization rates experienced increased incentives for property acquisition, given the enhanced ease of bringing products to market. Moreover, similar to other European countries and most of the world during the 19th century, agriculture was the dominant sector in Spanish society, as two-thirds of the population worked in the primary sector up to 1910 (Federico 2005).[2] This made that agriculture dominated everyday life for most of the Spanish society, shaping its dynamics, social relations and economic development.

In this sense, the area of study, which comprises the provinces of Huesca and Zaragoza in Aragon and the district of Tudela in southern Navarre (Figure 1), acted as a source for foodstuff, especially wheat for the more populated and industrialized Spanish regions during the mid-19th century, highlighting the importance of agriculture in this region. As Pinilla (1995) and Germán and Forcadell (1988) pointed out, Aragón supplied wheat to Barcelona through the Ebro River, although it was severely affected by the arrival of the foreign cereals by the end of the century (Sabio Alcutén 1989). For instance, in order to keep up with the rising demand for food from the increasing population, croplands in Aragon expanded during the first half of the 19th century (Pinilla 1995). Furthermore, the Tudela district exhibited particular suitability for olive groves and vineyards, with cereals predominantly allocated for livestock feed owing to the poor quality of pasturelands (Mikelarena Peña and Lana Berasain 1992). In this context, the mid-19th century expansion of the railroad facilitated the commercialization of agricultural goods from the Ebro Valley. Notably, rail lines linking Tudela and Zaragoza with Pamplona, Bilbao and Barcelona were strategically established to integrate the agricultural produce of the Ebro Valley with the industrial Basque and Catalan regions (Barquín 2007; Ormaechea 2017).

[2] Nicolau (2005 p. 150).

Figure 1. Area of Study.[3]



Source: Own elaboration.

Figure 1 illustrates the municipalities examined in this study, encompassing all the municipalities within the Aragonese provinces of Huesca and Zaragoza, along with the towns in the district of Tudela, located in southern Navarre.[4] While these municipalities accounted for only 6.8% of Spain's total land area and 4.4% of its population in 1860, they offer a representative snapshot of the Spanish economy during that era. Table 1 provides an overview

[3] The municipalities have been temporarily standardized in accordance with the methodology described in Beltrán Tapia et al. (2022) in order to be able to have the same municipalities from the late 18th century to 1930.

[4] As Figure 2 will show, not all the municipalities are included because the main data source, the *amillaramientos*, were not found for them.

of the main employment sectors in the provinces of Huesca and Zaragoza, the district of Tudela, and Spain.[5]

As demonstrated in Table 1, the economic structure of the three regions analysed in this paper closely paralleled that of the rest of Spain. The primary distinction lies in the relatively lower level of industrialization within the study area, as indicated in columns 2 and 6. This underlines the prominence of agriculture and real estate properties in the economic landscape of these societies, where they served as the primary recipients of investments, as opposed to industries, as was the case in Catalonia (Garrabou et al. 2001). Additionally, while the number of farm day labourers was similar between the three regions and Spain as a whole, ownership and rental patterns exhibited variations. On one hand, renting in Aragon appeared to be less common compared to Tudela and the entire Spanish nation. On the other hand, notable disparities in ownership were observed between Huesca and Tudela, whereas the province of Zaragoza displayed levels akin to those of Spain.

Table 1. Employment for population over 16 years old (%) in 1860

	Farm day labourers	Industrial workers	Liberal professionals	Owners	Renters	Trade and industry (owners & professionals)	Artisans
Huesca	22.5	0.2	1.0	25.4	0.8	2.6	4.7
Zaragoza	25.5	0.7	0.9	13.9	2.4	3.0	5.0
Tudela	25.1	1.0	0.8	9.6	8.3	3.3	6.3
Spain	23.1	1.7	0.5	14.4	5.0	4.1	6.6

Source: Own elaboration from the population census of 1860.

Concerning the agrarian sector, it's worth noting that the official statistics of the mid-19th century did not provide information for Navarre, which limited the comparison to Zaragoza and Huesca. Regarding cultivated land, the official statistics indicated that approximately 54.2% of Spain's territory was under cultivation. However, in Huesca and Zaragoza, due to the significant portion of land above the threshold suitable for cultivation (Pinilla 1995), the percentages were noticeably lower, standing at 29.4% and 30.1%, respectively.[6] Furthermore, the distribution between rainfed and irrigated croplands was nearly identical between Huesca

[5] These sectors comprised approximately 60% of the total employment across the four entities, with the remaining workforce encompassing teachers, domestic servants, clergy, and military personnel.

[6] Percentages obtained from the *Anuario Estadístico* of 1858, *Territorio-Extensión superficial del territorio*. The topography also influenced the percentages in neighbouring provinces, such as Lleida (46.2%) or La Rioja (33.7%).

and Spain as a whole, with around 5% of the cultivated land devoted to irrigation, and the remainder allocated to rainfed crops. However, the province of Zaragoza exhibited a significantly higher proportion of cultivated land under irrigation, amounting to 18.1%, which could be attributed to the advantage provided by the Ebro River for this province and the historical presence of irrigation facilities, such as the *Canal Imperial de Aragón* since 1776 (Peiro 1988).

In conclusion, despite some distinctions between the area under study and the broader Spanish context, the examination of a substantial number of municipalities (over 650) and their diverse characteristics, as it will be seen in the next section, render this region a robust representation of mid-19th century Spain.

Data[7]

In this section the variables are described and classified into three categories. First, the variables that are gathered from the *amillaramientos*. Second, those that are classified as First and Second Nature, and are obtained using GIS techniques and from official records such as population censuses. Finally, those coming from the *Floridablanca* census of 1787.

Amillaramientos

Conflicts during the first half of the 19th century prompted a series of fiscal reform attempts that culminated in the Mon-Santillán reform of 1845 (Comín and García García 1995). As part of this reform, the developing Spanish Liberal State sought to structure its fiscal framework, creating the *contribución territorial*, a tax intended to directly assess the income derived from properties of both individuals and institutions, such as companies or religious congregations. Consequently, the State required a comprehensive record of the properties owned by each individual and institution, a responsibility that fell upon the municipalities.

In this context, each town created the *amillaramientos*, which served as a property cadastre, providing information about the property owners within the municipality and the characteristics of their properties (Vallejo Pousada 2000).[8] To establish the *amillaramientos*, each municipality documented all property owners, including those with land, buildings, or animals in the town. Consequently, the *amillaramientos* constituted a comprehensive list of

[7] All wealth and monetary figures have been standardized to Pesetas of 1913, following Maluquer de Montes (2013).

[8] Although this literature highlights some concealment problems with this data source, for the area under study the problem came from grazing and pasture lands, and as their value was always reported this do not imply a problem for the statistical analysis (see Appendix, section A for a full explanation).

individuals and institutions along with a detailed account of their properties, enumerating them in terms of number and value. Importantly, the *amillaramientos* encompassed all individuals and institutions holding property within the municipality, regardless of whether they resided elsewhere.

However, the information contained within the *amillaramientos* specifically involved the calculations performed by the local evaluation committee to estimate the income a taxpayer could derive from those properties within a year. Therefore, rather than directly representing the intrinsic value of a property, this committee assessed the potential rental income that the owner was either earning or would earn. This calculation relied on the *cartillas evaluatorias*, an official document subject to regional government oversight, which outlined the gross income, associated costs, and resulting net income for each type of property. Thus, according to this information, each property in the *amillaramiento* was given a value taking into account its location, dimensions, quality and productivity, use, or type of crop in the case of land property. Therefore, while the figures reported in the *amillaramientos* reflected incomes, they encompassed a representation of the value of all properties held by each individual, whether acquired through purchase, inheritance, or marriage.[9] As a result, this dataset represents the historical wealth accumulation patterns of both individuals and institutions during the mid-19th century.

Henceforth, in order to obtain the information to calculate inequality at the municipal level, this paper relies on the information provided by the *amillaramientos* created in every municipality in Huesca and Zaragoza between 1848 and 1864.[10] For the case of Navarre, information is gathered from the cadastre made in 1848, which collected the same information as the *amillaramientos* (Instituto Gerónimo de Uztariz 1992).[11] Moreover, only the value of land and real estate properties is gathered and merged as only one measure of inequality because in certain municipalities the separation of land and real estate wealth did not occur. Although livestock was also reported in the *amillaramientos*, it was not included in the analysis due to the lack of this data in Navarre, and some municipalities in the province of Zaragoza.

In line with Piketty (2013), the calculation of wealth distribution among the top percentile (the Top 10% of owners) was employed as a measure of inequality at the municipal

[9] For clarity instead of using net income in the rest of the paper I will refer to wealth when talking about the value of properties, as net incomes are a representation of the total wealth owned by individuals.

[10] See Appendix Table A.1, for a distribution of the years.

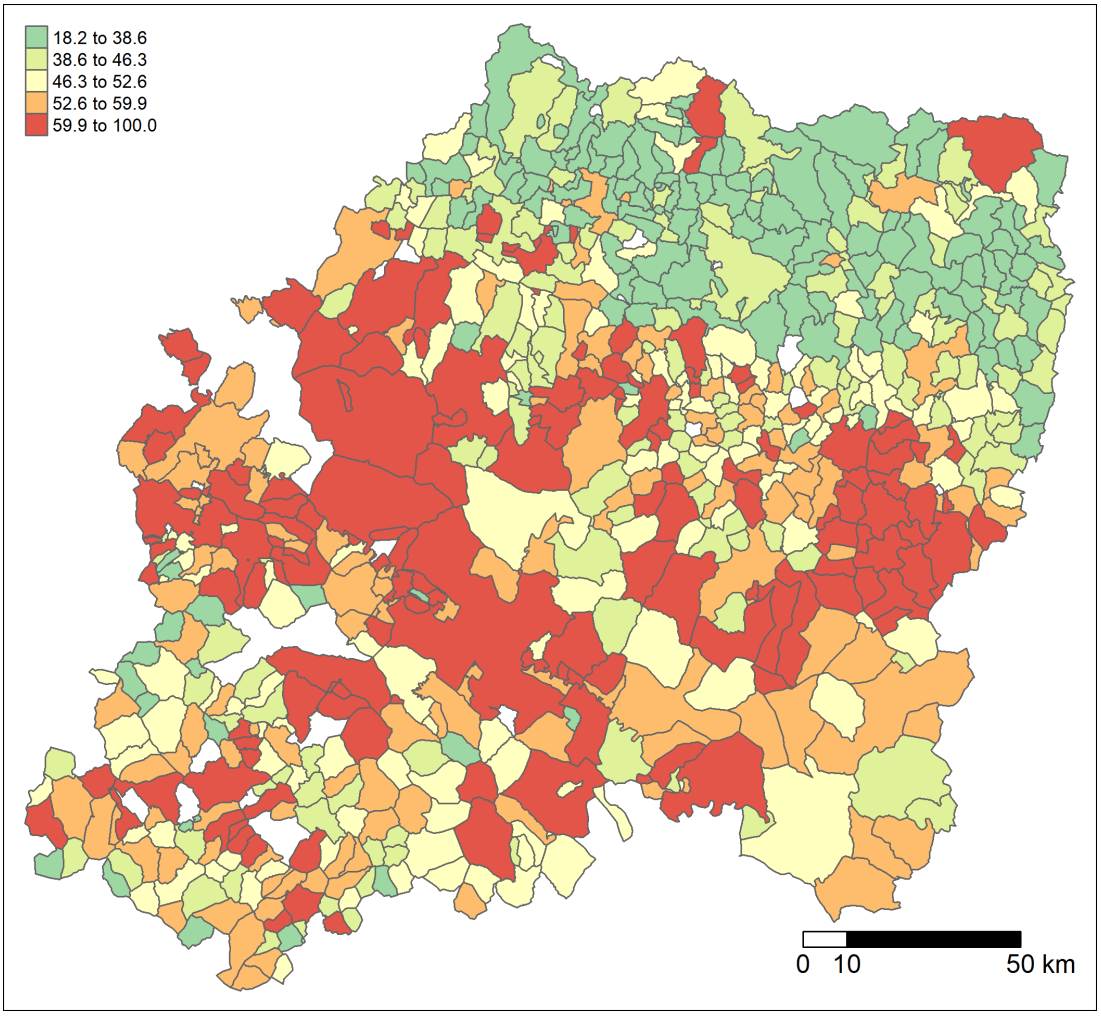
[11] While the information for all the municipalities in the provinces of Huesca and Zaragoza have been compiled by the author, the data for southern Navarre have been kindly shared by Jose Miguel Lana Berasain.

level. It is important to note that public institutions or the Church, even if they might have sufficient wealth to enter in the upper percentile, are not included in the calculation of the dependent variable. Furthermore, it's worth noting that the dependent variable only takes into account wealth distribution within each municipality, regardless of whether some owners had holdings in other towns.

Moreover, as noted by Tello and Badia-Miró (2018) in their analysis of Catalonia employing the same data source, it is important to acknowledge that this study exclusively focuses on property distribution related to land and real estate holdings. Consequently, this study provides a partial depiction of inequality, as it does not encompass industrial properties, financial assets, or income distribution. Nonetheless, it is essential to emphasize that the region under study was primarily oriented towards agricultural production, with industrialization only commencing towards the end of the 19th century, and this process was primarily within the agro-industry sector (German and Pinilla 1990). Hence, while the study of inequality is confined to the distribution of land and real estate, this limitation is relatively minor given the economic landscape of the region during the period under examination.

Figure 2 visually represents the quantile distribution of Wealth Inequality –sum of land and real estate net income in the *amillaramientos*- in the study area. Notably, a distinct geographical pattern emerges, with a concentration of high inequality observed in the central region, particularly along the Ebro valley. Conversely, in the northern municipalities of the Huesca and Zaragoza provinces, those situated in proximity to the Pyrenees, a significantly higher level of equality is evident, with the Top 10% holding less than 40% of the wealth in these towns. In the southwestern region of Zaragoza, the distribution is also characterized by greater equality, although it is not as pronounced as in the Pyrenees. As for the southern part of Navarre, the map illustrates that inequality was not confined to Aragon alone, as the Top 10% in towns surrounding Tudela displayed similar wealth shares to municipalities on the opposite side of the regional border.

Figure 2. Inequality, Wealth owned by the Top 10%



Source: Own elaboration with information from the *amillaramientos*.

The remaining variables sourced from the *amillaramientos* encompass categories of owners, wealth per capita, types of crops, wages, and productivity.

Within the first set of variables, owner categories were identified, distinguishing religious institutions (labelled as Church), public local authorities, predominantly the town council (labelled as Commons), and owners holding aristocratic titles (labelled as Aristocratic). For each of these variables, the share of wealth relative to the total wealth in each municipality was computed to measure the economic influence of these groups. In the context of Commons, it is expected that their presence would mitigate inequality or, at the very least, not exacerbate it. This is rooted in the historical role of common lands and public properties, highlighted by the literature as serving to alleviate the economic hardships of impoverished families (Beltrán Tapia 2015). Conversely, the Church's impact on inequality is expected to be somewhat less

straightforward, as its relationship with inequality may be more intricate. Moreover, the Mendizabal Disentailment, initiated in the late 1830s and primarily focused on the disentailment of Church properties, may have played a significant role. For instance, a lower share of the Church variable could suggest higher levels of expropriated properties and, consequently, increased inequality, given that these properties were often acquired by the wealthy (Sabio Alcutén 1997; del Valle Calzado 2016). Lastly, Aristocracy is expected to exert an increasing effect on inequality due to its historical association with privileged rights and feudal connections to the municipalities where they held influence, indicating a background of wealth accumulation.

In relation to wealth per capita, wages, and productivity, this set of variables is employed to gauge how affluence, increased production per hectare, and the wages earned by day labourers influence inequality. The calculation of wealth per capita involves summing the total wealth in the municipality and dividing it by the population reported in the 1860 Population Census. It is expected to have a negative impact on equality, as more prosperous towns tend to attract investors due to the potential for higher returns, potentially leading to an increase in wealth accumulation within the top percentile.

Moreover, data from the *amillaramientos* encompasses three categories of crops: cash crops, orchards, and cereals.[12] While the data source makes a distinction between vineyards and olive groves, for the sake of simplicity, both are combined, as it is assumed that they exhibit similar patterns of accumulation dynamics. These variables are calculated as the proportion of each of the three crop types in relation to the total surface area reported in the *amillaramiento*. Figures A.1, A.2 and A.3 in the Appendix represented the geographical distribution of these crops. A discernible pattern emerges: cereals are predominantly cultivated along the Ebro Valley and in the southeastern regions of the provinces of Zaragoza and Huesca. Cash crops, on the other hand, are primarily grown in proximity to major cities such as Zaragoza or Tudela and are subject to climatic constraints. Notably, cash crops are absent in the Pyrenees and the drier areas of the Zaragoza province. In contrast, orchards appear to thrive in the Pyrenees and the southern regions of Navarre and surrounding Aragonese towns.

Furthermore, to evaluate the land quality and the potential impact of increased productivity, the proportion of first-quality land over the total land is gathered from the data source. The *amillaramiento* classified land into three different quality types to represent

[12] The data for the Tudela district comes from Lana Berasain (1999).

potential production based on soil type and quality.[13] Although first-quality land had the highest tax rates, there is no correlation between concealment and the share of this land. Consequently, this variable will be employed to analyse how more productive land might influence property accumulation, with an expected positive effect. It is worth noting that although this variable is extracted from the *amillaramiento*, it should not be affected by the dependent variable, thus mitigating causality concerns. This variable primarily reflects soil quality rather than factors like irrigation, fertilizer usage, or other improvements made by property owners.

Finally, productivity and wages data are exclusively available for the Huesca province, as this information is found in the *cartillas evaluatiorias*, and these documents were attached only to the *amillaramientos* in this province. Regarding wages, the value is extracted for harvesting 1/10 of a hectare of rainfed cereal, which represents the amount of work a labourer could complete in a day, according to the *cartillas evaluatiorias*. Harvesting and rainfed cereal were chosen because they are reported in all municipalities, and harvesting was the agrarian task with the higher wage, setting a maximum benchmark for day labourers' earnings. Productivity is determined by calculating the kilos of cereals produced per hectare, and its value in Pesetas_{1913}.

Drawing from Milanovic et al. (2011), in the analysis only the variable that divides wealth per capita by the wage is included, reflecting the elite's extractive capacity. A higher value in this ratio is expected to heighten inequality, signifying an increased capacity to extract wealth from the elite. Regarding productivity, only Productivity in Pesetas_{1913}/ha, corrected by the share of cereal land in the municipality is studied. This is because high productivity in a town with a small capacity of production will not accurately reflect the potential effects of production on property accumulation.

First and Second Nature variables

The only First Nature variable included in this analysis is "roughness", which is computed as the degree of elevation heterogeneity within each municipality.[14] This measurement is in accordance with Riley et al.'s (1999) Terrain Ruggedness Index, which quantifies topographic variability. To calculate this index, Geographic Information System (GIS) techniques are employed, and the natural logarithm is applied to the Ruggedness index.

[13] For the district of Tudela this data was not possible to obtain, and therefore will not be included in the analysis when studying this variable.

[14] Other First Nature variables, such as average rainfall or temperature, are not included due to their correlation with each other and with other variables in the analysis. Among these correlated variables, ruggedness exhibits the least statistical issues.

The effect is expected to be negative, meaning that higher values of the index, signifying steeper terrain, will result in decreased inequality. This is because elevated slopes limit the potential for expanding cultivated lands and urbanization. For instance, when computing the Pearson correlation between roughness and the share of first-quality soil, there is a negative statistically significant correlation of 0.36. Similarly, the correlation between cereal productivity and roughness is negative statistically significant, having in this case a Pearson coefficient of 0.6. Therefore, in line with Gallego (2001), it is reasonable to expect that land with superior characteristics would be in higher demand.

Regarding population variables, the figures are obtained from the Madoz Dictionary, based on the Census of 1842 (*Censo de la matrícula catastral*). These figures are used to calculate the natural logarithms of the population levels in the mid-1840s for each town, as well as the population growth from that period to the 1860 Population Census. In accordance with findings in the literature (see for instance Wegge 2021), it is expected that population will exhibit a positive correlation with inequality, as more densely populated towns are likely to experience higher levels of inequality. Additionally, population growth is anticipated to have a negative impact, as an increasing number of inhabitants will result in greater demand for food and housing, potentially leading to higher revenues and returns on investments in land and real estate properties.

Furthermore, to gain insight into how proximity to markets influenced wealth distribution, two distance-related variables are incorporated. The first variable represents the natural logarithms of the straight-line distance from the municipality centre to Barcelona. It is anticipated that this proximity to Barcelona will have an increasing effect on inequality, as closer proximity may suggest higher returns on land investments, due to easier access to the Catalan market. The second variable measures the inverse of the distance to the district capital and is included for interaction with other variables, and therefore, higher values would indicate a closer distance, yielding higher results in the interaction. Similar to the previous variable, being in close proximity to a larger market, such as the district capital, is expected to increase inequality.

Ancient Regime Controls

These variables, which can be categorized into two groups, are sourced from the *Censo de Floridablanca*, offering comprehensive municipality-level data from the year 1787.[15] The first group encompasses four distinct variables, each reflecting the percentage of day labourers, priests, liberal professionals (lawyers, notaries, and traders), and artisans relative to the total population. The day labourer's variable is anticipated to exert a negative impact on inequality, suggesting that dispossessed agrarian labourers from the late 18th century might still be prevalent in the mid-19th century. In the case of priests, the effect is less straightforward due to the nationalization of Church estates occurring shortly before the *amillaramiento* (Iriarte 2002). A high percentage of priests might signify a significant Church presence, potentially leading to the concentration of Church properties in the town. These properties could then be acquired by a wealthy elite in the decades leading up to the *amillaramiento*. Moreover, a substantial presence of liberal professionals may contribute to increased inequality. During the privatization of commons and Church estates, this relatively small but affluent group could potentially acquire these estates, thereby amplifying inequality. Concerning artisans, a similar tendency toward increasing inequality may be observed. However, this less affluent group might face challenges in amassing properties. Similar to the effect of day labourers, this situation could suggest that individuals with lower incomes, lacking the capacity to acquire and retain properties, leave the top earners with the ability to further accumulate assets. Consequently, the effect of the percentage of artisans in the 18th century on inequality is less straightforward.

The second group of variables includes the jurisdictional lord of each municipality in the late 18th century. These variables indicate whether a municipality was under royal, religious, or aristocratic authority, assigning a value of one if the municipality was under one of these forms of governance and zero otherwise. However, for the purposes of this analysis, only the variable denoting being under aristocratic jurisdiction is employed, which will be used to address potential issues of causality, replacing the variable "Aristocracy" described earlier. Being under aristocratic jurisdiction is anticipated to lead to an increase in inequality, aligning with the negative findings related to this form of governance as revealed by Oto-Peralías (2019).

[15] The information to obtain this information was kindly provided by the Valencia Economic History Group.

Descriptive Statistics

Table 1 presents the summary statistics for the variables discussed above. Despite the lower threshold of 18.2% for the dependent variable, as illustrated in Figure 2, the average level of wealth held by the Top 10% was notably high in Navarre and Aragon. Nearly 50% of the wealth in land and real estate was concentrated in the hands of just 10% of the population. This wealth inequality level is significantly below other western countries, which according to Alfani (2023), during the mid-19th century, the Top 10% in Italy, the United Kingdom, the United States and France concentrated around three-quarters of the total wealth. If the entire individual sample is aggregated into a single territorial unit, the wealth concentration of the Top 10% reached 73.2%, which is consistent with the levels of wealth inequality observed in the United States and Italy (Alfani 2023).

In terms of the First and Second Nature variables, the average population was around 400 inhabitants, with the most populous town being Zaragoza, boasting 32,145 inhabitants. Population growth exhibited a significant average rate, although some towns experienced a decline in population during the period. The distance to Barcelona ranged from 148.3 to 362.5 kilometres, with an average distance of 243.7 kilometres. In terms of the distance to the district capital, most of the towns were situated within a distance of less than 10 kilometres (1/0.105), as the districts were relatively small, facilitating easy access to these local administrative capitals.

As for the *Ancien Régime* controls, there were 46 towns where information was missing in 1797, and therefore, they could not be included in the subsequent analysis. Furthermore, it is evident that the most numerous groups were artisans, and day labourers (*jornaleros*), or those who had to work for others to earn a living. Particularly noteworthy is the lower percentage of liberal professionals, such as lawyers, in comparison to the presence of religious individuals. As for the variables reflecting ownership structure, it is noteworthy that the presence of all three categories is relatively low, particularly in the case of the Church. This is likely due to the Disentailment process, which commenced around 15 years prior to the establishment of the *amillaramiento* and resulted in a significant transfer of Church properties to private individuals. The Commons category had more than double the representation of the Church category. This disparity is attributed to the Civil Disentailment that began just a few years before 1860, and it was expected to decline in the subsequent years following the formation of the *amillaramiento*. When examining the wealth owned by the aristocracy, it is particularly interesting to note that in some towns, nearly all properties were under noble ownership. This can be attributed to the

feudal origins of these properties and their historical ties to the town, as well as the acquisition of properties by aristocrats during the Disentailments.

Lastly, the last group of variables comprises data gathered from the *amillaramientos*. On percentages, the share of crops reveals that the primary land use was for cereals, followed by cash crops (vineyards and olive groves), with orchards lagging significantly behind. First quality land presents a similar pattern to cash crops, with a small presence on average, although there were municipalities where most of the land was highly productive. Moreover, the productivity for Huesca mirrors similar values to those obtained for the late 19th century in this province by Pinilla (1995), indicating the reliability of the source. Wealth per capita indicates that the average income from land and real estate properties was 58.4 $Pesetas_{1913}$ per year, while the average daily wage for harvesting was 2.7 $Pesetas_{1913}$.

Table 1. Summary statistics

Variables	N	Mean	SD	Min	Max
Share of wealth owned by Top 10%	655	49.317	13.149	18.242	100
First Nature					
Roughness (ln)	655	3.173	0.825	1.200	4.800
Second Nature					
Population in 1845 (ln)	655	5.997	0.825	3.664	10.378
Population growth 1845-1860	655	3.163	2.536	-7.748	16.816
Distance to Barcelona (ln)	655	5.496	0.227	4.999	5.893
Inverse Distance to District Capital	655	0.105	0.169	0.019	1
Ancien Régime Controls					
Day labourers	609	5.585	5.105	0	56.200
Priests	609	0.920	0.508	0	3.300
Liberal workers	609	0.166	0.491	0	7.400
Artisans	609	1.692	1.562	0	11.600
Owners					
Commons value share	655	2.331	5.182	0	43.208
Church value share	655	0.997	2.097	0	18.288
Aristocratic value share	655	3.517	10.131	0	97.179
Lordship jurisdiction in Ancien Régime	609	0.012	0.110	0	1
Amillaramiento *Variables*					
Wealth/pc ($Pesetas_{1913}$)	655	58.360	30.494	1.721	334.140
Share of cash crops (%)	640	10.553	14.477	0	96.028
Share of cereals (%)	640	46.781	27.712	1.232	100
Share of orchards (%)	640	0.788	3.373	0	63.895
First quality land (%)	621	10.322	10.949	0	90.710
Average daily wage harvesting rainfed cereal ($Pesetas_{1913}$)	353	2.666	0.998	0.471	7.431
Wealth per capita/Daily wage	353	20.447	12.473	3.024	70.119
Productivity (kg/ha)	353	760.572	227.720	297.739	1999.580
Productivity ($Pesetas_{1913}$/ha)	353	1108.961	309.238	301.590	2433.676
Cereal productivity	353	37.667	27.468	2.005	198.016

Methodology & Results

This section assesses the determinants of inequality by using the municipality level information presented above. Despite the spatial correlation of the dependent variable seen in Figure 2, using a spatial correlation model produces the same results, and therefore an OLS model is used.[16]

$$Ineq_i = \alpha + \beta_1 X_i + u_i$$

Where *Ineq* is the inequality measured as the share of wealth owned by the Top 10% in municipality *i.* Moreover, *X* comprises the *Amillaramiento*, *First and Second Nature* and *Ancien Régime* variables described above. The *u* accounts for the error term, which is clustered according to the geographical distribution of each municipality in its district. These clustered standard errors are introduced to control for the correlation that might happened within each district.

Results

Table 2 presents the results of the OLS regressions that incorporate various determinants of wealth inequality, spanning from columns (1) to (5). As anticipated, the topographical steepness of municipalities is revealed to diminish inequality, with this First Nature variable accounting for approximately one-third of the variation of wealth accumulation in mid-19th century Spain. To exemplify, based on the values provided in column (5), holding all other factors constant, a municipality with a roughness one standard deviation above the average would exhibit an inequality level 9.1% lower than the average municipality. This influence is pivotal, as it encompasses aspects such as land suitability for cultivation, land productivity, available expansion space, accessibility to markets, and its repercussions on demographic patterns.[17] All of these collectively underscore the significance of topography as a critical factor in the acquisition and accumulation of land and real estate properties. For instance, limited available land, coupled with reduced productivity due to the quality of the land and restricted potential for housing expansion, may act as disincentives for the accumulation of land and real estate due to the lower returns on this investment.

Similar to the results obtained in the literature, population and population growth increased inequality, as bigger towns were more unequal. This result reflects more equal rural

[16] Results upon request.

[17] As Pinilla (2004) has stressed, Spain was, together with Switzerland, the only European country where agricultural land covered only half of the country's surface, with the European average being at 83.8%.

towns as it has been found for other European countries. The larger towns are often indicative of greater market opportunities and, consequently, yield more attractive returns on investment, fostering increased wealth accumulation, rendering it a more profitable endeavour. Moreover, population growth in preceding years catalysed heightened demand for the assets under scrutiny here, namely, foodstuffs and housing. This further substantiates the notion that property owners demonstrated rational behaviour concerning their investments in land and real estate. For instance, the average municipality in the region had a population of 402 inhabitants in 1845, with an average annual growth rate of 3.2%, as depicted in Table 2. This indicates that over the subsequent 15 years until 1860, there would be an influx of roughly 190 new inhabitants, equivalent to approximately 40 new families.[18] As a consequence, this population growth necessitated the construction of new houses and an increased demand for foodstuffs to cater to the expanding populace.

With regard to market accessibility, as assessed by the distance to Barcelona, it is evident that proximity to the Catalan capital had no discernible impact. This outcome can be attributed to the ongoing process of integration in the emerging Spanish national market, which likely did not induce substantial effects on land or real estate accumulation. In particular, landowners may not have perceived significant advantages in proximity to the Catalan market. Issues pertaining to connectivity and transportation within Aragon may have persisted as the primary challenge in the mid-19th century, affecting landowners in the region equally, irrespective of whether they were located on the border with Catalonia or on the opposite side of Aragón.[19]

Similarly, the value of public municipality's properties over total wealth in the town did not exhibit a clear statistically significant impact on wealth inequality. However, the literature underscores the communal as a pivotal element in alleviating the plight of the impoverished (Beltrán Tapia 2015), highlighting that the access to the communal pool of resources offered a means to mitigate their lower incomes, which will be explored in the mechanisms section. Furthermore, in relation to the influence of Church-owned properties, the results show that it was not having a statistically significant impact on wealth accumulation in the upper percentile.

[18] Families of 5 members are considered for this calculation.

[19] See for instance Sabio Alcutén (2002) for the cost to transport cereals to the Ebro Valley and the transportation problems before the railroad arrive to the heart of the western district of Ejea in the province of Zaragoza. See also Sabio Alcutén (1989).

To assess the influence of the aristocracy on wealth inequality, two distinct measures are employed. In column (3), the analysis introduced the aristocratic share of total wealth, while in columns (4) and (5), a dummy variable is included to signify whether a town fell under lordship jurisdiction during the *Ancien Régime*.[20] As elucidated in the Summary Statistics section, this approach is adopted to mitigate potential issues related to causality between the aristocratic share and the dependent variable.[21] Notably, the results yielded striking similarities between these two variables, although the explanatory power is superior when the aristocratic share is incorporated. This positive association between the nobility and wealth inequality underscores the substantial economic influence wielded by this social stratum in mid-19th century Spain. For instance, in a municipality that fell under noble jurisdiction during the 18th century, the upper percentile would have accumulated approximately 30% more wealth compared to the average town. Furthermore, the persistent impact of lordship jurisdiction aligns with the findings articulated by Franco de Espés (2022) regarding the aristocracy in Aragon during the 19th century.[22] As the nation underwent a transition from an economy founded upon the social and economic relations of the *Ancien Régime* to a more modern one over the course of the century, the nobility displayed an inclination to adapt to these transformations. Formerly held properties and rights were reconfigured within the framework of the new Liberal administration bodies, such as the land registry offices. Consequently, these results corroborate the evolution of the aristocratic elite from its *Ancien Régime* roots into a prominent force within the emerging capitalist society.

In relation to wealth per capita, the results are statistically significant, and positive, as expected, increasing in 3.5 percentage points the wealth accumulated by the top percentile if the town increased its wealth/pc in one standard deviation. Wealthier municipalities attract investors and motivate local residents to amass greater assets. Greater prosperity within these towns may signal elevated wages and increased purchasing power, potentially resulting in augmented profits within the local market and, consequently, higher returns on investment. For instance, towns with higher wealth per capita may command higher rents for comparable types

[20] The Pearson correlation between the two variables is 0.29, statistically significant at 1%.

[21] The introduction of the aristocratic share of total wealth in column (5) is due to the restriction on observations in this regression, as almost all the observation with aristocratic jurisdiction are eliminated in this model.

[22] See also Atienza López and Forcadell Álvarez (1991), Pérez Picazo (1991) and Sánchez Marroyo (1991)

of housing, rendering real estate investment and accumulation in these prosperous municipalities more financially rewarding.

In the context of specialization on cash crops (olive groves and vineyards), the initial results indicate no discernible effect of this variable on wealth inequality. Nonetheless, it is important to note that, as argued by Pinilla (1995), these crops were notably market-oriented. Consequently, the mechanisms section will feature a more comprehensive analysis aimed at exploring whether proximity to important regional markets may interact with the cultivation of cash crops, and therefore affect inequality.

The economic structure of the municipalities is incorporated into the analysis by considering the distribution of priests, artisans, liberal professionals, and day labourers in the year 1797. In this context, only the presence of artisans exhibits statistical significance, resulting in an increase in wealth inequality, although day labourers are significant in column (5), which will be explored in the mechanisms section. This outcome suggests that a higher prevalence of this occupational group is associated with a reduced population possessing the purchasing power and capacity required to accumulate and retain land and real estate assets. Consequently, this scenario creates more market opportunities for the affluent to acquire properties and accumulate wealth, ultimately leading to heightened inequality. Nonetheless, the effect would be small, increasing inequality in 3.1% over the average with one standard deviation rise in the number of artisans in a given town in 1797.

Lastly, Table A.1 in the Appendix replicates columns (4) and (5) of Table 2, introducing District Fixed Effects in Columns (3) and (4), and incorporating spatially lagged Communal, Church, and Wealth/pc in Columns (5) and (6). Concerning the former, the results mirror those without District Fixed Effects, affirming the outcomes presented in Table 2. As for the latter, the lagged variables utilized were derived from the *amillaramiento* and may raise causality concerns. Following Blume et al. (2015) and Cerulli (2017) when spatial correlation is observed in a particular variable, it could be assumed that neighbouring observations may reflect the value of that variable in a given observation.[23] Therefore, causality problems are overcome since the dependent variable does not influence independent variables in neighbouring observations. For instance, inequality in a town should not be influencing the amount of communal lands in the neighbouring municipality. The results in Table A.1

[23] In the case of Communal, Church, and Wealth/pc, the Moran I statistic is statistically significant, indicating spatial correlation among municipalities in these variables.

corroborate those presented in Table 2, demonstrating that wealth/pc contributed to inequality, but inequality did not affect wealth/pc. Furthermore, some effects of communal properties on inequality were observed, which, as mentioned earlier, will be further explored in the mechanisms section.

Moreover, Table A.2 in the Appendix shows the results of the regression analysis but for three different population thresholds. Being 500 inhabitants the median population in 1860, and the average 1,000, the three thresholds try to represent the different types of municipalities in the region under study, while keeping an adequate number of observations for each group. For those municipalities below 1,000 the results are the same than for the whole sample, while for those towns more populated, aristocracy and wealth/pc do not have an effect on inequality. However, column (7) introduced wealth/pc and share of wealth owned by nobles spatially lagged, following the methodology explained above for Table A.1, columns (5) and (6). In this case, while wealth/pc remains statistically insignificant, aristocracy mirrors the result for the rest of the sample increasing inequality, confirming the results obtained for Table 2.

In conclusion, the results presented in Table 2 illustrate that market dynamics and accessibility played a crucial role in wealth accumulation. Despite the arguments made by Stiglitz (1986), as well as the demonstration by Garrabou et al. (2001) for Catalonia, asserting that sharecropping, indirect exploitation or family farms might be more efficient, the incentives to accumulate properties during the period under study were related to power and status. It conferred market influence upon the owners, influencing the allocation of agrarian units of production to landless families, housing, providing job opportunities, and controlling the credit markets as well as the foodstuff market when rent payments were made in kind. In this context and following Binswanger et al. (1995), elites used their influence to further accumulate wealth in those towns with higher productivity or improved market access where they could increase their rent extraction capacity, have a larger share of the housing rental market, or a more advantageous position in the credit market, as greater property ownership were related with lower interest rates (Sabio Alcutén 1996). This is also corroborated by the nobility's capacity to adapt to the evolving landscape of liberal property rights and the emerging market economy, highlighting the persistence of aristocratic elites to retain their economic and social power. Moreover, as pointed out by Germán and Forcadell (1988), Germán and Pinilla (1990) and Pinilla (1995), the liberalization of the national market and the advent of a market economy were positioning the region under analysis as a significant agricultural producer in the national market. This made investments in land, as well as in elements such as flour and oil mills –real

estate properties related to the agro-industry– a logical choice for the top 10% within the region's specialization, in contrast to Catalonia where the industrial sector might have been more appealing for investment.

Table 2. Inequality (Share of Top 10%). OLS regressions

	(1)	(2)	(3)	(4)	(5)
Roughness (ln)	-9.206***	-8.198***	-4.876***	-5.647***	-5.442***
	[0.849]	[0.538]	[0.550]	[0.673]	[0.801]
Population in 1845 (ln)		4.494***	5.174***	5.136***	4.288***
		[0.638]	[0.678]	[0.643]	[0.819]
Population growth 1845-1860 (%)		1.130***	1.121***	1.317***	1.227***
		[0.151]	[0.194]	[0.152]	[0.157]
Distance to Barcelona (ln)		3.802	1.555	1.301	-0.980
		[2.942]	[2.620]	[2.904]	[2.647]
Communal (%)			-0.141*	-0.132	-0.090
			[0.078]	[0.090]	[0.091]
Church (%)			-0.151	-0.232	-0.223
			[0.143]	[0.153]	[0.154]
Aristocracy/ Aristocratic jurisdiction			0.449***	13.656***	13.531***
			[0.039]	[1.817]	[2.299]
Wealth/pc Pesetas$_{1913}$			0.082***	0.106***	0.116***
			[0.025]	[0.032]	[0.037]
Cash crop (%)					0.028
					[0.031]
Artisans (%)					0.827***
					[0.124]
Priests (%)					0.858
					[0.878]
Liberal prof. (%)					0.882
					[1.129]
Day labourers (%)					0.174
					[0.137]
N	655	655	655	655	595
Adj. R2	0.333	0.420	0.565	0.467	0.490

Intercept omitted. Standard errors clustered by district in brackets, and statistical significance: *** 1%, ** 5% and * 10%

Wages and Productivity

In this section, an analysis of how wages and productivity may have influenced inequality are presented, aligning with the argument put forth by Milanovic et al. (2011). These authors contend that wages played a pivotal role in the wealth accumulation of the elite, as they would reflect the ability of this group to extract wealth. Table 3 showcases the regression analysis removing in the three regression models roughness and wealth/pc due to the correlation with the variables analysed in this section. Column (1) includes the exploration of the effect of first quality soil on inequality for the whole sample, while columns (2) and (3) are only for the municipalities in the province of Huesca, the only region in the sample where wages and productivity data at the municipal level have been obtained.

First quality land had a positive and statistically significant impact on property accumulation, although when productivity is included is no longer significant, due to the correlation between both variables.[24] Nevertheless, for the whole sample, column (1), the significant effect of the variable confirms the arguments made for roughness. Similarly, cereal productivity, which measures the productivity per hectare of cereals and is adjusted based on the percentage of land allocated to this crop in the municipality, indicates that productivity contributed to increased inequality. In a municipality with productivity one standard deviation above the average, inequality would be approximately 4.4% higher than in an average town. Thus, the findings for first-quality soil and productivity aligns with the previously discussed argument that higher productivity, leading to greater returns on land investment, resulted in a rationale behaviour of the elite, as they would increase property accumulation due to the higher expected profits.

The increasing inequality effect of wealth/wages seen in in columns (2) and (3) could be attributed to a decline in wages or an increase in general wealth per capita. In both cases, such a change would imply heightened extraction power wielded by the socio-economic elite. A greater wealth per capita would indicate potential for increased profits and, consequently, opportunities to enhance returns on investment. Lower wages would denote more immediate benefits due to reduced costs, thus affording more chances to amass cash wealth and potentially the resources required to invest and accumulate land or real estate assets, further amplifying returns and benefits. Moreover, the result for cereal productivity further emphasizes the role of productivity on wealth accumulation. Additionally, high-quality soil is no longer statistically significant in column (3), showing that this variable was partially reflecting land productivity.

Table 3. Inequality and productivity and wages. OLS[25]

	(1)	(2)	(3)
First quality land	0.126***	0.203***	0.108
	[0.039]	[0.078]	[0.083]
Wealth per capita/wages		0.230***	0.214***
		[0.024]	[0.082]
Cereal productivity			0.073**
			[0.003]
N	576	350	350
Adj. R2	0.466	0.524	0.527

Regressions using model (5) from Table 2. Standard errors clustered by district in brackets, and statistical significance: *** 1%, ** 5% and * 10%

[24] The Pearson correlation coefficient is 0.46, statistically significant at 1%.
[25] Table A.3 in the Appendix displays all the variables.

Mechanism

This section will focus on elucidating the various mechanisms that underpin inequality within a pre-industrial agrarian society. To this end, the model in Table 2 column (4) is used to calculate how the slopes of the variables of interest, as illustrated in the first column of Table 4, are influenced when interacted with various other factors detailed in the second column under "Interaction.".[26] These slopes adhere to the same rationale as the coefficients represented in Tables 2 or 3, providing a more accessible means of comprehending interactions involving continuous variables, complemented by the graphical representations presented in section B of the Appendix.

Table 4. Interactions and effect on coefficients[27]

Variable	Interaction	When Interaction being equal to:	Slope of the Variable (coefficient)
Population growth 1845-1860	Roughness	2.345 (- 1 SD)	1.42***
		3.187 (mean)	1.06***
		4.029 (+ 1 SD)	0.70***
Commons	Roughness	2.345 (- 1 SD)	-1.14***
		3.187 (mean)	-0.67***
		4.029 (+ 1 SD)	-0.20**
Day labourers in 1797	Commons	-2.914 (- 1 SD)	0.30**
		2.308 (mean)	0.24**
		7.531 (+ 1 SD)	0.18*
Cash crops	Distance to district capital	-0.067 (- 1 SD)	-0.04
		0.108 (mean)	0.01
		0.278 (+ 1 SD)	0.07*
Cereals	Distance to Barcelona	0.003 (- 1 SD)	-0.09***
		0.004 (mean)	-0.07***
		0.005 (+ 1 SD)	-0.05*

Roughness

In this case, it is analysed how roughness affected the impact on inequality of population growth and Commons properties. Concerning population growth between 1845 and 1860, it is important to note that while population growth heightened inequality, the ruggedness of the terrain was found to mitigate this negative impact. The steeper the terrain, the less pronounced the increase in inequality attributable to population growth. Notably, the impact is nearly halved when transitioning from a roughness index of 2.4 to 4. This aligns with the rationale articulated previously. A more challenging terrain, characterized by limited access to other markets, constrained cropland expansion, or restricted urbanization areas, serves to

[26] The selection of the regression model in Table 2 column (4) is due to the differentiated statistical significance of some variables in column (4) and column (5) when roughness and wealth/pc are removed.

[27] It has to be taken into account that the average of the variables presented here do not exactly coincide with the ones presented in the Table 1 (Summary Statistics) due to the reduction of the observations when calculating the interaction. Same with the Productivity and Roughness as it is only for the province of Huesca.

curtail the economic dynamics stemming from population growth. This would have a direct impact on the returns obtained by land and real estate investments, limited the raise of wealth accumulation made by population growth.

In the case of Common properties, their impact on inequality is noteworthy, despite their absence in Table 2. Commons exert a positive influence, resulting in a reduction of inequality, particularly in municipalities characterized by lower topographical roughness. Furthermore, the extent of this impact varies significantly, being tenfold higher in towns with a roughness index of approximately 2.4 compared to those with an index of 4. This suggests that municipalities with the same amount of Common properties but differing topographical characteristics would experience markedly distinct accumulations within the upper percentile. This observation might hint at a phenomenon emphasized by Sabio Alcutén (2002) in the western part of Aragon. Common lands served as a means for day labourers and impoverished farmer families to acquire cropland. Consequently, in municipalities where these commons were suitable for cultivation and not exclusively for grazing, the legal allocation of lands by the town council to those in need could contribute to a reduction in inequality. Moreover, in instances where farmers made unauthorized land acquisitions, the registration of these lands in the *amillaramiento* served as a means of legitimizing such ownership. Hence, municipalities endowed with identical levels of Commons properties, yet subject to variations in the suitability of their common lands for cultivation due to their topography, appear to exhibit a substantial influence on wealth accumulation.

Day labourers and commons

In this case, Table 4 and Graph B.5 delve into the interaction between communal resources and the percentage of day labourers in 1797 within each municipality. First and foremost, it should be noted that a reduction of one standard deviation in Common properties is not feasible, as there cannot be a share of -2.9%. A decrease in communal resources –perhaps attributable to the sale of communal land, for instance – translates into an escalation in wealth inequality. This suggests that the wealth owned by the municipality was, in a way, mitigating the impact that the presence of propertyless families had on wealth accumulation. For instance, the absence of commons in a town could signify that impoverished families could not access free grazing lands and firewood, or food products collected from these lands. Similarly, the lack of a public slaughterhouse or mill could result in higher prices for meats or grain processing. Consequently, these families in the lower percentile would be more vulnerable to

economic shocks, such as market fluctuations and crop failures, making it easier for the upper percentile to acquire properties from them during challenging times.

Crops and markets

Finally, the last interaction explored the relationship between crops and distance to markets measured as the distance to a district capital and Barcelona. Regarding the relation between cash crops and distance to district capitals, Table 4 shows that there was only an effect when increasing one standard deviation, however Graph B.8 in the Appendix, representing the Johnson-Neyman plot for the interaction, shows a clearer interpretation. When the municipality was within 5 kilometres to a district capital, there was a statistically significant effect of cash crops on inequality, increasing it.[28] Therefore, this means that being closer to the district capital, with higher shares of cash crops, the municipality would have higher inequality.

This observation aligns with von Thünen's agricultural land use classification (Fujita and Thisse 1986) and corroborates the argument put forth by Padró et al. (2019). Proximity to the district capital, characterized by a more vibrant market and enhanced connectivity, might incentivize both local landowners and small-scale farmers to allocate their lands to vineyards and/or olive groves. For the former, a greater concentration of these crop lands translates to a larger share of the wine and olive oil market within the district, encouraging land accumulation to bolster their market presence. For the latter, specialization in cash crops becomes a rational choice to generate income, facilitating access to the local market for the purchase of essential foodstuffs that would otherwise be cultivated on their own plots, as proposed by Padró et al. (2019). However, as highlighted by Sabio Alcutén (2002), in the informal credit market, which constituted a pivotal component for propertyless families and impoverished farmers, the absence of collateral or the imposition of higher interest rates on these families may result in a heightened risk of default, eviction, and bankruptcy when reliant on a single cash crop. This, in turn, could render these families more vulnerable to property acquisition by the affluent, providing an easier avenue for wealth accumulation.

When considering the influence of cereals and their commercialization in relation to Barcelona, Graph B.7 and Table 4 present a clear depiction of the interaction between these two variables. The presence of cereals within a municipality is associated with a decrease in inequality, and this effect becomes more pronounced the farther the town is from Barcelona. Hence, the findings suggest that proximity to the Catalan market contributes to property

[28] Nevertheless, these range comprises only 53 municipalities of the 655 in the region, or 8.1%.

accumulation, as this geographical advantage likely encourages landowners to acquire more land for the purpose of benefiting from the commercialization of cereals. This advantage may manifest in various forms, such as reduced transportation costs due to larger product quantities or a larger share of the Catalan market.

Conclusions

The understanding of how inequality has evolved in the past centuries and its determinants is crucial to understand the dynamics that shape modern inequality (Milanovic et al. 2011; Piketty 2013; Alfani 2023). Moreover, as Galor and Zeira (1993), Alesina and Rodrik (1994), Aghion et al. (1999), Cingano (2014) or Berg et al. (2018) show inequality hampers economic growth, having a direct impact on politics and access to healthcare and education (German 1984; Marco-Gracia and Luque de Haro 2023; Cinnirella and Hornung 2016; Beltrán Tapia and Martinez-Galarraga 2018; Goñi 2021). Therefore, comprehending the evolution and determinants of inequality is crucial to have a comprehensive understanding of how inequality affected economic development in developing countries in the 19th century and nowadays.

Thus, this paper not only shows the inequality levels in a wide range of towns in line with the works of Alfani et al. (2022), Alfani 2023, Wegge (2021), but following Tello and Badía-Miró (2018) it also depicts its determinants, which facilitates an understanding of how inequality has evolved. This is particularly interesting for Spain as a case study, because during the 19th century, it was a developing society in a period with an important rage of political, social and economic changes. Moreover, agriculture, which employed the majority of the population, was experiencing important structural changes as it was put through in García Sanz and Garrabou (1985). Therefore, this paper focused on this case study in order to disentangle how in an agrarian and developing country, the initial steps into the capitalist economy affected inequality. This shed light on how this change could happened in other societies during this period or for more recent cases in developing countries.

Echoing the arguments presented by Gallego (1998 and 2001), this paper illustrates how market forces and productivity were instrumental in property accumulation and, by extension, in wealth inequality in mid-19th century Spain. Market and productivity ruled wealth distribution, while the economic elites were able to retain power due to their previous privilege status. Factors such as the presence of more productive lands, easier access to local markets, and a growing population incentivized market behaviour, leading to a predominance of wealth accumulation and market-oriented investments over traditional property conceptions. Wealth

was not concentrated in remote mountainous villages; rather, it was accumulated in thriving towns where market access was convenient and high returns were anticipated.

In conclusion, this paper addresses two key issues. First, it affirms the argument put forth by Binswanger et al. (1995) that elites managed to augment their wealth, despite large land holdings not being the most efficient means of agrarian production during this period. Secondly, this paper sheds light on the reasons behind the rise in inequality during the 19th century, as highlighted by Prados de la Escosura (2008) for Spain, and demonstrated in other Western countries by Alfani (2023). Thus, in agrarian and developing nations during the 19th century, such as Portugal, Italy, Greece, or Spain, market access, productivity, and the continuous consolidation of power by the socioeconomic elite played a crucial role in shaping the evolution of inequality, influencing economic development, as emphasized by Aghion et al. (1999) and Berg et al. (2018).

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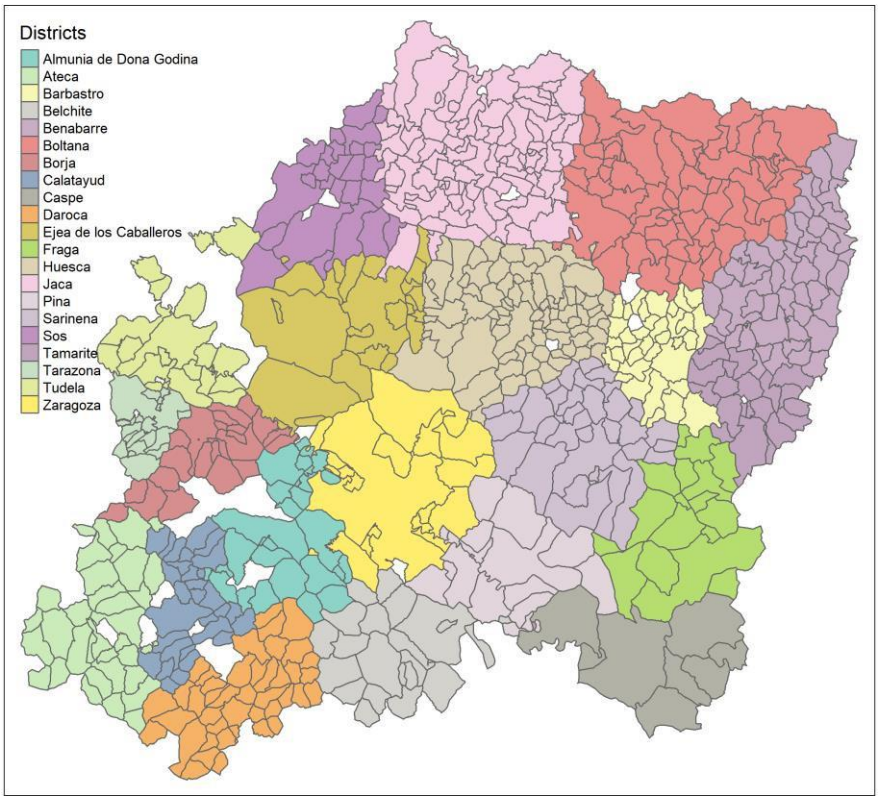
Appendix

Figure A.1. Districts

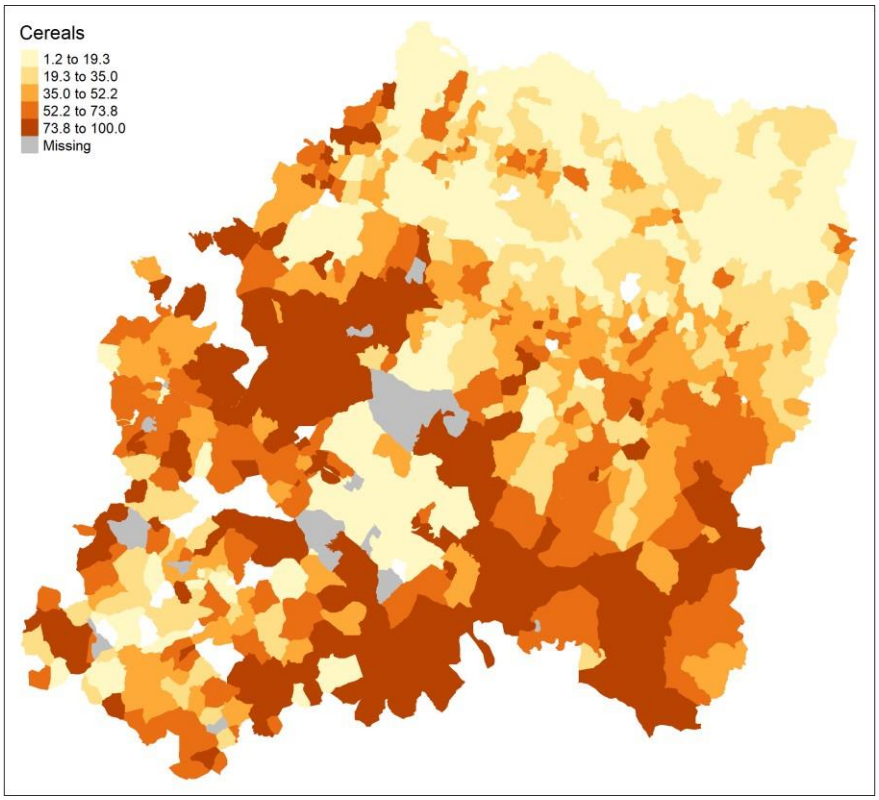


Source: Own elaboration.

Table A.1. Year Distribution

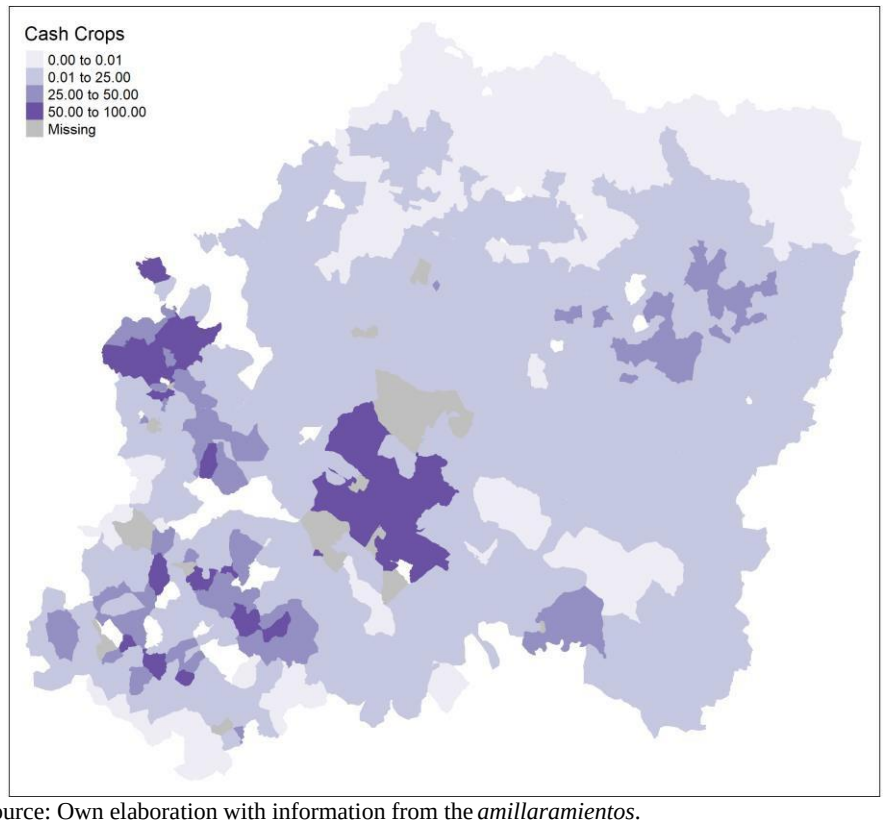
Year	Frequency	Percent	Cum.
1848	2	0.3	0.3
1849	23	3.5	3.8
1850	4	0.6	4.4
1851	15	2.3	6.7
1852	4	0.6	7.3
1853	5	0.8	8.1
1854	1	0.2	8.2
1855	1	0.2	8.4
1856	1	0.2	8.5
1860	23	3.5	12.1
1861	108	16.5	28.5
1862	93	14.2	42.7
1863	373	56.9	99.7
1864	2	0.3	100.0
Total	655	100	

Figure A.1 Cereals



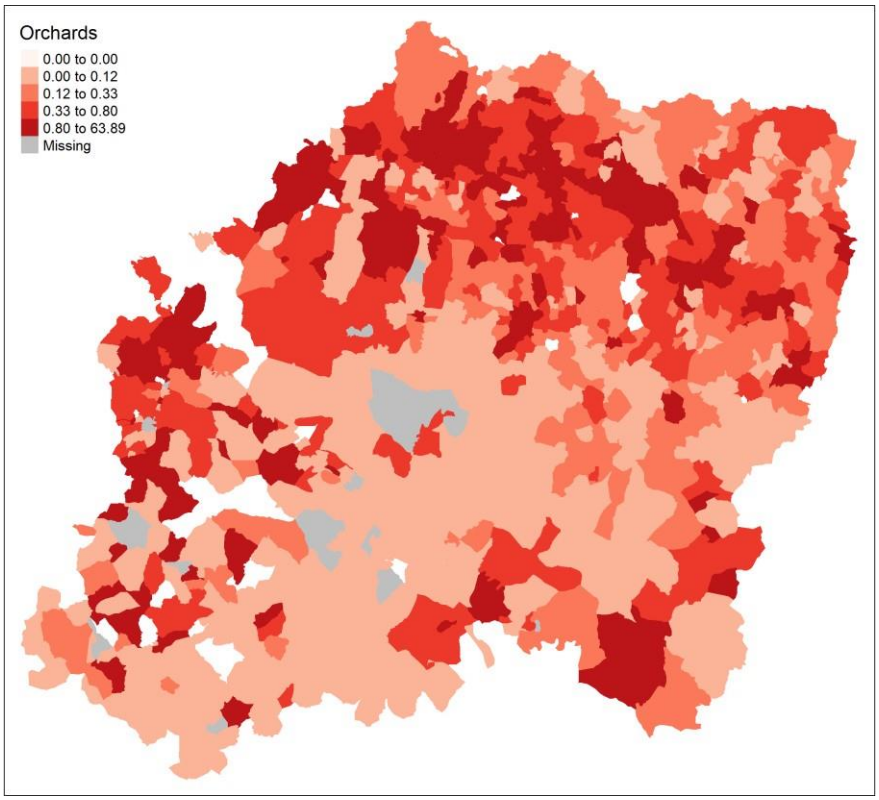
Source: Own elaboration with information from the *amillaramientos*.

Figure A.2 Cash Crops



Source: Own elaboration with information from the *amillaramientos*.

Figure A.3 Orchards



Source: Own elaboration with information from the *amillaramientos*.

Section A

Concealment explanation

For the data used in this paper, the reported land represented 58.2% of the actual land, indicating an approximate 40% concealment of land. Significantly varying degrees of concealment were observed among the three provinces, with higher levels in southern Navarre (around 75%), Zaragoza (approximately 50%), and lower concealment in Huesca (about 34%).

However, the primary concern revolves around grazing and pasture lands. Considering that there are 20 municipalities missing data in Zaragoza, the total reported hectares of cultivated land in the *amillaramientos* amounted to 365,559.2. Del Moral Ruiz reported 369,548.7 cultivated hectares for the province of Zaragoza in the 1850s, and in 1860, Pinilla (1995, table A.3) reported 370,412 hectares. Yet, Pinilla also noted that in 1860, there were 1,254,536 hectares designated for grazing lands, pastures, and meadows. When these non-cropland areas were factored into the amillaramiento data, the total was only 148,972.1 hectares. A similar pattern emerged in the comparison with Huesca province. The hectares reported in the *amillaramientos* exceeded those calculated by Pinilla (1995, table A.1), with 393,630.5 compared to the 316,124 reported by Pinilla. However, the difference once again lay

in the area designated for grazing lands, with the amillaramiento reporting 515,644 hectares compared to the 1,127,676 hectares calculated by Pinilla (1995).

Therefore, it becomes evident that the significant discrepancy in reported land area primarily stems from the omission of grazing lands, meadows, and pastures. This omission was particularly noticeable in certain towns in the province of Zaragoza, where approximately 40% of the municipalities did not report the surface area of their pasture lands, although they reported their corresponding values. By considering the croplands reported by 15 of these towns and comparing them with the cultivated area data from local maps dating back to the early 20th century (*Minutas MTN50*), the concealment in this sample decreased from 63.6% to 16%. This suggests, as previously mentioned, that the main issue concerning land concealment in this region primarily pertained to grazing and pasture lands. Nevertheless, this should not significantly impact the analysis since the values of these lands were indeed reported, thus posing no hindrance to the overall analysis.

Table A.1. Inequality (Share of Top 10%). OLS regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Roughness (ln)	-5.647***	-5.442***	-4.601***	-4.329***	-5.934***	-6.088***
	[0.673]	[0.801]	[0.848]	[0.947]	[0.734]	[0.763]
Population in 1845 (ln)	5.136***	4.288***	4.880***	4.320***	4.208***	3.247***
	[0.643]	[0.819]	[0.588]	[0.760]	[0.534]	[0.734]
Population growth 1845-1860 (%)	1.317***	1.227***	1.221***	1.223***	1.063***	0.962***
	[0.152]	[0.157]	[0.186]	[0.195]	[0.131]	[0.136]
Distance to Barcelona (ln)	1.301	-0.980	11.022	9.940	1.165	-1.342
	[2.904]	[2.647]	[7.382]	[7.882]	[3.082]	[2.874]
Communal (%)/Lag	-0.132	-0.090	-0.093	-0.083	-0.348**	-0.214*
	[0.090]	[0.091]	[0.088]	[0.098]	[0.141]	[0.114]
Church (%)/Lag	-0.232	-0.223	-0.205	-0.171	0.410	0.427
	[0.153]	[0.154]	[0.191]	[0.222]	[0.426]	[0.466]
Aristocracy/ Aristocratic jurisdiction	13.656***	13.531***	12.576***	12.003**	10.312***	9.942***
	[1.817]	[2.299]	[4.365]	[5.281]	[2.654]	[3.148]
Wealth/pc $Pesetas_{1913}$/Lag	0.106***	0.116***	0.098***	0.120***	0.080***	0.085**
	[0.032]	[0.037]	[0.028]	[0.032]	[0.043]	[0.041]
Cash crop (%)		0.028		0.012		0.022
		[0.031]		[0.037]		[0.039]
Artisans (%)		0.827***		0.779***		0.918***
		[0.124]		[0.249]		[0.153]
Priests (%)		0.858		0.952		0.757
		[0.878]		[0.860]		[0.877]
Liberal prof. (%)		0.882		0.416		1.073
		[1.129]		[1.404]		[1.046]
Day labourers (%)		0.174		0.166		0.187
		[0.137]		[0.131]		[0.135]
N	655	595	655	595	655	595
Adj. R2	0.467	0.490	0.496	0.512	0.440	0.464
District Fixes Effects	No	No	Yes	Yes	No	No

Intercept omitted. Standard errors clustered by district in brackets for columns (1), (2), (5) and (6), and robust errors for columns (3) and (4), and statistical significance: *** 1%, ** 5% and * 10%

Table A.2. Inequality (Share of Top 10%). OLS regressions

	Below 500		500-1000		Above 1000		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Roughness (ln)	-5.285***	-4.440***	-5.638***	-5.731***	-4.891***	-5.492***	-4.793***
	[0.983]	[1.215]	[1.447]	[1.402]	[0.972]	[1.201]	[1.149]
Population in 1845 (ln)	4.946***	5.010**	2.764	0.924	5.755***	5.573***	5.444***
	[1.679]	[2.056]	[2.682]	[2.741]	[1.570]	[1.874]	[1.800]
Population growth 1845-1860 (%)	1.302***	1.272***	1.130**	1.026**	1.395***	1.452***	1.363***
	[0.309]	[0.390]	[0.511]	[0.457]	[0.415]	[0.431]	[0.425]
Distance to Barcelona (ln)	-0.648	-2.373	-2.45	-5.142*	5.159	3.455	3.556
	[3.786]	[2.996]	[3.223]	[3.014]	[4.069]	[4.906]	[4.610]
Communal (%)	-0.109	-0.102	-0.078	-0.028	-0.334*	-0.182	-0.204
	[0.090]	[0.107]	[0.159]	[0.163]	[0.190]	[0.205]	[0.185]
Church (%)	-0.965**	-0.921*	0.096	0.294	-0.286	-0.252	-0.438
	[0.392]	[0.523]	[0.250]	[0.241]	[0.211]	[0.266]	[0.282]
Aristocracy/ Aristocratic jurisdiction	30.319***	32.856***	19.702***	18.401***	1.021	1.18	0.260**
	[4.588]	[3.727]	[2.468]	[2.480]	[1.254]	[1.431]	[0.125]
Wealth/pc Pesetas$_{1913}$	0.112***	0.141***	0.178***	0.163***	0.028	0.024	0.029
	[0.043]	[0.050]	[0.052]	[0.049]	[0.028]	[0.030]	[0.036]
Cash crop (%)		0.036		-0.009		0.001	-0.008
		[0.052]		[0.071]		[0.036]	[0.035]
Artisans (%)		0.924***		1.226***		0.116	0.135
		[0.272]		[0.347]		[0.347]	[0.335]
Priests (%)		0.201		-0.693		3.850**	4.126***
		[1.114]		[1.062]		[1.789]	[1.542]
Liberal prof. (%)		1.750		8.170*		0.144	-0.19
		[1.431]		[4.474]		[1.135]	[1.032]
Day labourers (%)		0.069		0.237		0.233	0.205
		[0.148]		[0.208]		[0.155]	[0.155]
N	294	262	196	184	166	150	150
Adj. R2	0.405	0.423	0.465	0.487	0.335	0.354	0.382

Intercept omitted. Standard errors clustered by district in brackets, and statistical significance: *** 1%, ** 5% and * 10%

Table 2. Inequality (Share of Top 10%). OLS regressions

	(1)	(2)	(3)
Population in 1845 (ln)	3.799***	3.021**	2.389*
	[0.644]	[1.254]	[1.374]
	0.907***	0.996***	0.899***

Population growth 1845-1860 (%)	[0.175]	[0.269]	[0.265]
Distance to Barcelona (ln)	-0.860	-4.076	-3.926
	[2.025]	[7.747]	[7.374]
Communal (%)	-0.401***	-0.269*	-0.207
	[0.082]	[0.151]	[0.128]
Church (%)	0.124	-0.113	-0.039
	[0.250]	[0.441]	[0.437]
Aristocracy/ Aristocratic jurisdiction	0.647***	0.578***	0.595***
	[0.044]	[0.038]	[0.032]
Cash crop (%)	0.095***	0.139	0.136
	[0.034]	[0.133]	[0.130]
Artisans (%)	0.969***	1.036***	1.158***
	[0.287]	[0.166]	[0.187]
Priests (%)	0.045	-0.863	-0.650
	[0.838]	[0.715]	[0.823]
Liberal prof. (%)	1.410	2.936***	3.315***
	[0.862]	[0.943]	[0.868]
Day labourers (%)	0.285***	0.244	0.178
	[0.096]	[0.233]	[0.196]
First quality land	0.126***	0.203***	0.108
	[0.039]	[0.078]	[0.083]
Wealth per capita/wages		0.230***	0.214***
		[0.024]	[0.024]
Cereal productivity			0.073**
			[0.033]
N	576	350	350
Adj. R2	0.466	0.514	0.527

Intercept omitted. Standard errors clustered by district in brackets, and statistical significance: *** 1%, ** 5% and * 10%

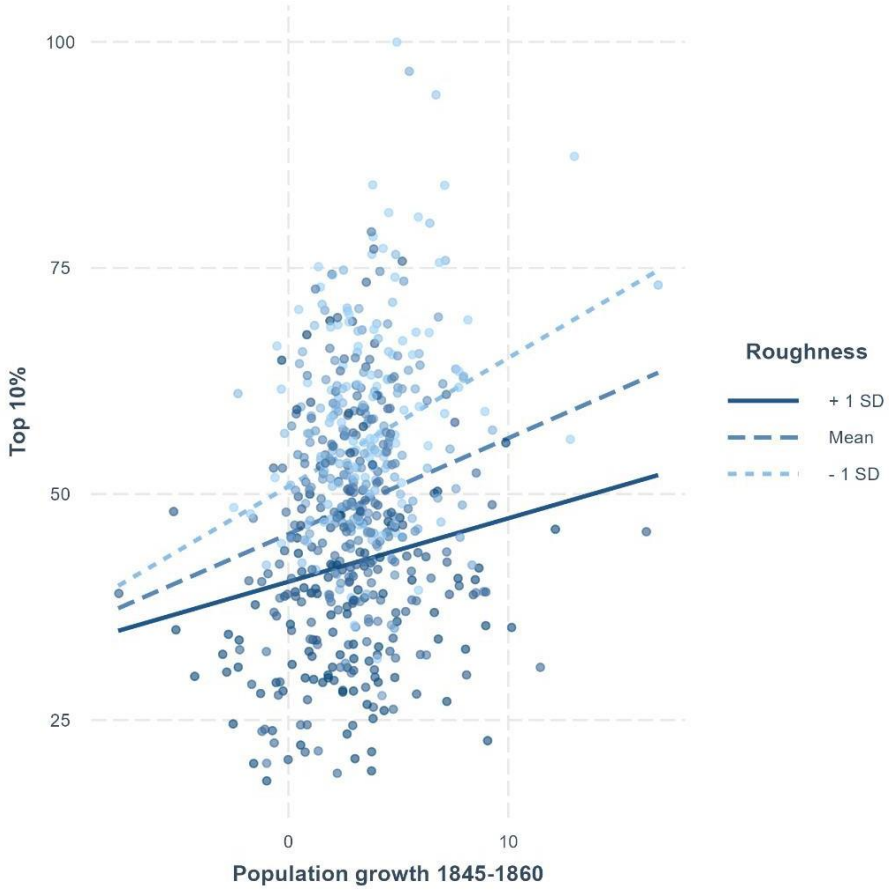
Section B. Mechanisms

Table B.1. Mechanism. OLS

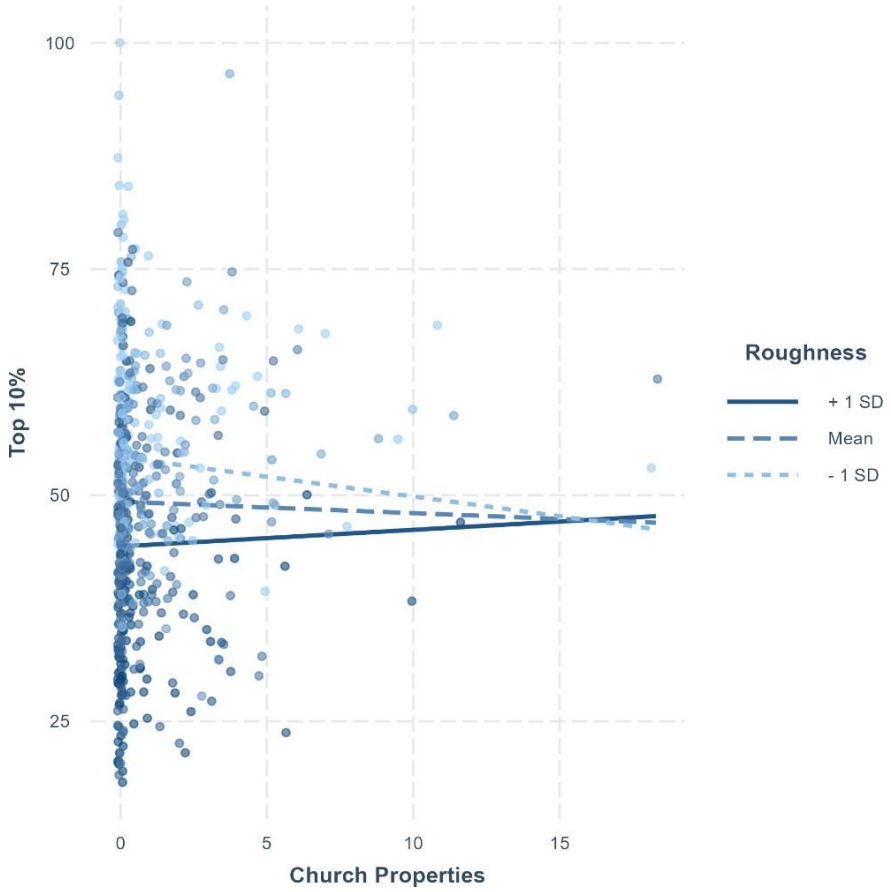
	(1)	(2)	(3)	(4)	(5)	(6)
roughness	-6.262***	-5.411***	-5.868***	-6.228***	-5.570***	-6.470***
	[0.808]	[0.807]	[0.963]	[0.804]	[0.740]	[0.698]
growth 45-60	2.422***	1.210***	1.215***	1.259***	1.231***	1.324***
	[0.601]	[0.156]	[0.154]	[0.156]	[0.157]	[0.159]
church	-0.247	-0.226	-1.299*	-0.197	-0.289*	-0.143
	[0.221]	[0.157]	[0.724]	[0.144]	[0.170]	[0.172]
com	-0.159	-0.030	-0.089	-2.447***	-0.099	-0.145
	[0.088]	[0.091]	[0.094]	[0.401]	[0.092]	[0.090]
day_lab	0.224	0.266*	0.172	0.140	0.163	0.202
	[0.096]	[0.139]	[0.140]	[0.140]	[0.138]	[0.130]
cashcrop_cult	0.041	0.022	0.031	0.020	-0.020	-0.006
	[0.032]	[0.030]	[0.030]	[0.029]	[0.042]	[0.027]
adjustada_dist_cpj					-8.706***	-1040.6
					[2.536]	[1153.4]
Cereals						-0.157*
						[0.091]
roughness:growth	-0.427**					

	[0.172]					
com:day_lab		-0.011**				
		[0.005]				
church:roughness			0.368			
			[0.233]			
Com:roughness				0.558***		
				[0.093]		
cashcrop_cult:_dist_cpj					0.324**	
					[0.163]	
Cereals:dist_bcn						19.327
						[23.289]
N	595	595	595	595	595	595
Adj. R2	0.459	0.491	0.491	0.503	0.495	0.504

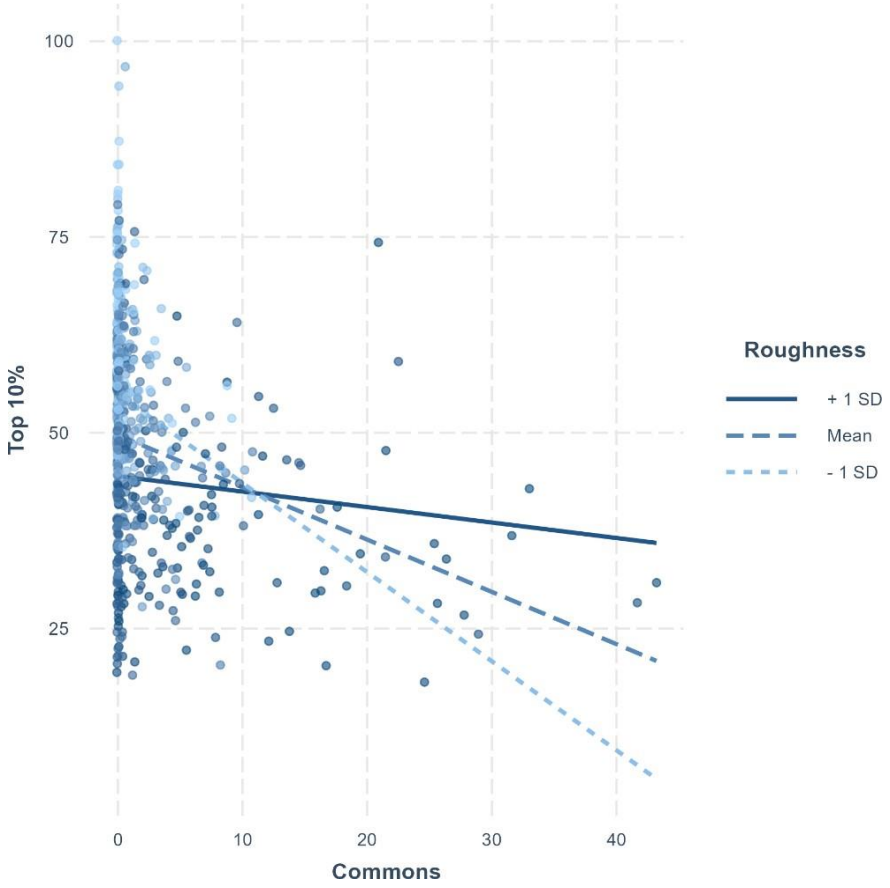
Graph B.1. Interaction Plot: Population growth and Roughness, and result on Inequality



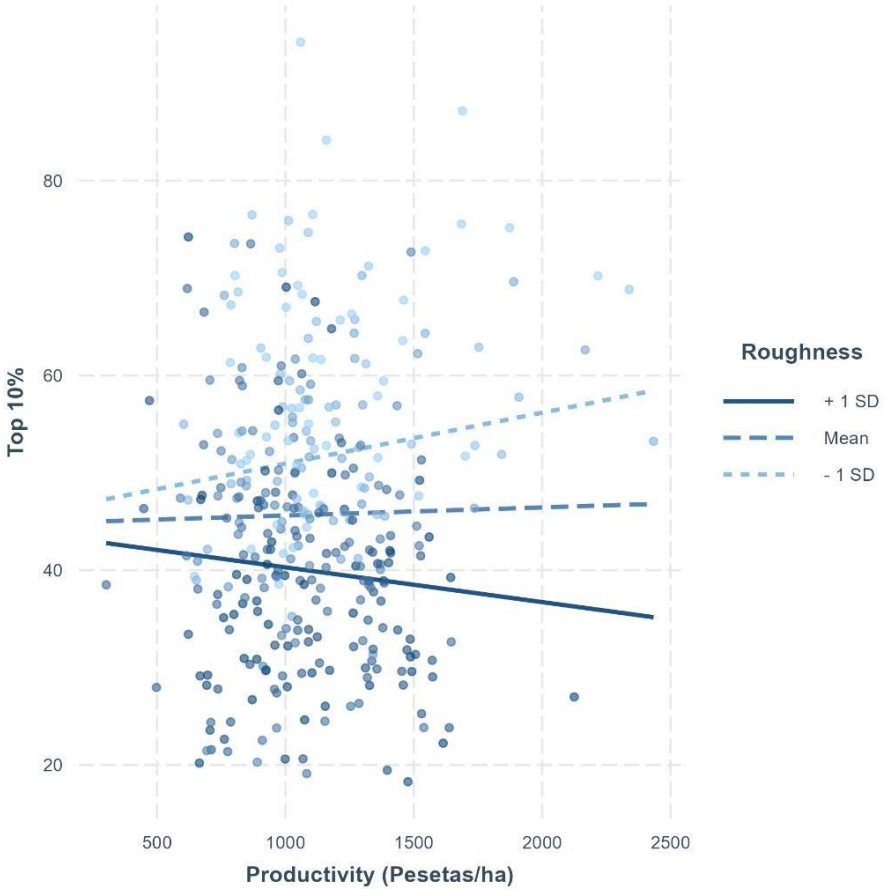
Graph B.2. Interaction Plot: Church Properties and Roughness, and result on Inequality



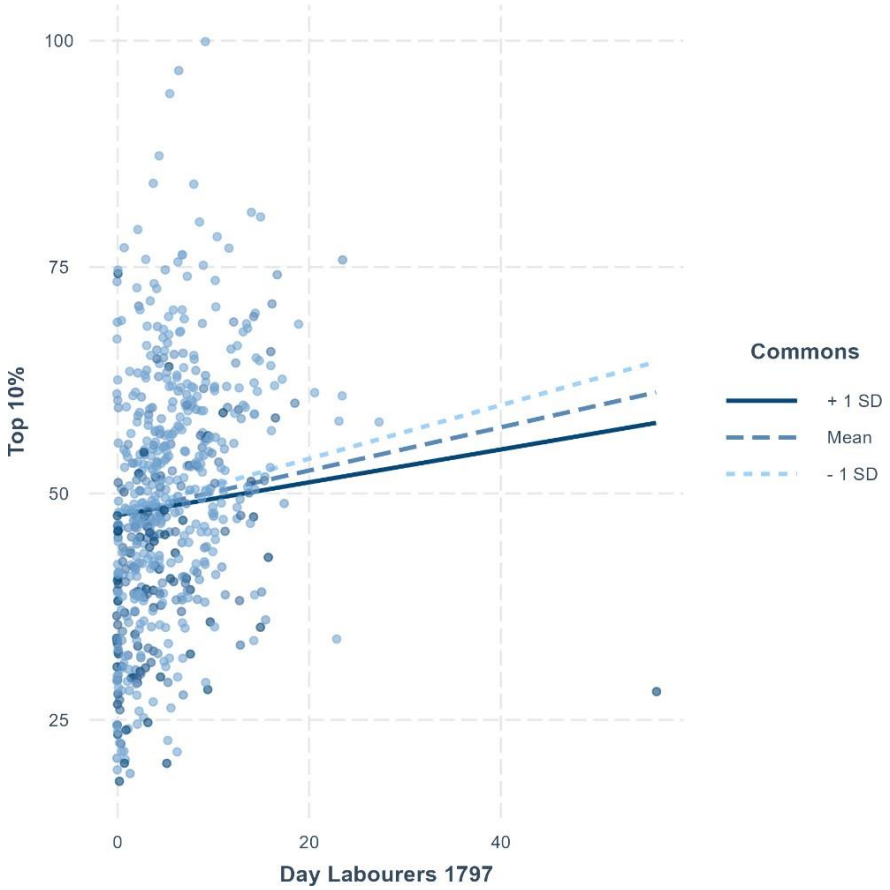
Graph B.3. Interaction Plot: Common Properties and Roughness, and result on Inequality



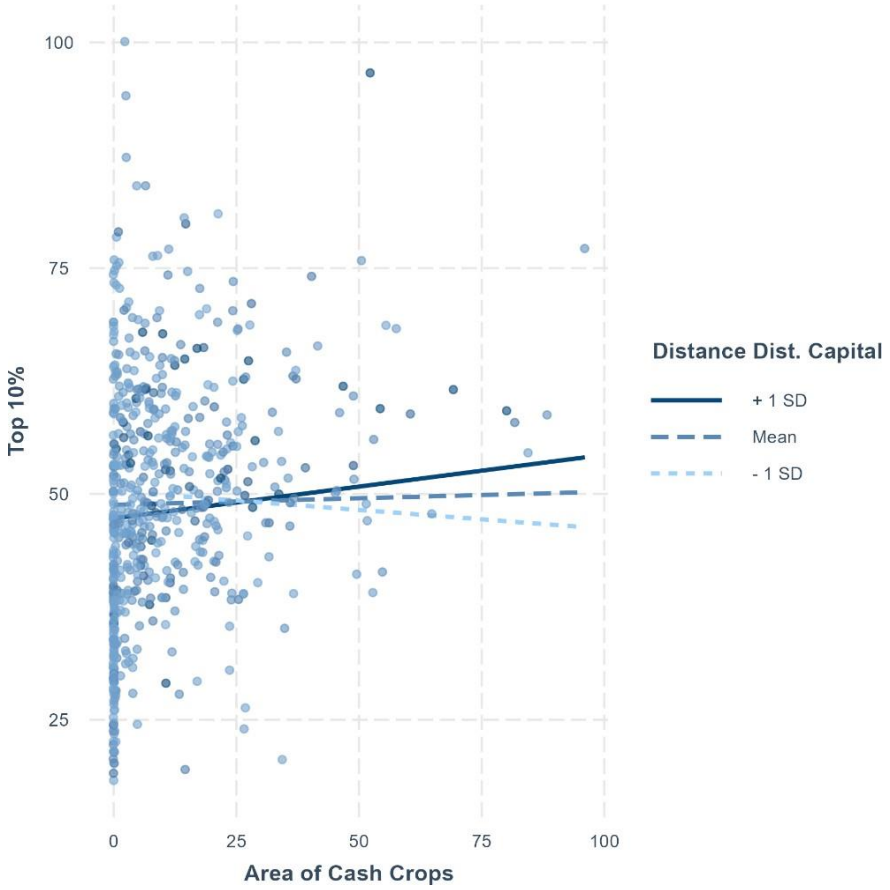
Graph B.4. Interaction Plot: Productivity and Roughness, and result on Inequality



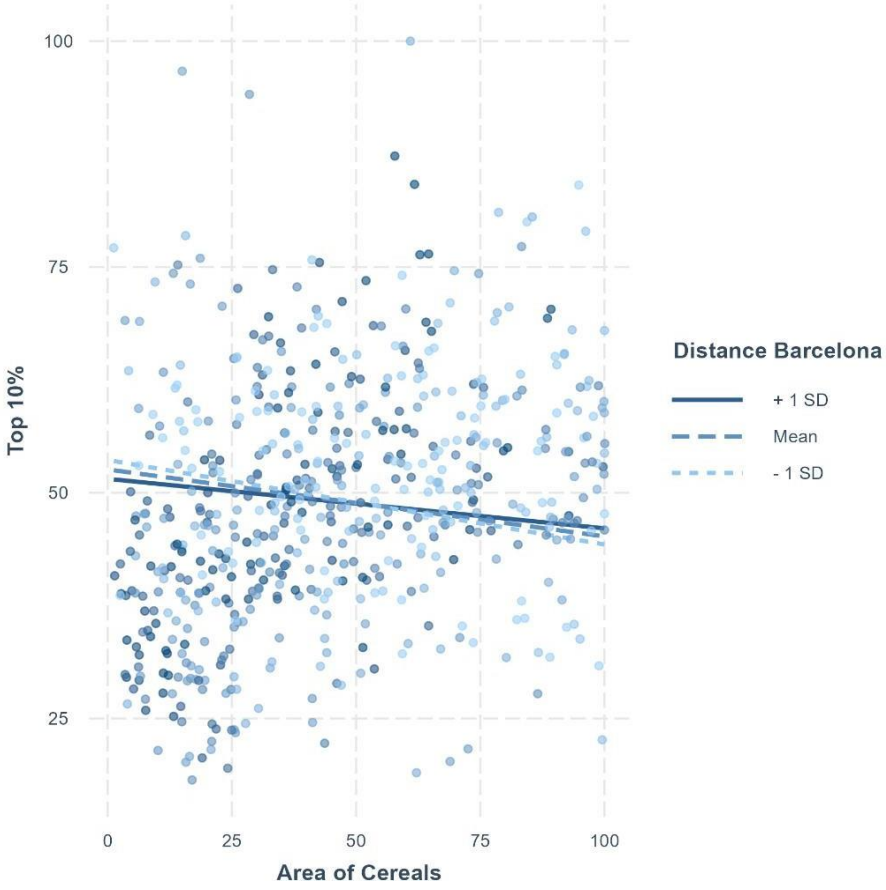
Graph B.5. Interaction Plot: Commons-Day labourers in 1797 and result on Inequality



Graph B.6. Interaction Plot: Inv. Distance to District Capital-Area of Cash Crops and result on Inequality



Graph B.7. Interaction Plot: Inv. Distance to Barcelona-Area of Cereals and result on Inequality



Graph B.8. Johnson-Neyman Plot of the Cash crops and Distance interaction. Johnson-Neyman plot