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Keywords: Wealth Inequality, Mexico, Political Economy, Distribution dynamics

JEL: N36, D31, I32, H20

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June 2023

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1. Introduction: Inequality and the development of the Mexican economy after independence.

Inequality occupies a central position in the political debates about fairness, access to opportunity and the winners and losers of economic development. However, outside a handful of countries, very little is known about its historical trajectory. For the case of Mexico, the expectation is that it has been historically unequal. One needs only to look at a "*retablo de castas*[1]*"* or read descriptions of travelers through the late *Nueva España* or the early Mexican Republic, such as Alexander von Humboldt, who called Mexico "the country of inequality" to know inequality was extremely high. Art expressions, chronicles, the treatment of Indigenous populations captured in historical sources and political action tell a story of contrasts, of a society highly stratified along class and race divisions. Stagnant living standards for the many and opulence for a small clique.

Although much can be learned from these historical accounts, they cannot offer us a quantitative answer that pierces through the veil of time to connect the political and economic events with their distributive dynamics. Therefore, this paper looks to fill in the gap in the historiography of Mexico's inequality by studying the distribution of wealth though its first century of independence employing a novel source, a collection of nearly 5,000 wills from notary archives around Mexico. This paper contribution is the use of novel statistical techniques in an historical setting with a consistent through time source of data to reconstruct the levels and trends of Mexico's wealth inequality and its possible relation to the political economy events of the time.

Studying the distribution of wealth in Mexico during the 19th century is an important yet understudied subject. Wealth plays an important role in the livelihood of the population in preindustrial societies. Therefore, reconstructing the distribution of wealth for the entire period allows us to better understand both inequality dynamics and potential changes in living standards. Thus, this article contributes to the literature in two important ways: first, it provides the first long-term reconstruction of the wealth distribution for 19th century Mexico employing a consistent data source for the entire period. Second, it moves forward

[1] a decorative painting depicting the different social groups as classified by ethnicity/skin color

the historiography of the period to incorporate wealth inequality as an important aspect of the political and economic events.

The recent focus on inequality in Mexico has put almost all its efforts into studying the 20th century, especially the second half. Some efforts have tried to look at the past to connect what we know about the 20th century with the 19th. For example, Castañeda Garza and Krozer (2022) used wills and social tables to reconstruct wealth inequality for Porfirian Sonora. Bleynat, Challú and Segal (2021) employed welfare ratios to reconstruct wage inequality for the 19th and 20th centuries. Baldomero-Quintana, De la Rosa-Ramos and Woo-Mora (2022) used spatial segregation in an instrumental variable setting to see the persistent effect of segregation in Mexican cities since colonial times. Finally, Lopez Alonso's (2007, 2015) anthropometric approach employed heights to trace the evolution of living standards from 1850 to 1950.

However, these works, innovative in their use of sources and methods and agreeing with the high levels of inequality, leave some questions unanswered. For example, what does the distribution of wealth for the entire country look like? Who were the winners and losers through the entire 19th century? What is the pattern that inequality follows, and what mechanisms can plausibly explain it? In summary, what was the level of inequality and what can explain its evolution? This paper responds to these questions left unanswered by the literature.

The recent inequality literature has benefited from solid innovation in both methods and sources employed. For modern or industrial societies, studies have preferred using income data as a representative picture of the distribution of economic resources in society. Among the more influential studies to provide methodological advances when dealing with income, it is possible to trace at least two streams: one that focuses on income shares and top incomes and another that focuses on the entire distribution. Those emanating from the Kuznets tradition or income shares perspective include Kuznets (1953), Piketty (2003), Atkinson (2007), Roine and Waldenström (2008) and Atkinson, Piketty and Saez (2011). On the other hand, among those that focus on the entire distribution, we find Stiglitz (1969), Timbergen (1975), Goldin and Margo (1992), Milanovic (2005, 2006) and Atkinson (2008).

The methods used in studying income distribution in either of the streams are handy for modern sources, income statistics, administrative data such as tax records, and mean incomes. However, the lack of sources in pre-industrial settings makes their translation to studying pre-industrial inequalities more difficult. Methods like social tables, as applied in Lindert and Williamson (1983), Milanovic, Lindert and Williamson (2011) and Allen (2019), are more adaptable to the variability of sources; however, incomes are not always available in pre-industrial times. Rather than using income in these periods, wealth is a good option as it captures the origin of economic resources (Lindert 1986, Bengtsson, Missiaia, Olsson and Svensson 2017; Castañeda Garza and Krozer 2022). Prominent among those resources are land holdings and some forms of movable wealth such as financial assets and valuable objects.

The methods to work with wealth distributions are specially designed to exploit sources like wills and probate inventories, for example, the state multiplier method developed for these purposes by Lampman (1962) and Atkinson and Harrison (1978). The sampling methods developed by Lindert (1981) and recently, the new methodologies advanced by Lindert and Williamson (2016) and Cummins (2021, 2022) to deal with probate inventories and Alfani and Ammannati (2017) with the Italian *estimi.*

The reconstruction of the distribution of wealth using wills is a cumbersome process. It is plagued with technical challenges that range from the over and under-representation of social groups to the correct valuation of assets. Moreover, the methods employed to deal with these difficulties are imperfect and can only offer a good idea of the trends in inequality, not the exact point values. Therefore, the best strategy for a robust estimation of the wealth distribution is to combine the methods to exploit their strengths and ameliorate their weaknesses. For that reason, this work takes advantage of the previously discussed methodological approaches. Furthermore, it develops a new method applied to historical inequality by exploiting the statistical properties of the theoretical lognormal and generalized beta distributions to reconstruct the distribution of wealth for Mexico's first century of independence.

1.1. An overview of the historical context

After 1521 with the fall of Mexico-Tenochtitlan and the subsequent Spanish conquest of Mesoamerica, Aridoamerica and the Septentrional lands to the west of the Mississippi river, the Viceroyalty of New Spain was created. For the next 300 years, that vast territory was subject to colonial rule that introduced several layers of stratification into society. For instance, among the unequalizing institutions introduced were the *encomienda*[2] and the establishment of a caste system with at least 22 "classes" based on racial combinations, place of birth and percentage of Spanish blood. This system is perhaps best illustrated in the famous paintings known as *retablos de castas*. These paintings visually represented the social status of the distinct groups that used their skin color, facial features, clothing and occupations to highlight their social position and economic wellbeing. This caste system was not just a cultural manifestation, it was legal (Masters 2018). The land that would become Mexico was embedded with inequality-producing institutions over time.

Three centuries of such institutional setting left structural inequalities still visible today (Baldomero-Quintana, De la Rosa-Ramos and Woo-Mora 2022). Although the Independence War (1810-1821) had more to do with the political upheavals during the Napoleonic Wars (Mikaberidze 2020) and with the political ambitions of the creoles than with poor people's interests; inequality was present in the political discourse. The best example is insurgent leaders José María Morelos y Pavón with his famous *Sentimientos de la Nación*. A highly influential document in Mexican constitutional history in which ideas about equality are heavily drawn from the progressive Cadiz Constitution of 1812, the French Revolution and the E.E.U.U. Declaration of Independence.

After independence, political instability became an ever-present condition. The new sovereign nation started its life as the Mexican Empire, just to be proclaimed a republic two years later in 1823. After a period of brief stability during the mandate of the first president Guadalupe Victoria (1824-1829), instability became the daily life of the republic. Between 1821 and 1876, civil strife was a constant; it was reflected in more than 150

[2]The *encomienda* was devised by the Spanish crown to exploit the work of the indigenous population and, in some cases, of the Spaniards. The system worked for years until the "service" to the crown was completed and then released from the encomienda. The *encomenderos* were the people who administered the encomienda and profited from the near free labour.

pronunciamientos[3] (Fowler 2010, 2012a, 2012b) and four different constitutions, 1824, 1836, 1843 and 1857.

Mexico's first years were frantic with several civil and foreign wars. The wars with the United States (1846-1848) and France (1861-1867), the constant conflict with the northern nomads (Apache and Comanche) and, the constitution of 1857 and the War of the Reform that followed its promulgation brought enormous changes to the country. Less than 50 years after independence, Mexico had less than half of its original territory; with a chronically depopulated north, the State and the church were separated leading to the seizure of church property and, eventually, the consolidation of the State.

The more accepted historiographical consensus about the Mexican economy indicates that all these conflicts and instability exacted a high cost. For example, Coatsworth (1989) argues that the Mexican economy after independence suffered a loss equivalent to 21% of GDP per capita. Salvucci and Salvucci (1993) argue that the loss was 50% of GDP between Independence and the middle of the 19th century. Although more recent additions to the literature, such as Sanchez Santiró (2010), point to a more complex development in which economic growth did occur for some years, the overall picture is not of a healthy growing economy.

This pattern of economic development or perhaps economic stagnation does come with distributional consequences. There were winners and losers, the losers most likely situated at the bottom of the income and wealth distribution. The winners were those who were able to capture the Mexican institutions and influence its policies. Hernandez Jaimes (2013) and Martínez Carmona (2015) signal the critical role played by financial and commercial agents that benefited and sometimes exerted significant influence on fiscal and financial decisions, such as credit negotiations and tax collection, especially during periods of war.

The combination of political instability, powerful elites able to capture the State, constant warfare, a weak fiscal position for the government and economic stagnation strongly implies opposite distributional forces clashing constantly. Thus, peaks and valleys are expected in wealth inequality's long-run behaviour. However, in a context of economic

[3] A Pronunciamiento is a rebel declaration that often contains a political program or a set of demands. It often was part of a plan that called upon society to act against the government.

stagnation, in a pre-industrial time with an intensely stratified society, a sustained level of high wealth inequality must imply a high-level extraction of resources by the top.

Table 1: The arrow of the distributional forces.

Forces	Causes of the upward direction	Causes of the downward direction	Note
Political Instability	Can lead to State capture by private interests, thus increasing inequality.	Can also lead to the confiscation/expropriation of property and bankruptcies, reducing inequality.	The effect can be ambiguous in case of regional divergencies, i.e., different tax regimes at a regional level.
Wars	Can increase inequality if the war is financed through regressive mechanisms that transfer money to the elites.	Can decrease inequality if the war is destructive to capital/wealth.	The destructiveness of large wars can overpower the regressiveness of its expenditures.
Weak public finances	If it leads to excessive borrowing it can increase inequality via the transfer effect (Samuelson 1967, Stiglitz 1999, Alfani and Di Tullio 2019).	If it leads to tax reform, it can reduce inequality via progressive taxation.	
Economic growth	A growing economy has the potential to accommodate higher levels of inequality as there is a larger surplus of resources (Milanovic, Lindert and Williamson 2011).	A stagnant economy has less potential to accommodate wealth accumulation unless exploitation increases. A shrinking economy can reduce inequality by cutting the gap between low, middle and high wealth groups.	A shrinking economy can reduce inequality by cutting the gap between low, middle and high wealth groups.
Government expenditures	Regressive expenditures increase inequality, i.e., military expenditures.	Progressive expenditures reduce inequality. i.e., social expenditures.	

2. Data and the estimation of long-run trends of wealth inequality.

The data employed consist of 4,937 wills from 26 of 32 states in Mexico. The geographical coverage encompasses more than 90% of the inhabitants of the country as most of the population concentrated in the center. The wills come from different archives around the country: the Archivo Histórico de Notarías from El Colegio de México, archivo de Testamentos de Sonora from El Colegio de Sonora, Archivo General del Estado de Yucatán, and Archivo Municipal de Saltillo. Additionally, the wills from the state of Michoacán are those collected by Chowning (1999). See the appendix A for details about the sample characteristics.

The wills in the archives are stored in what is usually called "*Actas*" or proceedings that contain the testator will, the inventory of goods and often other dispositions such as specific donations to charity, the church and other notarized documents. Therefore, each disposition or document is registered under the same proceeding (*Acta*) number belonging to the individual testator. The process to collect the sample required to check all dispositions for each proceeding, thus starting with more than 30,000 documents to end with the 4937 wills. The high attrition rate of the documents (83.5% discarded) was a product of the quality of conservation of such documents, the 4937 documents are those that had a complete inventory/list of the assets belonging to the testator.

Although coming from different archives, the source type is the same. All the 4937 observations are wills with their corresponding inventory/list of assets. They are reported following the same procedure by the notaries. The will contains a brief summary of the life of the testator listing its family, assets, debts, occupation and the testator wishes after death. The inventories contain the testator own valuation of its assets, this of course can be a source of bias as the testator can inflate of deflate their value, unfortunately there is no correction for this possible source of bias as it is impossible to verify the valuation. However, given the fact that the wills provided specific instructions of what to do with the assets, for example how much money should be given to each heir, and were not used for debt collection as in the case of probates, it's unlikely that the values are heavily biased. Thus, the value reported in each inventory is treated as an accurate value.

To ensure that results are not driven by possible errors while capturing the data from the picture containing the inventory, a placebo test was implemented. The placebo test consists of randomly assigning the values for the observations that correspond to deciles 1, 5 and 10 of the distribution and then estimating the Gini coefficient. If the results drastically change from the unbalanced sample, then it could imply that the results are very sensible to capture errors. However, the results are similar, implying that results are robust to capture errors in the data (you can see the results of the placebo test in appendix H).[4]

The only manipulation done to the data is to subtract the debts from the assets reported. Through this procedure we arrive at the net wealth of each testator. In the cases in which debts exceed the asset values, thus resulting in negative net wealth, the value was set to zero. The reasoning behind treating negative wealth as zero is that although negative values can be used in the calculation of the Gini coefficient, the resulting values would be greater than 1. Greater than 1 Gini coefficients suffer from two important drawbacks. In one hand, they are more difficult for interpretation. On the other, in cases in which Lorenz curves intersect, having negative values creates ambiguity making it difficult to determine which distribution is more unequal (Chen, Tien-Wang and Rhai 1982). For these reasons, both the wealth and income inequality literature refrain from using negative values. Additionally, using net wealth is in line with the most recent wealth inequality literature dealing with similar sources (Bengtsson, et al. 2017).

Table 2: Frequency count by archive, period and region

	1810-1850		1851-1910		
Region	Archive	No. Obs.	Archive	No. Obs.	Total
North	AMSAL/COLSON/COLMEX	1/139/43	AMSAL/COLSON/COLMEX	59/679/8	929
Center	COLMEX	2901	COLMEX	273	3174
Bajio	COLMEX	67	COLMEX	9	76
South	Chowning/AGEY/COLMEX	44/9/76	Chowning/AGEY/COLMEX	399/219/11	758
Total		3280		1657	4937

Note: For more details at state level see Appendix A 5A.

[4] The procedure randomly assigned 30% of the distribution for each decade. This means that even if there were capture errors in 1481 wills the results would remain within the same range. The confidence intervals for both placebo and unbalance estimates overlap.

Table 3: Frequency count by archive, state and period

	1810-1850		1851-1910		
Region	Archive	No. Obs	Archive	No. Obs	Total
Aguascalientes	COLMEX	4	COLMEX	2	6
Baja California	COLMEX	1		0	1
Chiapas	COLMEX	1		0	1
Chihuahua	COLMEX	3	COLMEX	1	4
Coahuila	AMSAL	1		59	60
DF	COLMEX	2411	COLMEX	229	2640
Durango	COLMEX	3	COLMEX	1	4
Estado de Mexico	COLMEX	227	COLMEX	18	245
Guanajuato	COLMEX	40	COLMEX	6	46
Guerrero	COLMEX	28	COLMEX	5	33
Hidalgo	COLMEX	107	COLMEX	13	120
Jalisco	COLMEX	23		1	24
Michoacan	Chowning	44	Chowning/COLMEX	399/5	448
Morelos	COLMEX	57	COLMEX	5	62
Nuevo León	COLMEX	5		0	5
Oaxaca	COLMEX	9		0	9
Puebla	COLMEX	54	COLMEX	4	58
Querétaro	COLMEX	35	COLMEX	2	37
San Luis Potosí	COLMEX	17	COLMEX	2	19
Sinaloa	COLMEX	2	COLMEX	1	3
Sonora	COLSON	139	COLSON/COLMEX	679/2	820
Tamaulipas	COLMEX	2		0	2
Tlaxcala	COLMEX	10	COLMEX	2	12
Veracruz	COLMEX	38		0	38
Yucatán	AGEY	9	AGEY/COLMEX	219/1	229
Zacatecas	COLMEX	10	COLMEX	1	11
Total		3280		1657	4937

Source: Author's calculation.

Tables 2 and 3 display the regional and state composition of the wills used divided in two period 1810-1850 and 1860-1910. The first period overrepresent the center of the country, the second one is more balanced with roughly similar number of observations by region. Although the geographical composition is a source of bias, it is less concerning since according with Mexico historical statistics (2014) more than 80% of the national population at the time comes from the center of the country. On the other hand, the second period has a

more balanced geographical composition, although still slightly biased toward the north. One possible source of concern is that the estimates could be biased by the wealthier regions, however, it is less of a concern since most of the wealth was concentrated in the center and the north only became an important source of wealth at the end of the period. In Appendix I, a regional weighted estimate is presented as a robustness check.

Like all historical sources, this collection of wills present issues. The challenges are the sample's representativeness, the underrepresentation of the poor and young, the overrepresentation of the rich and old, the correct valuation of the assets, and the relationship between high mortality events such as epidemics, wars and famines and the time wills are registered. These issues are important to keep in mind when performing statistical manipulations and generating estimates. In the following subsection, it will be explained how those problems have been handled.

2.1. The challenges of using wills for the estimate of wealth distributions.

As Lindert (1986) points out, the sample's error to the population is less concerning when enough observations are available. Therefore, rather than diluting the sample by attempting to estimate yearly or two-year distributions, it is better to pool the observations together to generate a large enough sample per benchmark year. Following Castañeda Garza and Krozer (2022), a ten-year interval estimation is the best option to ensure that more than 100 observations are available per benchmark year[5]. This procedure makes the sampling error less concerning.

The second cause of concern is the correct valuation of the assets in the wills. In these sources, it is inevitable to rely on the reported value in each will protocol. However, there is a possibility that those values are wrong. For example, if the testator lied or exaggerated the asset valuation or the notary committed a mistake. Unfortunately, it is not possible to perform corrections for this concern. However, at least it is possible to check the consistency of the reports across different notaries for the same period and state. In the

[5] For example, Levy (2016) uses 339 wills to study a 50-year period in the state of Yucatán. Frank (2004) uses 669 wills for 19th century Rio de Janeiro, and Castañeda and Krozer (2022) use 509 wills to study a 40-year period in Sonora. In the present study, the nearly 5,000 wills enable the possibility to have almost as many wills per benchmark year as the previous studies have for their entire periods.

wills sample, the values of assets such as ranches and haciendas are largely consistent. Thus, this issue is not a paramount concern. See Appendix A for details.

The more relevant concerns regard the over and under-representation of groups. Wills, as with probates, tend to have two biases. First, wills are biased towards older and wealthier people as the young and the poor tend to leave fewer wills. This problem becomes an under-representation of the young and the poor and an over-representation of the rich and old. This overrepresentation of the rich is potentially exacerbated by the occurrence of high mortality events. For example, the epidemics of cholera, typhus and yellow fever that struck the country or some of its regions during the 19th century (Álvarez Amezcua et al. 1960), could have altered the frequency at which the less affluent population set up wills while the richest segment of the population set up their wills at a normal pace. There are different methodological options to address these issues. The desirable solution is to use the estate multiplier method (Lampman 1962, Atkinson and Harrison 1978). However, since the method relies on the inverse mortality of each individual will, and age is not available for most observations, this method is of no use.

As an alternative to the estate multiplier method, five different methods are used to estimate the wealth distributions, their results are shown in Table 3 below:

1) Leave the sample unbalanced. Alfani and Ammannati (2017), in their reconstruction of inequality for the Florentine State, suggest that lack of data is data in itself and argue in favour of not employing any balancing or correction method for their data. Furthermore, they argue that the lack of poor people in the data only biases their estimates downwards as poor people will have very small or almost zero wealth. Thus, leaving the sample unbalanced, or truncated at the bottom, and performing estimations will yield a conservative estimate of inequality. An unbalance sample has the advantage of being a conservative estimate than function as a benchmark if the data undergoes adjustments. It can capture the overall trend without further introducing uncertainty factors coming from adjustment assumptions. Additionally, bootstrapping techniques (see Appendix E) can be used to produce confidence intervals and generate upper and lower bound estimates within the unbalanced sample.

The bootstrap procedure is a common method employed to produce confidence intervals extensively used with synthetic inequality measurements such as the Gini coefficient (Dixon, Weiner, Mitchell-Olds and Woodley 1987). The procedure takes the original or observed sample and then using sampling with replacement draws a new sample. The bootstrap is set to a desire number or repetitions, 1000 in this case. Then, the resulting 1000 new distributions can be used to estimate the sample properties such as standard deviation and with that estimate confidence intervals at the desire confidence level, in this case 95%.

2) Use the "true" or known class structure of the society to construct wealth social tables. Social tables have the advantage of being able to weight the estimates by the population share by multiplying the observations by constant factors (Milanovic, Lindert and Williamson 2011). The construction of social tables necessitates the identification of social classes or occupational categories in which the population can be divided. For the construction of these social tables two different class structures are employed, one simplified to the bare minimum classes. This bare minimum is the method Castañeda Garza and Krozer (2022) used with the social structure reported by Iturriaga (2012). The second one, more complex or detailed, uses the information contained in the *Padrón de Trabajadores de la Ciudad de México* (Registry of Workers from Mexico City) from 1790 and 1842 reported in Perez Sotelo (2011) and *the Padrón de Guadalajara* (Registry from Guadalajara) from 1791 reported in Castañeda and Gómez (2000). The occupations reported in the 1790 and 1791 documents are combined to generate the occupation from the decades of 1810 up to 1830. From 1840 to 1910, the 1842 document is the best proxy for the social structure. Social tables can be constructed with ten big occupational categories that follow the Mexico City and Guadalajara registries.

   The construction procedure for the social tables is straightforward, first all observations are classified by occupation using either the simplified classification from Iturriaga (2012) or the more complex one using López Sotelo (2011) and Castañeda and Gómez (2000). Then, the observations with the same occupation are

aggregated for each decade to obtain both a mean wealth value for each occupation category and the population share. Finally using the mean wealth and the population share, inequality is estimated.

Although social tables are very useful, they suffer from two main shortcomings. First, they tend to underestimate within group inequality, therefore social tables like those constructed with the bare minimum of groups would suffer from this problem more. However, as the classes are divided into more groups (Rodríguez Weber 2016), accuracy increases, and inequality is less underestimated. The second problem associated with the social table method is the weights assigned to the population. Social structures can be less stable than the assumption of certain constancy through time. Nevertheless, they remain a good conservative estimate that reveal trends over time.

The results from the simplified social tables are reported in Figure 1 and Table 4. The "complex" social tables are used to analyze the distributive dynamics (See Section III and Appendix B). A caveat of using these Mexico City and Guadalajara structures is that it is primarily urban and therefore underrepresents the rural areas where most of the population lived. However, even if these more detailed social tables represent only urban Mexico, they are still helpful in analyzing distributional dynamics since the economic and political elites are concentrated in the urban centers.

3) Lognormal fitting. A third approach to balance the sample for each decade is to fit a theoretical distribution. In this case, the lognormal distribution. The lognormal distribution is one of the most used distributions for the study of income or wealth inequality (Chotikapanich et al. 1997, Nishino and Kakamu 2017). Its main advantage is to be able to adjust for missing data at the bottom of the distribution. Its main drawback is that it's not the best fit for the upper tail. To fit an observed distribution into a theoretical one, first it is necessary to be sure that the distribution of the data reasonably follows the intended distribution. There are two easy ways to

verify this assumption: 1) to draw the non-parametric density functions, and 2) to construct probability to probability plots in which we can observe how closely the sample follows the theoretical distribution (See Appendix C for details).

4) Lognormal weighted. When a distribution does not properly fit the data it is possible to use a weighted distribution to model the data (Saghir, Hamedani, Tazeem and Khadim 2017). The probability density function of the lognormal wealth distribution is used to obtain a weight for each observation. This approach uses the probability within the lognormal distribution as analytical weights for the unbalanced sample to estimate wealth inequality following the procedure proposed by Chotikapanich, Griffiths and Rao (2007).

5) Generalized Beta. The generalized beta distribution of the second kind (GB2) is a four-parameter distribution that has been proven to be very successful in fitting income and other data with long upper tails (McDonald, 1984, pp. 660, McDonald and Ransom 2008, Hajargasht and Griffiths 2013). Among its properties, the GB2 distribution contains within it several other distributions or special cases such as the Pareto, lognormal. gamma, the two parameters Weibull distribution, the Singh-Maddala, Dagum and the Burr 1,2 and 3 distributions. The GB2 flexibility and success in fitting data for several countries make it one of the best distributions to study inequality.

Table 4: Results, Inequality Estimates by Method.

Decade	Gini unbalanced	LB (95%CI)	UB (95%CI)	Lognormal weighted	Lognormal	Social tables	Generalized Beta	LB(95%)	UB(95%)
1810-1819	0.7735	0.7373	0.8096	0.702	0.8396	0.84645	0.7795166	0.7421275	0.8169057
1820-1829	0.7577	0.7088	0.8067	0.6777	0.80657	0.74619	0.8452873	0.7343613	0.9562134
1830-1839	0.8957	0.8609	0.9305	0.824	0.94291	0.96027	0.9133675	0.8660033	0.9607318
1840-1849	0.763	0.7351	0.7908	0.6915	0.85857	0.79277	0.8103625	0.7514577	0.8692672
1850-1859	0.735	0.6895	0.7806	0.669	0.81794	0.69401	0.7356536	0.6900524	0.7812548
1860-1869	0.8416	0.7801	0.9032	0.633	0.8559	0.67823	0.8511319	0.7863137	0.9159501
1870-1879	0.7562	0.6862	0.8263	0.7294	0.8856	0.66382	0.7477845	0.6816344	0.8139346
1880-1889	0.7602	0.7165	0.8039	0.6601	0.8227	0.69125	0.8583	0.7957352	0.9209108
1890-1899	0.8285	0.7889	0.8681	0.7005	0.8995	0.73436	0.9421855	0.8861133	0.9982578
1900-1910	0.8514	0.8198	0.8831	0.7295	0.9042	0.	0.9775783	0.9246661	0.9999999

Source: Author's calculation.

The social table method (method 2) and the parametric distributions (methods 3 to 5) are not too dissimilar from the unbalanced sample (method 1). The social tables method corrects the biases under and over-representation by assuming a class structure based on historical sources such as the occupation registries. The parametric distributions correct for the underrepresentation of the poor by "modelling" a complete distribution that fits the available data. None of the methods is without problems. The biases can only be ameliorated, not wholly corrected. The different measurements suggest two trends, a general decrease in wealth inequality during the first half of the 19th century and a rising trend in the second half.

The methods that employ parametric distributions seem to achieve very similar results (see Figure 1 below). All of them are better at reducing the bias in the bottom part of the distribution but not in the upper section. Given the nature of the sources, that wills tend to overrepresent the rich, the correction for the upper part of the distribution is less concerning. For sure, the data has censoring issues, but those are more at the bottom, that is missing zeroes, than at the top missing top fortunes. The benefit of employing multiple methods to estimate inequality is that the observed trends are more robust to sampling issues. As a robustness check, an exercise fitting a censored Singh-Maddala distribution is conducted and the results confirm the overall findings but with less pronounced swings (See Appendix D).

Considering Alfani and Ammannati's (2017) arguments about how even unbalanced data can produce reliable estimates of inequality, the unbalanced measurement will be considered the preferred or baseline estimate for the political economy analysis. There is another practical reason to prefer the unbalanced measurement to the other methods. The other methods are closer to be upper or lower bound estimates and the unbalanced measurement conveniently lies between them capturing the overall trend.

2.2. Results

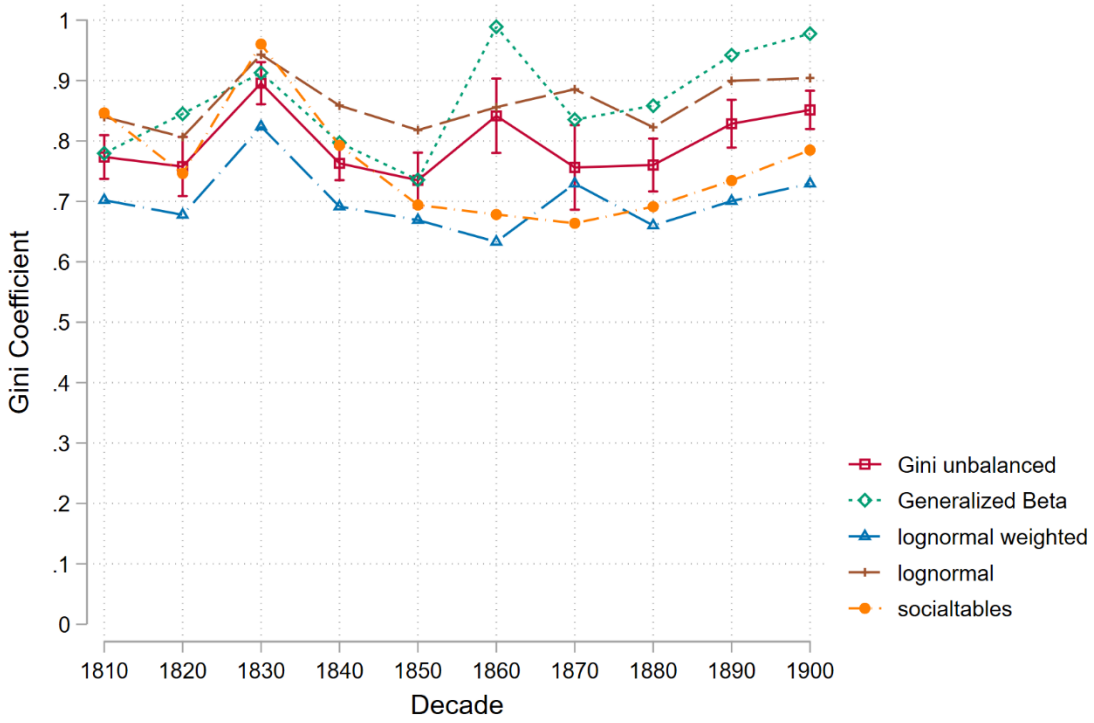

Figure 1: The Evolution of Wealth Inequality in Mexico 1810-1900. Source: Author's calculations. Note: confidence intervals are at the 95% level.

Figure 1 shows the peaks and valleys of inequality, the peaks corresponding to the periods of strong reliance on the merchant-financier "*agiotistas"* (the 1830s), the consolidation of powerful regional and national elites (1860s) and the formation of an oligarchical regime (1880-1900). The valleys correspond to the periods of intense warfare (the 1840s-1850s)

and reconstruction (1870s) in which the State's need for resources led to expropriations, forced loans and defaults, for example, during the Mexican-American War, the nationalization of church property during the War of the Reform (1857-1860) and the new tax regimes during the so-called *República Restaurada* period after the defeat of the French.

With the death of Juárez (1872) and the end of his long rule, soon a new critical period commenced. In 1877 a new dictatorship was established. Porfirio Díaz, a French intervention hero, took power following the *Plan of Tuxtepec*[6] and ruled Mexico for more than 30 years until 1910, when the Mexican Revolution prompted his resignation. The Porfirian regime brought civil strife to an end for a time. With peace, Díaz started a long-term project of modernizing the Mexican economy by integrating the *hacienda* economy and fostering industrialization. The Porfirian government is best described by Haber (2002), Haber, Mauro and Rozo (2003) as an attempt to solve the autocrat "commitment problem" of establishing credible constraints to discretional power while maintaining support from inside the regime (Boix and Svolik 2013). The solution to the commitment problem is crony capitalism.

Cronyism, by default, entails winners and losers of the distributive game. Political powers lead to economic power in a vicious circle that reinforces itself. This crony capitalism corresponds to the rising trend we see in Figure 1 from the 1880s. To some extent, the Mexican Revolution was a reaction against the cronyism of the Porfirian regime that overlapped the interests of workers, peasants and a counter-elite that, although economically powerful, was politically disenfranchised.

In light of the results, an important question is how this long-term inequality trend relates to the literature? The only other wealth inequality measurements for Mexico during the 19th century are for a region or a city, Morales (1976, 1995) for Mexico City and Castañeda Garza and Krozer (2022) for the state of Sonora. The measurements from Morales (1976, 1995) uses a census of property owners for the years 1813, 1848 and 1864. Morales' Gini estimates are lower than the ones estimated here, but that is to be expected as they are for Mexico City and at the time the most valuable properties where not in the cities but in the provinces, for example, the haciendas that produced sugar in Morelos, Pulque in Hidalgo or

[6] A rebellion that overthrown the government of President Sebastian Lerdo de Tejada.

the Mining and Cattle haciendas in the North (Bazant 1969, 1977). Although Morales' estimates are lower, they are still relatively in synch with this article, the 1813 and 1848 estimates display the same trend, only the 1864 diverges but still matched the lognormal weighted estimate. On the other hand, Castañeda Garza and Krozer's estimates for Sonora for 1871 to 1910 match the trend with inequality rising during the Porfiriato.

Outside synthetic indices of inequality, the work of Blaynat, Challú and Segal (2021) exhibits a similar trend, their welfare ratios indicator displays a zigzag pattern over the entire 19th century and their Williamson ratio (y/w) estimates match the trend during the Porfiriato. Challú (2010) and López Alonso's (2015) anthropometric evidence also validates the long-term trends. López Alonso's elite and soldier samples increasingly diverge over the second half of the 19th century. The 1820s and 1830s height registries in central Mexico reported by Challú show that the population was getting shorter which could signal increasing inequality.

The significant increase in inequality during the 1830s and the apparent ambiguity showcased among the estimates for the 1860s still require an accounting. The 1830's spike is probably associated with Isidro Barradas' 1829 invasion and the decree that attempted to confiscate property from the Spanish inhabitants living in the country (Bazant 1983). As a result of the decree, the foreigners who owned property and the corporations fearing further expropriations sold their land to wealthy nationals. Thus, further concentrating wealth in even fewer hands. A similar development occurred in the 1860s when Juarez's government seized and sold the properties of those who allied with the French, for example, the fracture of the large latifundia of the Sanchez Navarro and Zuluaga. However, in this later case, it also involved the transformation of private property into property of the nation.

For the 1860s, the results appear ambiguous. Three out of five measurements point towards increasing inequality, while two go in the opposite direction. What drives the divergence between the estimates? One possibility is that the smaller number of observations introduces measurement errors. The ambiguity can be offset by focusing on the preferred estimate, the unbalanced series, and the generalized beta (Appendix I). Both of these series confidence intervals overlap between the 3 higher estimated series with the higher series through the whole period.

Figure 2 below can help us understand what happens inside each method result. Figure 2 presents the different Lorenz curves corresponding to each estimate. As in Figure 1, the unbalanced, lognormal and GB2 estimates resemble each other. However, the social tables and lognormal weighted, although producing similar Gini coefficients, much lower than the other three, do so differently.

The social tables place more weight in the upper 40 percentiles. On the other hand, the lognormal weighted puts more weight in the bottom 50% and the top 20%. In the case of the simplified social tables, it is easy to see that within-group inequality is seriously underestimated, and thus the estimates are less accurate. For the lognormal weighted, it could be the result of not accounting for the upper tail censoring of the distribution. To clarify the results and the long-term trend, there is an attempt to build a Singh-Maddala censored distribution in Appendix D.

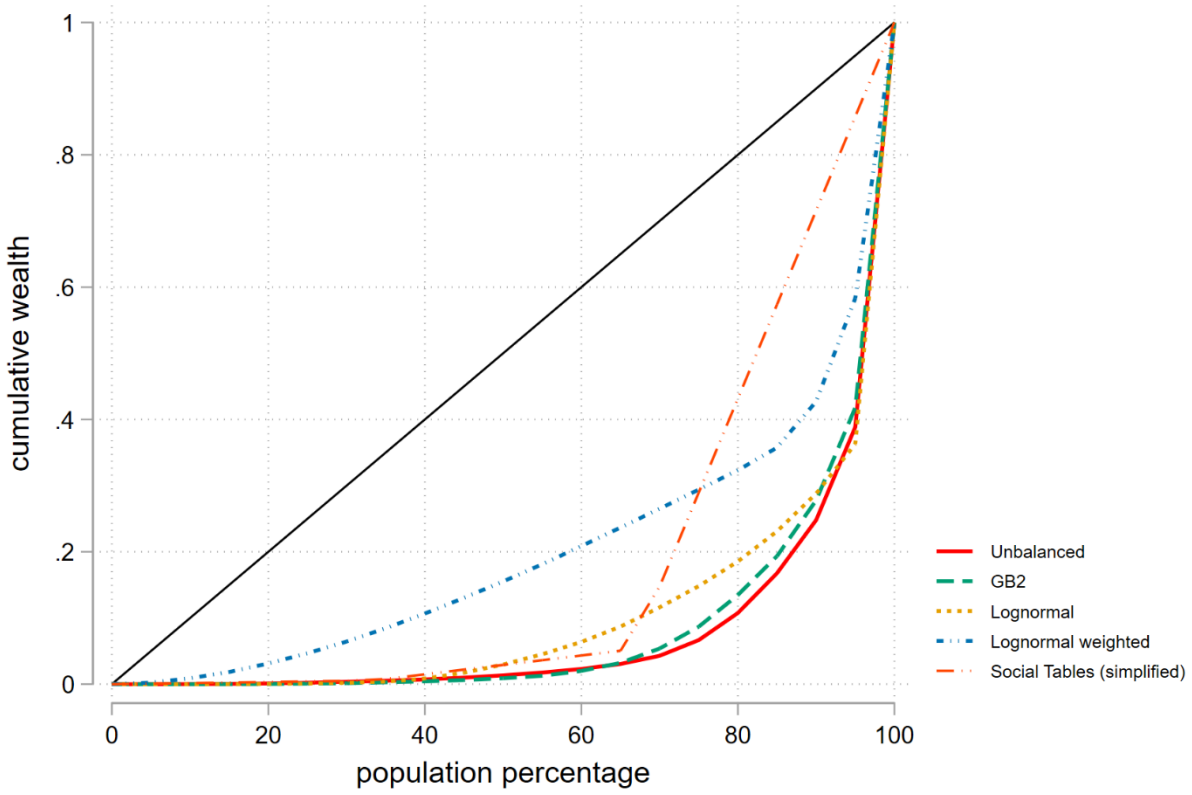

Figure 2: Lorenz curves for 1860. Source: Author's calculations

Finally, another source of validation of the results comes by doing an international comparison of the results. Comparing with Sweden during the 19th century (Bengtsson et al. 2017), the Gini coefficient values range between 0.85 to 0.91. Comparing with 19th century Finland (Bengtsson et al. 2018) wealth inequality fluctuated between 0.94 and 0.91. Comparing with Brazil (Silveira 1985) for the late 19th century, the Gini values move between 0.92 and 0.95.

Table 5: Top 10% wealth shares

	Mexico	Sweden	Finland	US
c.1800	72.5	73.6	90.7	62
c.1850	60	78.9	94	64
c.1900	76.3	86.2	87	75

Sources : Bengtsson et al. 2017 (Sweden), Bengtsson et al. 2018 (Finland), Alfani and Schifano 2021 (US).

Table 8 shows that the top 10% wealth is on a similar level as for the US, but with a lower concentration of wealth than in Sweden or Finland. This might be because European societies where more stratified and both Mexico and the US were starting their development as modern capitalist nations.

3. Winners, losers and the dynamics of the wealth distribution.

The trend represented in Figure 1 closely follows the political economy developments in the country. The substantial changes follow events such as civil wars, foreign wars, regime changes and legal and institutional transformations. Inequality increased as the fiscal-military state (Alfani and Di Tullio 2019) grew, for example, during the 1820s and 1830s. Inequality decreased during times of destructive wars that forced the government to obtain extraordinary resources via forced loans and expropriations, for example, during the Mexican-American War. Inequality increased during the land grabs of the 1880s when the government approved the Colonization Law of 1883, legalizing the land grab of Indigenous communal lands. Inequality kept growing during the Porfirian regime up until the Mexican Revolution.

The social table method described in Section II can be used to examine the winners and losers through time and track how these macro changes and events affected the distribution of wealth by its impact on the different occupational categories or classes. In addition, we can track the changes among different distribution cuts, the 5%, 10%, the middle 40%, and the bottom 40% and their respective ratios.

In section II, there is a distinction between simplified wealth social tables, those that contain only three wealth groups, "high," "middle", and "low", and the complex wealth social tables, those that contain ten occupational categories. These more detailed social tables can be used to track the distributional dynamics by observing who among those occupational groups won, lost or remained unaffected in the wealth distribution.

3.1. From Independence to the First Centralist Republic, 1810-1839.

The Mexican historiography focusing on the first years of independence points out the military's prominent role. The threats from Spain and the E.E. U.U., as well as the civil strife that produced more than 20 changes in government between federalist and centralist factions (Meyer 1990, Ávila et al. 2013), caused the expenditures destined for the military to explode. The military budget reached heights of 80% of the total budget (*Memorias de la Hacienda Pública* 1828-1868, Hernández Jaimes 2013). As a result, the public budget led to enormous profits for many generals and military commanders.

Table 5, confirm the period's historiography. The greatest winner is the military, their relative gains, that is the increase in their share of wealth, overshadowed all other occupational categories, thus driving inequality up. However, it is important to note the jump in wealth and mean wealth during the 1830-1839 period. A big difference of the 1830s with the other decades is the increase in wealth for the military, in the 1830s the number of high ranking officers with huge haciendas increase. This increase in high ranking officers with rich properties can be explained by the prominence of the military settling political disputes and capturing the federal budget. Of course, there is a possibility that the biases of the sources magnifies this effect, however, the historiographical evidence support the accumulation of wealth for the military elites.

Table 6: Detailed social tables, 1810-1819-1830-1839.

Occupation	Population share (1790)	1810-1819 Wealth (1900 prices)	Wealth share	1830-1839 Wealth (1900 prices)	Wealth Share	Occupation number	1810-1839 change in wealth share
Agriculture	2.01%	$63,067.78	0.71%	$1,619,948.96	0.59%	7	-17%
Artisans / Crafts	35.69%	$18,180.25	0.21%	$398,931.04	0.15%	1	-29%
Commercial	10.59%	$780,448.13	8.82%	$22,724,050.62	8.30%	3	-6%
Government	4.38%	$1,465,665.86	5.34%	$12,151,898.73	4.44%	5	-17%
Liberal professions	4.15%	$472,824.30	9.68%	$32,445,569.61	11.84%	6	22%
Military	1.11%	$4,207,220.32	16.56%	$113,741,772.11	41.52%	8	151%
Nobles/ Hacendados	0.13%	$857,073.66	47.53%	$56,506,329.09	20.63%	10	-57%
Religious	6.78%	$811,233.46	9.17%	$34,025,316.44	12.42%	4	36%
Services	33.88%	$100,568.17	1.14%	$260,474.73	0.10%	2	-92%
Without occupation	1.28%	$75,020.48	0.85%	$48,525.57	0.02%	9	-98%
Mean Wealth		$12,959.45		$297,096.33			

Source: Author's calculation. The 1900 prices were estimated for all the detailed social tables constructing and index with the subsistence basket prices from Challú and Galvarriato (2015). The wealth column reports the aggregate wealth of all the observations that fall within each occupational category.

3.2. The period of foreign and civil wars, 1840-1859

Table 7: Detailed social tables, 1840-1849-1850-1859.

Occupation	Population share (1842)	1840-1849 Wealth (1900 prices)	Wealth share	1850-1859 Wealth (1900 prices)	Wealth Share	Occupation number	1840-1859 change in wealth share
Agriculture	2.14%	$195,636.71	0.96%	$176,654.18	1.27%	7	32%
Artisans / Crafts	28.77%	$106,227.45	0.52%	$173,621.17	1.25%	1	139%
Commercial	14.07%	$1,157,916.99	5.71%	$1,000,449.97	7.21%	3	26%
Government	20.41%	$4,496,180.71	22.17%	$1,336,130.95	9.63%	5	-57%
Liberal professions	1.65%	$3,370,115.76	16.61%	$1,363,059.40	9.83%	6	-41%
Military	0.13%	$4,236,173.80	20.88%	$4,660,873.84	33.60%	8	61%
Nobles/ Hacendados	7.45%	$3,500,096.00	17.25%	$3,177,090.76	22.90%	10	33%
Religious	0.64%	$2,778,690.51	13.70%	$1,758,664.47	12.68%	4	-7%
Services	23.45%	$ 405,679.69	2.00%	$201,461.76	1.45%	2	-27%
Without occupation	1.29%	$38,023.53	0.19%	$22,966.74	0.17%	9	-12%
Mean Wealth		$28,570.06		$27,741.95			

Source: Author's calculation.

In 1835, Mexico changed from a federal to a centralist republic abolishing the 1824 Federal Constitution. The change signaled an even more chaotic period for the young nation. In 1836, Texas proclaimed its independence. Comanche and Apache's attacks intensified (DeLay 2008). The country failed to renegotiate its foreign debt, and the Mexican-American War (1846-1848) started. It was a ruinous period for the country and most of its inhabitants.

Table 6 shows that at least at the urban level, most occupational groups show losses, which helps to explain why between the 1840s and 1850s in Figure 1, there was an inequality reduction. Only the service workers display gains that might be explained by the expansion of commercial activities and the earnings from the services provided to the E.E.UU occupation forces (Guardino 2017, p.10). Historians such as Hernández Jaimes (2013) and Martínez Carmona (2015) have pointed out that the merchant-financier so-called "*agiotistas*" made tremendous gains from the 1830s up to the middle of the 19th century. However, the more detailed occupational group social tables are not granular enough to differentiate these individuals as a group from other high-wealth groups such as the *hacendados*.

After the Guadalupe-Hidalgo Treaty settled the Mexican-American War, important reforms were taken by the new government of President Herrera. General Mariano Arista, Minister of War, took the task of reforming the military. Its reforms diminished the number of generals and officials and reduced the number of personnel and presidios (military bases/forts). Mariano Arista became president in 1851 and continued his reforms. However, the military elites did not receive these reforms well (Fowler 2022). The military reforms and the country's fragile financial situation led to a rebellion that forced his resignation and brought general Santa Anna back to power.

Santa Anna's dictatorship lasted from 1853 to 1855 and was quickly overthrown by the Ayutla Revolution. The revolution produced a new government led by President Ignacio Comonfort. Comonfort's government produced new reforms *(Leyes de Reforma*), among them the so-called *Ley Lerdo* that forced the church to sell its non-used properties. This

legal reform to confiscate church property led to significant distributional changes. According to Bazant (1977), the property of the church amounted to more than 20% of the national wealth, that huge pool of wealth suddenly got into the hands of the Mexican government. The church's property was sold to private owners to obtain revenues for the State; both the government and the new private owners benefitted from the law. This government also promulgated the 1857 Constitution and triggered the Civil War (Fowler 2022, pp. 43-88), known as the War of the Reform.

Table 10 displays the changes between the 1840s and 1859. The artisans/craftsmen is the group that gained the most, followed by the nobles / *hacendado* group. Again, most groups lost. This can be the result of intense political instability and the conflicts such as the Ayutla Revolution and the War of the Reform. The gains of the *hacendado* class are offset by the losses of the other groups. This development can explain the somehow steady downward trend during the period in Figure 1.

3.3. The oligarchical period, 1860-1910

Unfortunately, the sample of wills does not contain enough occupational information for the years between 1860 and 1910 to produce comparable 10 group social tables. However, it is possible to construct growth incidence curves. This is a useful tool to visualize the impact of the aggregated change in wealth between two points in time at each vigintile of the distribution (Ravallion and Chen 2003) and thus analyze the distributional dynamic. Figure 5 reports two panels, a) and b), in which growth incidence curves for 1820-1859 and 1860-1910 are reported.

Panel a) reports what happened to the population divided in quintiles from the 1820 to 1859 period. The majority of the groups show losses. As pointed out before, the historiography of the periods agrees about the economic catastrophe of those years. Figure 5 Panel a) adds support to this development. On the other hand, Panel b) reports a growth incidence curve for the 1860-1910 period. This time starts at the end of the War of the Reform and the French Intervention (1861-1867). It includes the whole capitalist development project of the Juárez *Republica Restaurada* and the *Porfiriato* in which the country intensified its

modernization. During this period, we can see that all the quintiles of the population increased their wealth.

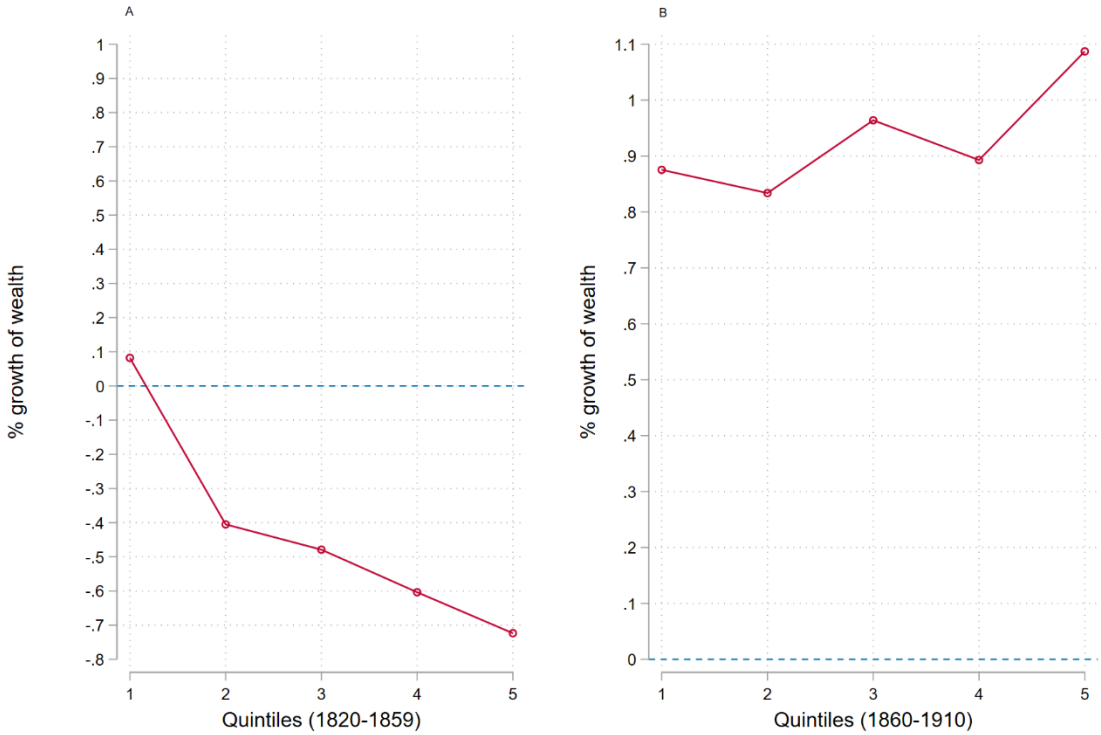

Figure 3: Growth incidence curves for wealth. Panel a) 1820-1859. Panel B)1860-1910. Source: Author's calculation. Notes: The calculations use the unbalanced sample. In the left axis scale 1 = 100%.

The development captured in Panel b) fits well with the inequality increase observed in Figure 1 and the recent Mexican income inequality literature (Castañeda Garza and Bengtsson 2020, Bleynat, Challú and Segal 2021). This period was characterised by the increased commercialization of life in the cities, the integration of the Mexican economy in the Atlantic trade, large inflows of foreign capital in sectors such as mining and railroads and early industrialization with the vertical integration of the *hacienda* economy (Haber 1989). At the same time, the 1883 Colonization Law was approved in this period, allowing the expropriation of communal lands. It is when an oligarchical political system designed to extract rents consolidates, often suppressing violently, any workers attempt to build labour organizations.

To see how these periods of generalized losses or gains affected the long-term inequality trend, we can look at the evolution through time of wealth ratios, with particular emphasis on the 1/10, 10/40, 1/40, 1/50 and 10/50 ratios and the share of wealth concentrated at the top 5% and 10%, middle 40%, and the bottom 40%.

Table 8: Wealth ratios

Period	**Top1% to top 10%**	**Top 10% to middle 40%**	**Top 1% to Middle 40%**	**Top 1% to bottom 50%**	**Top 10% to bottom 50%**
1810-1819	0.33	2.76	0.90	20.05	61.47
1820-1829	0.44	2.42	1.06	9.39	21.53
1830-1839	0.51	6.94	3.50	134.82	266.95
1840-1849	0.29	1.93	0.56	8.77	30.30
1850-1859	0.35	1.67	0.58	5.10	14.75
1860-1869	0.42	3.20	1.35	23.66	56.33
1870-1879	0.30	1.40	0.41	9.44	31.89
1880-1889	0.27	1.98	0.54	8.15	30.10
1890-1899	0.30	2.92	0.89	21.33	70.28
1890-1910	0.31	3.41	1.04	19.35	63.39

Source: Author's calculation.

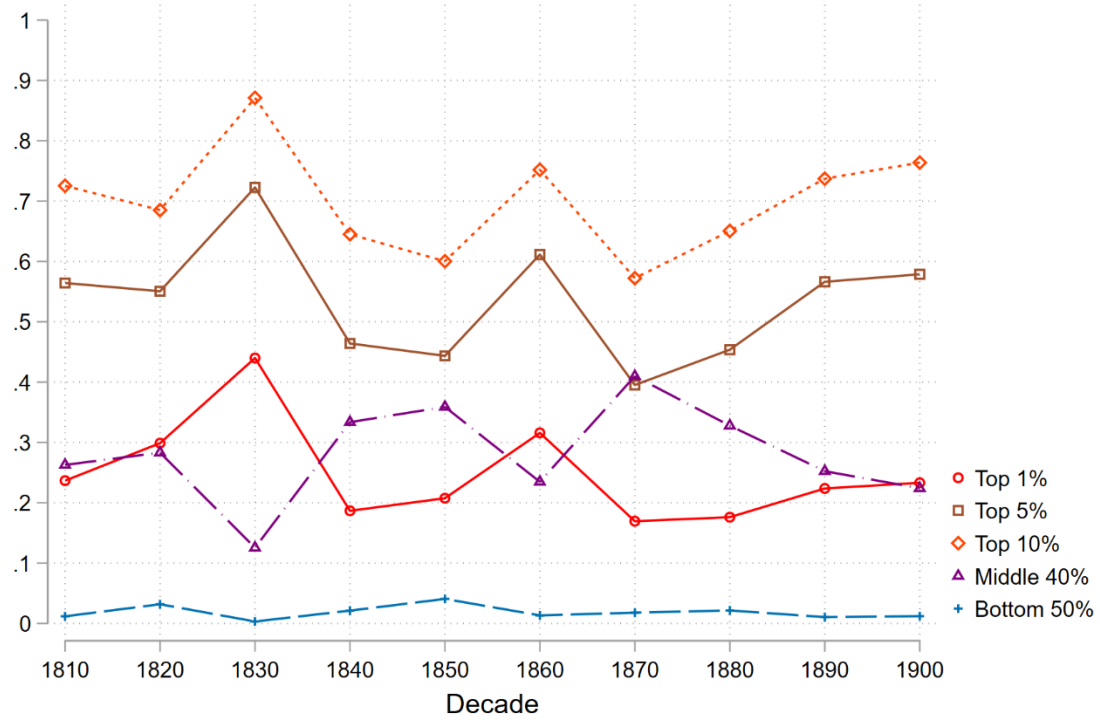

Figure 4: Wealth shares for the top 1%, top 5%, top 10%, middle 40% and bottom 50%. Source: Author's calculation.

Table 11 and Figure 4 show the widening of the wealth distribution. During the entire 19th century, it is clear that the dynamic of wealth inequality was dominated by what happened within the top 10% and middle 40%, especially the top 1% and 5% of the wealth distribution. The 5% concentrated between 55% and 72% of the total wealth. It is the vast fortunes, mostly belonging to prominent generals, heads of State and large landowners. The bottom 50% of the wealth share is almost constant, moving between 1% and 3%.

An important thing that deserves to be mentioned is that contrary to Lindert's (1986) findings for the case of Britain, there is something of a classical Marxian class division, with some wide differences between each group regarding their wealth share. The top 10% and especially the top 5% and 1% are substantially different from the rest, but even the middle 40% and bottom 50% are considerably different. This class heterogeneity might be a result of the regional differences in quality and type of occupations. Even if more than 90% of the population lived in rural areas, with a largely non-monetized economy living from

subsistence agriculture, the wealth gaps suggest differences in land and asset values. Figure 4 indicates that the urban elites, powerful local warlords, and *caudillos* were a tiny clique controlling most of the resources at the expense of the middle part of the distribution.

4. Conclusions: A long-run view of 19th century's Mexican inequality.

During the entire Mexican 19th century, viewed as a single period, Mexico's wealth inequality seemed relatively steady. In either of the five measurements, inequality starts and ends close to the same level. However, looking only at those two points can be misleading. Undoubtedly, inequality was high throughout the century, but a different picture emerges when dividing the century into sub-periods. Inequality was high but not constant. There were periods when inequality decreased substantially, even if it remained high in absolute terms. The dynamics of inequality are best captured by the changes in the top wealth holders, especially the top 5%.

The growth of military expenditures and the development of a rudimentary fiscal-military state are related to the growing inequality during the first decades after independence. The emergency measures taken during times of war and the reforms taken in their aftermath seem closely related to the moments of equalization. Moments of stability and instability leave distributional changes. It was not until the *Porfiriato*, the period in which the Mexican state finally enjoyed some decades of continued stability and economic growth, that this pattern of distributional twists and turns ended, and was followed by a period of continuously rising inequality.

Is it this rising inequality during the last part of the 19th century that might explain, as Katz (1982, pp.20-22) suggested, the discontent from the middle class *rancheros* that triggered some of the Northern uprisings during the Mexican Revolution? This group lost opportunities for upward mobility during the *Porfiriato* and clearly displayed a zero-sum dynamic, when the top 1% won, they lost. This 19th-century pattern is a quintessential political economy phenomenon. Inequality only goes down when most, if not all, of the population suffers losses, and goes up in stable times when an oligarchy captures the State (Wasserman 2015). This behaviour means that the structure of the Mexican economy was regressive. In this sense, the Mexican 19th century might be defined as a state struggling to

form capacities only to employ them in the service of the military, political and economic elites.

Although this paper contributes to the historiographic understanding of Mexican inequality and to the methodological tools used to study inequality, it leaves questions for future research. Wills can be an important source; extending the available number of wills in time and geographical coverage is a critical step towards more precise estimates. In addition, the introduction of parametric distributions as a tool for studying historical inequality requires refinement, ideally pointing to the construction of censored distributions that can better capture the lower and upper tails. The results generally point towards decreasing inequality in the first half of the 19th century and rising inequality in the second half. If this interpretation is correct, then the causal identification of these trends' drivers remains open for debate.

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5. Sources and references.

5.1.Archival Sources.

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