Exporting Craft Guilds to Latin America – An Economic and Textual Analysis

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Abstract

Employing a novel and cutting-edge textual analysis, I show that the European institution of craft guilds was transplanted differently across different Latin American societies after the arrival of the Spaniards. I collected and digitised 54 Mexican and Peruvian guild ordinances, which reflected the craftsmen's producer preferences and affected the local economy. Transforming this qualitative text data into quantitative evidence reveals that Mexican guild ordinances centred predominantly on quality regulations while religion was more pronounced in Peru. I argue that these differences arose due to the unique institutional and social matrices into which the Spanish craft guilds were exported. I analyse the development of the institutions throughout the colonial era together with the overall composition of the Latin American craft guild system. The results imply that state-of-the-art computer methods can uncover previously hidden patterns, complementing qualitative research in addressing major questions in economic history.

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1 Introduction

Guilds shaped the socio-economic fabric of various societies across the globe from the Middle Ages up to the nineteenth century. Throughout history, there have been two types of guilds. First, craft guilds were producer-interest groups that supplied and regulated the production of a certain set of goods and services within the local economy (e.g., Ogilvie 2019). Second, merchant guilds were regional and long-distance trade associations. By contrary, merchant guilds did not directly supply goods and services to consumers as their members specialised in the wholesale market (e.g., Ogilvie 2011). This dissertation will exclusively focus on the former type of guilds.

As a local institution, the craft guild system jointly determined the rules of economic activity with the political authorities. They regulated who could legally produce goods, how crafts were learned, and the minimum product quality required, among other things (e.g., Ogilvie 2019). Those humanly devised constraints affected the cost of producing, thereby impacting economic performance (North 1991, 97). Researching historical guilds may help economies to design more efficient institutions in the future, augmenting wealth for all of humanity.

One of the fundamental questions in economics concerns why some countries are rich while others are poor. Perhaps, richer countries developed better institutions. Consequently, policy recommendations advocate transplanting "good" institutions from the industrialised to the developed world in order to trigger economic growth. However, this is a superficial perspective on the interplay between institutions and growth. In this dissertation, I will investigate a unique case of institutional transplantation in which the pre-existing qualitative evidence does not reveal much, but by applying a quantitative textual analysis I am able to reveal hidden differences in the transplantation of the same institution, namely craft guilds. My quantitative findings suggest that the surrounding institutional structure must be considered when transplanting an institution into a new country. Moreover, it is important to look at more granular levels of institutional transplantation as differences in outcome cannot be fully explained by overly simplistic models assuming the binary presence or absence of an institution. It is necessary to investigate what craft guilds actually did and how they ultimately affected the socio-economic fabric. This cannot be captured by a simple institutional dummy variable, but requires a continuous spectrum, perhaps even along multiple dimensions (Ogilvie and Carus 2014, 406, 488–9). My methodology not only fosters the understanding of the transplantation of Spanish craft guilds into Latin American colonies in the premodern world, but also points towards a new research branch focusing on how we can measure institutional transplantation more generally, including in modern societies.

European craft guilds have been thoroughly analysed (e.g., Ogilvie 2019). In the medieval period, the Spanish craft guild system emerged which was transplanted to Latin America during the colonial era (e.g., Klein 1967; Konetzke 1947). In contrast, the historiography on Latin American guilds is relatively scarce. Existing secondary literature is old and primary sources have mainly been analysed in a purely qualitative manner. In this dissertation, I expand the historiography of the Latin American craft guild system by performing a textual analysis of

original source material. I have compiled and digitised a unique text data set containing Mexican and Peruvian craft guild ordinances issued during the colonial era. By applying state-of-the-art methods from computer science, I have conducted the first natural language processing (NLP) analysis on guilds. Utilising NLP facilitates the transformation of qualitative text data into quantitative insights (e.g., Carus and Ogilvie 2009). With this approach, I can answer the first two questions more systematically than ever before and, in the end, empirically test my main hypothesis.

First, what can be inferred about the Latin American craft guild system as a whole? Urban centres typically featured multiple guilds for various crafts, such as bakers, hatters, and others. Analysing available primary material about every individual guild that ever existed is feasible, but overly detailed. To draw conclusions about broader trends concerning the Latin American craft guild system, it is necessary to aggregate and simplify the data complexity. Otherwise, it can be very challenging to detect general patterns. But even then, it is difficult for a human to reach over-arching conclusions that are not subjectively biased. By comparison, NLP is significantly more objective and facilitates a holistic economic analysis. For example, I will investigate how many guild ordinances mention words related to entry barriers, human capital, or other economic concepts. Due to my large sample size, I can reach general conclusions about the Latin American craft guild system.

Second, how did the craft guild system evolve during the colonial era? Craft guilds existed in Latin America from the beginning of Spanish rule until the nineteenth century. The craft guild system should not be perceived as a static concept. Rather, it was a gradually changing institution in which certain guilds renewed their ordinances, issued reformed mastership certificates, witnessed unprecedented litigation cases, and more. The compiled text data set includes Mexican and Peruvian ordinances that were created between 1557 and 1801. This large corpus enables the construction of topic indices. For instance, I built an index that measures the importance of human capital. This could not have been achieved without tools from NLP, as I explain below. The constructed indices make it possible to draw conclusions about the development of the craft guild system in Latin America.

Finally, I test the main hypothesis whether Spanish craft guilds were transplanted differently across Latin America. Although Mexico and Peru were both ruled by the Spanish Crown, it is highly likely that the Mexican craft guild system differed from the Peruvian one. As an institution, the craft guild system was woven into the wider institutional matrix of its surrounding society. Accordingly, Spanish craft guilds were exported into distinct institutional matrices and should therefore display varied characteristics. The country-level answers to the preceding two questions provide initial evidence that supports my main hypothesis. In order to test this hypothesis further, I apply advanced NLP algorithms. Every digitised guild ordinance was transformed into a high-dimensional vector. Ordinance vectors with a high level of semantic similarity are located close to each other. I show that the collected sample is clearly separable by country and century. To conclude, I provide quantitative evidence using cutting-edge NLP algorithms that Spanish

craft guilds were transplanted differently across Latin America, casting light on the complex interactions within the institutional and social matrices.

The subsequent sections are structured as follows. Section 2 reviews the literature on Latin American and Spanish craft guilds. Section 3 presents the theoretical framework explaining how the craft guild system emerged in Latin America and, more importantly, how it was affected by the underlying institutional matrix. Section 4 presents the primary sources. The digitisation process is delineated in Section 5. The methodology for conducting a state-of-the-art textual analysis is explained in Section 6, with Section 7 presenting the results, and Section 8 providing an in-depth discussion. Section 9 concludes.

2 Literature Review

The Spanish craft guild system was exported to Latin America in the course of colonisation. To understand whether craft guilds were transplanted differently across Latin America, it is necessary to shortly introduce what the Spanish colonialists initially exported to the New World. Hence, I will first briefly review the Spanish craft guild system and provide indispensable knowledge about the colonial period. Throughout the whole literature review, I will concentrate on the craft guilds' economic impact. Qualitative research on Latin American craft guilds is summarised and compared where possible. Finally, I present a rare quantitative study on Italian guilds to showcase the inspiration for the methodology section.

2.1 Spain

Spanish guild ordinances were promulgated before 1500 (Moral Roncal 1998, 35–7). However, these ordinances neither displayed a strict internal hierarchy nor regulated the production and distribution of goods (Rumeu de Armas 1944, 105–6). This gradually changed with the dawn of the Bourbon Dynasty in the early sixteenth century (Klein 1967, 187–8). The Spanish craft guilds began to closely mirror those found in other parts of Europe (e.g., Ogilvie 2019)

A ratified ordinance was the foundation of a guilds' legal existence. Consequently, the political authorities and the craft guilds were intricately intertwined. The city hall and the city council wielded a large influence over guild regulations. The Spanish monarch was ultimately in charge to approve a proposed ordinance (Molas Ribalta 1970, 45).

Apprentices were at the bottom of the internal hierarchy. Journeymen had successfully completed their apprenticeship and could further advance by becoming a master. Being eligible to move up to the status of master was typically tied to non-economic criteria, such as gender or ethnicity. In many cases, this even applied to being admitted to the guild as an apprentice. Masters were the only persons that were permitted to provide training in their occupation, as is frequently mentioned in surviving ordinances (e.g., Zofío Llorente 2005, 443–63).

In the early sixteenth century, Madrid's craft guild system lagged behind that of Toledo and Seville. This changed when the city became the capital of Spain in 1561 (Carbajo Isla 1985, 67; Zofío Llorente 2005, 292–3). In 1686, the five major guilds of Madrid formed a union to increase their profits. They even elicited features of merchant guilds as they expanded their influence beyond the local economy (Zofío Llorente 2005, 293–5). In the late eighteenth century, craft guilds were no longer able to enforce their legal monopolies. It became less risky for masters to violate their guild ordinances and hire more apprentices and journeymen than stipulated (Moral Roncal 1998, 132–9).

The Catholic religion embraced all spheres of the Spanish socio-economic fabric. Craft guilds had their own Catholic associations, so-called confraternities. Upon admission to a guild, one simultaneously became a member of the guild's confraternity. These associations provided some welfare support for poor guild members and perpetuated the Catholic belief within

their institution (e.g., Molas Ribalta 1970, 50–4). As a caveat, recent studies suggest that the quantitative magnitude of this welfare support was only minor (e.g., Bavel and Rijpma 2016). In Barcelona, the boundary between guilds and confraternities became so blurred throughout the eighteenth century that a distinction between both associations was not possible any more (Molas Ribalta 1970, 51).

2.2 The Colonisation of Latin America

In 1492, Cristopher Columbus arrived in Latin America. This marked the beginning of an unprecedented discontinuity in Latin America's socio-economic fabric. By 1521, the Spaniards had conquered the Aztec Empire in central Mexico. The conquest of the Inca Empire was under way as early as 1532. The Spaniards exploited these regions economically, forced Christianity upon the indigenous population, imposed their language, and introduced a plethora of further changes. The Viceroyalty of New Spain was the first administrative institution, founded by the Spanish Crown in 1535. Throughout the colonial period, Mexico City served as the capital. In 1542, the Crown established the Viceroyalty of Peru as its second administrative region in the Americas. Lima was chosen as capital. Both viceroyalties existed for nearly 300 years before Peru and Mexico achieved independence in the early nineteenth century. Consequently, they were of utmost social and economic importance to Spain (e.g., Chasteen 2001). For the remainder of this dissertation, I will focus on Mexico and Peru.

2.3 The Viceroyalty of New Spain

A number of historians have investigated the craft guild system of New Spain during the colonial era. Carrera Stampa (1954) provides an extensive overview of Mexican craft guilds from 1521 to 1861. Other authors focus on specific cities such as Mexico City, Guadalajara, and Puebla de los Ángeles (e.g., Nieto Sánchez 2018; Rivas-Jiménez 2008). Analogously to Spain, every Mexican craft guild required an ordinance that was confirmed by the viceroy of New Spain in order to be officially recognised (Carrera Stampa 1954, 150–1; Gies 1995, 22). This legal document constituted the bedrock of most guild activities.

Entry barriers to Mexican craft guilds were tied to non-economic criteria. Carrera Stampa (1954) reported that some guilds required applicants to be of "pure blood" (51). Indigenous people, blacks, mixed ethnicities, and females were excluded (226–7). Nonetheless, exceptions were made throughout the sixteenth century. In 1549, the chairmakers' guild of Mexico City allowed indigenous people to take the master's examination, as stated in their ordinance. The gilders' and painters' guild prohibited natives to sell their goods without a mastership certificate (229). This implies that the indigenous men were permitted to work within the craft guild system. Evidence suggests a liberalisation of entry barriers at the end of the colonial era. In Guadalajara, "masters and journeymen came from all [ethnicities]" throughout the eighteenth century (Gies 1995, 30). Greater openness was "a result of expanding industrial production" (30). In 1814,

Viceroy Félix María Calleja published a decree which abolished craft guilds in New Spain. Conversely, this did not lead to the immediate dissolution of the craft guild system. It simply "opened the the crafts to anyone who desired to practice them" (Rivas-Jiménez 2008, 46).

Eligible apprentices joined the guild between the age of 9 and 18. Masters trained apprentices in exchange for free labour. From an economic perspective, this learning agreement was susceptible to opportunism by both contracting parties. On the one hand, masters had an incentive to keep apprentices for as long as possible (Carrera Stampa 1954, 25). On the other hand, apprentices could run away before generating any return on investment for their masters. Because of this, apprentices "pledged to be industrious and faithful and to protect the quality and reputation of the craft" (Gies 1995, 34). The length of the apprenticeship varied across crafts. For example, a goldsmith's apprentice graduated on average after more than five years, whereas only two years were required in the shoemakers' guild (33–4). Subsequently, the apprentice had to become a journeyman within the internal guild hierarchy (Carrera Stampa 1954, 37–8). Journeymen could apply to undergo a guild examination to attain master status. If they successfully passed the exam, they were granted a mastership certificate (41). Every year, inspectors and a warden were elected from the pool of masters. They represented their guild in front of political authorities, monitored the training agreement between apprentices and masters, and examined journeymen who applied to become masters (60–72).

Guild representatives were extremely important for enforcing the monopoly privileges that were granted by the political authorities. In Guadalajara, inspectors had the authority to seize silver that was crafted in workshops not belonging to a certified master. The inspectors would carry those illegally produced goods to the city council (e.g., Samayoa Guevara 1962, 104), which was responsible for the enforcement of the prescribed guild regulations (Gies 1995, 74). Similar to elected guild inspectors, the city council appointed officials that visited and examined every workshop (17–8). The local political authorities enforced the guild monopoly and profited from its activities. As an illustration, journeymen had to pay a fee before they were allowed to take the guild examination (46). The city council even acted as an external agency to prevent abuse of apprentices by their masters (43). However, well-connected guild masters frequently held positions on the city council (Carrera Stampa 1954, 155), casting doubt on its effectiveness as an independent agency. Those examples demonstrate the interdependent nature between the craft guild and the local political authorities within the web of the wider institutional matrix.

The first officially recognised guild in Guadalajara was the shoemakers' guild in 1570. The shoemakers obtained this status because they convinced the political authorities that their guild would stop the decline in craftsmanship (Gies 1995, 23). Their ordinance clearly specified mandatory product quality. This was done to signal to the customers that the goods were genuine (Carrera Stampa 1954, 177). Furthermore, guilds justified their policy of protecting customers from defective merchandise. Supposedly, poor work would defraud buyers and harm well-trained guild members who faced less demand (Gies 1995, 74). Inspectors and appointees of the municipal governments ensured the required product quality with their regular workshop visits.

Fines were imposed to compel masters to meet the stipulated standards (42). The ordinances implicitly safeguarded the guilds' monopoly. Masters were only allowed to own a single workshop and could not execute two different crafts at the same time (Carrera Stampa 1954, 178–9; Gies 1995, 42). By guild law, each master could only hire two apprentices. In late colonial Guadalajara, some masters started to recruit eight or nine apprentices. This evoked a heated debate and masters who violated their ordinance were fined substantially, even to the extent of closing their workshops (Gies 1995, 38). Clearly, the Mexican craft guild system impeded competition and ensured that the producer-interest groups would collectively maximise their profits.

Guild-related confraternities regularly worshipped and praised their patron saints (Gies 1995, 130). Additionally, the confraternity served as a form of charity to provide support to impoverished members. Relatives of a guild brother were allowed to join the guild confraternity although they were neither members of the guild nor did they meet the non-economic criteria applied in the admission process (Carrera Stampa 1954, 80–2). All in all, Catholic belief played a very substantial role in guilds throughout the colonial period and had a profound impact on the socio-economic fabric of Mexico's society.

2.4 The Viceroyalty of Peru

According to Konetzke (1947), the Latin American craft guilds cannot be seen as mere transplantation of their European counterparts. This Latin American scholar advocates to examining guilds within the wider socio-economic matrix (421). Although the Spaniards exported the same institution, the implementation and development of the craft guild system, he contends, differed across Latin American countries. The leading scholar on Peruvian guilds criticised Konetzke's work as heterodox with regard to the contemporary research consensus (F. Quiroz Chueca 1995, 6). Latin American craft guilds were merely replications as the ordinances of Seville served as role models (Muro Orejón 1989, 298). Consequently, Peru's guild literature should display similar themes and trends compared to Mexico. In the following, I will focus on Lima's craft guild system, which can be seen as representative for the administrative region of Peru.

Analogously to Mexico, the viceroy of Peru approved an ordinance to recognise a craft guild as a legal entity. In the early sixteenth century, the Peruvian craft guild system partially emerged as a response to the competition from non-Spanish producers in the colony (F. Quiroz Chueca 2021, 68). The political authorities supported the formation of guilds by craft workers as it facilitated tax collection. This process occurred gradually and accelerated in the later half of the sixteenth century (F. Quiroz Chueca 1995, 10–5). It is important to note that there existed free crafts which were overseen by the municipal government in an indirect manner (69). The entry barriers to join a closed producer-interest group resembled those of the Mexican craft guild system. However, F. Quiroz Chueca (1995) mentioned that guilds with lower prestige, such as the hatters or button-makers, also admitted indigenous people (60–6).

As in Spain and Mexico, the internal hierarchy consisted of apprentices, journeymen, and masters. The dyers' guild demonstrates one example of guild opportunism in the human capital market. In 1616, the dyer masters wished to extend the apprenticeship duration from two to three years. The viceroy averted this change and described such a duration as excessive (20).

The power dynamic between the local government and the craft masters seemed to shift back and forth. In 1535, the city council issued price tables to which guilds had to adhere. The guilds responded by charging higher prices on unlisted goods. The city council put this evasion to an end (99). The authorities levied a tax per capita, which a guild could pay collectively as a community of solidarity. Not the political authorities, but the guild members, were responsible for collecting taxes from its members (69). This intensified both surveillance and connectivity within a guild.

Lima's guilds complained about imports which directly reduced their market share. In fact, guild practices in Lima mainly served to resolve conflicts surrounding excessive competition throughout the colonial period. Craft guilds in Lima were negligent about the production processes, as shown by "the lack of interest in the ordinances and guild practices in working techniques, procurement and distribution of materials, permitted volumes of production, [...]" (F. Quiroz Chueca 2021, 69). Ensuring product quality by inspector visits to workshops was an infrequent practice. In the final decades of the colonial era, Lima's city council gained more regulatory control over emerging craft guilds (70). This depicts a granular deviation from the Mexican craft guild system. While competition was also an ubiquitous theme, Mexican guilds appeared to have been more conscientious regarding product quality.

Likewise, guilds in Peru facilitated the control of the colonial society, in particular to uphold Christianity (69). Promoting the Catholic faith and providing welfare support to poor guild members was at the centre as confraternities worshipped their patrons and organised public and private festivities (F. Quiroz Chueca 1995, 5–6).

2.5 Quantitative Studies on Craft Guilds

So far, the presented literature indicated that there may have been some subtle differences in the transplantation of the Spanish craft guild system between Mexico and Peru. Nevertheless, it remains very difficult to discern general trends or to establish if those differences were systematic. The qualitative research in the historiography provides a rich historical context, but lacks the objective measurability to answer the hypothesis as to whether the Spanish craft guild system was transplanted differently in different parts of Latin America. Nowadays, economic history "is using more quantitative data and modern econometric techniques to study more quantitatively tractable versions of the big questions" (Abramitzky 2015, 1247). A deep understanding garnered from qualitative research enables the modern economic historian to grasp the limitations of the collected data and to more effectively interpret the statistical results. In short, quantitative analysis is indispensable to support a hypothesis, but insufficient to fully explain the complex

mechanisms beneath the findings.

The literature on quantitative studies regarding craft guilds is small for a simple reason. Most sources are written, textual documents. Nevertheless, more recent work on craft guilds started to incorporate descriptive statistics which permits aggregation of an urban craft guild system to a more abstract level. For example, researchers compiled the number of guilds in a city, the average number of members within a guild, the average age to become a master, and more (e.g., Ogilvie 2019). This captures the concept of craft guilds as a whole, as opposed to investigating the finer micro-level nuances, which might not always have had a substantial impact on the economy at large.

One method to generate more quantitative data is to transform qualitative, textual documents into a quantitative source (e.g., Carus and Ogilvie 2009). Mocarelli (2008) did so to explore the effect of the guild system on technological regulation and human capital investment, drawing on a database covering guilds across 50 Italian cities spanning the thirteenth to nineteenth century (1). The author found that 702 out of 1,155 guild ordinances did not mention technological regulation. Examining the other 453 ordinances led him to the conclusion that technological regulation was important, but only for crafts that produced higher quality goods, such as silk products (9). Apprenticeships were not legally recognised in about 60% of all ordinances. The author's interpretation points towards the possibility of private contracts as a mechanism to pass on specialist craft knowledge from one generation to another (10–1).

Mocarelli (2008) transformed guild ordinances into quantitative data, effectively simplifying complex text into a higher-level representation of the Italian guild system as a whole. The database was already available, and it is highly likely that the author read all 1,155 ordinances to assess how many of them mentioned technological regulations or apprenticeships. This process must have been very time-consuming. "One recent development that has the potential to transform economic history is the use of computationally intensive methods to convert large-scale qualitative information into quantitative data" (Abramitzky 2015, 1248). To the best of my knowledge, the current literature on guilds has not employed such an approach. My dissertation fills this gap by using state-of-the-art methods from natural language processing to analyse guild ordinances.

3 Theoretical Framework

Craft guilds were institutions (Ogilvie 2004, 288). There are various theories why institutions emerge (see Ogilvie 2007). For Latin America, it is reasonable to assume that many institutions arose by "accident" because the arrival of the European imperial powers pushed the continent onto a new path-dependency (658). Most importantly, institutions cannot be analysed in isolation. They must be considered within the institutional matrix in which they are embedded. This is necessary due to strong interdependencies in the cluster of institutions (Ogilvie and Carus 2014, 406).

The arrival of the Spaniards along with their institutions provides a unique research setting to observe the influence of distinct institutional matrices on the same institution. "As Spanish American cities formed in the 'New World' craft guilds along the European pattern also emerged" (Gies 1995, 22). Although the craft guild system varied across Spain, I assume that the Spanish colonialists exported a fairly identical concept to their colonies, as described in Subsection 2.1. Subsequently, they implanted the concept of the Spanish craft guild system into the distinct institutional and social matrices of Mexico and Peru.

This theoretical framework motivates the hypothesis investigated in this dissertation, namely that the craft guild system was implemented differently across Latin America. Consequently, differences between the development of Mexican and Peruvian craft guilds may be attributable to the complex interaction effects within the cluster of institutions. Variations of the Latin American craft guild system could be ramifications of the distinct institutional matrices. Why else should the same Spanish institution have developed differently in Mexico and Peru?

4 Data

I was able to track down 54 guild ordinances from Mexico and Peru issued between 1557 and 1801 (Table 1). They were reprinted in two compilations. The Mexican ordinances were published by the Mexican Department of Labour in 1938. The director wrote a short essay about the compiled primary sources (Vásquez 1938a). Similarly, the Peruvian ordinances are preceded by a qualitative discussion of the importance of ordinances as a historical source (F. Quiroz Chueca 1986). Both compilations were published by typesetting and have until now never been scanned for digital use. In this section, I will explain how the original source material was created, why it is fruitful to analyse, and possible biases underlying the collected sample.

4.1 The Process of Drafting and Confirming Craft Guild Ordinances

An ordinance was necessary for a guild to be legally recognised. Without this document, guild members were not able to set or enforce any regulations (Ogilvie 2019, 208–9). Evidently, guild ordinances had a profound impact on the local economy. As a consequence, multiple parties, each with its own interests, were involved in the process of drafting and confirming a guild ordinance. The most common procedure for passing an ordinance into law in colonial Latin America is depicted in Figure 1.

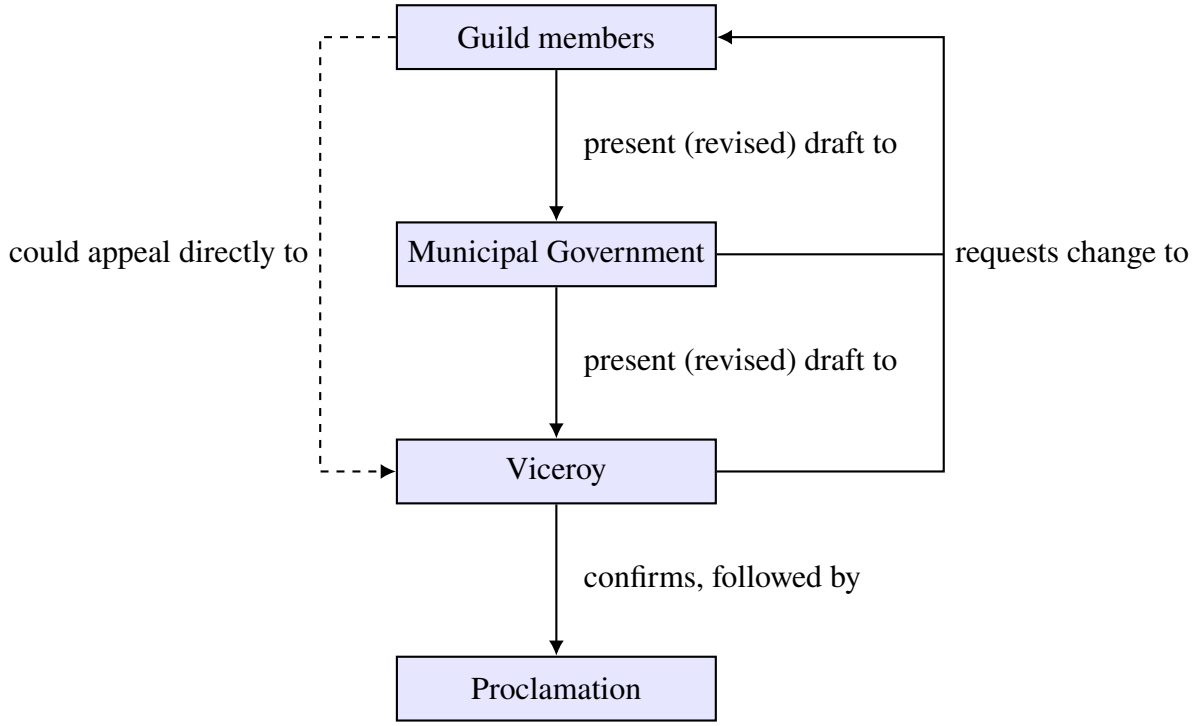


Figure 1: Process of drafting and confirming a guild ordinance in Latin America

Notes: Please see text for more information.

Initially, leading members of the informal producer-interest group created a draft which was then presented to the city council (F. Quiroz Chueca 1986, xvi). If amendments or modifications

were requested, the municipal government could return the draft. If not, the attorney general had the task of transferring the ordinance to the viceroy. It is known that the attorney generals possessed Spanish ordinances and even became specialised in assessing drafts (xvii). Potentially, the viceroy sent revisions back to the city council, which would inform the guild members, creating a feedback loop. Alternatively, he would approve the ordinance by sending a brief confirmation letter (e.g., F. Quiroz Chueca 1986, xvii–xviii; Vásquez 1938a, 11). Lastly, the ordinances were proclaimed in the public marketplace "so that no one can claim ignorance" (shoemakers and tanners 1562, Lima; see Table 2).

The institutional balance of power between the municipal government and the guild members affected the content of the ordinances. In the seventeenth century, the modifications made by the local authorities were rare. By contrast, by the second half of the eighteenth century, the altercations had become more frequent (F. Quiroz Chueca 1986, xvii). The reader should not form the impression that there existed only a single route to ratify a guild ordinance. For example, guild members could bypass the municipal government and directly appeal to the viceroy. As a result, the viceroy was deemed to be the ultimate instance to resolve conflicts between both local institutions, the municipal government, and guilds (xix). In addition, there were cases (e.g., dyers 1613, Lima; see Table 2) in which the municipal government had the legislative authority to issue regulations within the scope of their powers (xvii).

The final draft of a guild ordinance normally displayed a similar structure across guilds. A brief introduction would provide a reason why an official entity should be formed. The main body of the ordinance would list a number of statutes, often enumerated in arabic or roman numerals. These regulations represented the specific requirements proposed to become guild law. A very short legal phrase frequently concluded the document. The majority of the collected guild ordinances have this structure. An exception are ordinances which consisted of small amendments to a previous ordinance. For instance, after a guild was officially established, members occasionally addressed minor or newly emerging issues. Those ordinances were typically very short and did not contain an enumeration of regulations (see *otras ordenanzas* in del Barrio Lorenzot 1920). At times, very old guild ordinances were partially or even completely replaced by new ones (hatters 1592, Mexico City; Table 1). Within the collected sample, all 54 ordinances have a text body containing enumerated regulations.

Year	City	Guild	#Words	Viceroy
1561	Mexico City	hatters	2997	Luis de Velasco
1574	Mexico City	candle-makers	1703	Martín Enríquez
1579	Mexico City	hatters	601	Martín Enríquez
1584	Mexico City	silk-weavers	1019	Diego Mejía de la Cerda (Mayor)
1592	Mexico City	hatters	668	Luis de Velasco, 1st Marquess of Salinas
1592	Mexico City	cloth-makers	736	Luis de Velasco, 1st Marquess of Salinas
1596	Mexico City	gold-weavers	1146	-
1597	Mexico City	turners and carpenters	746	Gaspar de Zúñiga y Acevedo
1599	Mexico City	gold-beaters	977	Gaspar de Zúñiga y Acevedo
1600	Mexico City	tailors and jewelers	1467	Gaspar de Zúñiga y Acevedo
1605	Mexico City	cloth-finishers	1340	Gaspar de Zúñiga y Acevedo
1609	Mexico City	harness-makers	346	Luis de Velasco, 1st Marquess of Salinas
1618	Mexico City	candle-makers	860	Diego Fernández de Córdoba
1620	Mexico City	bakers	496	Diego Fernández de Córdoba
1622	Mexico City	bakers	847	-
1676	Puebla de los Ángeles	cloth-weavers	915	Enríquez de Rivera y Manrique
1706	Mexico City	tallow chandlers	710	Francisco Fernández de la Cueva
1721	Mexico City	sackcloth-weavers	4506	Baltasar de Zúñiga y Guzmán
1746	Mexico City	silver-smiths	8382	-
1757	Oaxaca	cotton-weavers	2305	-
1770	Mexico City	bakers	3946	Carlos Francisco de Croix

Table 1: Overview of digitised ordinances from Mexico, 1561 – 1770

Notes: Column "#Words" indicates the total word count of the listed guild regulations, excluding the introduction, conclusion, confirmation, and exchanges between guild members and the authorities. Column "Viceroy" shows who was asked to confirm the ordinance, or had already approved it. In rare cases, the city major approved the ordinance, labelled as "(Mayor)".
Source: Ordinances are from the published edition in "Ordenanzas para los Gremios Obreros de la Nueva España, 1561-1770".

Year	City	Guild	#Words	Viceroy
1557	Lima	tailors and hosiers	2066	Hurtado de Mendoza
1562	Lima	shoemakers and tanners	3112	Diego López de Zúñiga y de Velasco
1577	Lima	hatters	1451	Francisco de Toledo
1604	Lima	ribbon-makers	3117	Luis de Velasco, 1^{st} Marquess of Salinas
1604	Lima	shoemakers and tanners	3245	Gaspar de Zúñiga y Acevedo
1605	Lima	sword-smiths	2407	Gaspar de Zúñiga y Acevedo
1608	Lima	cap-makers and silk-weavers	2672	Juan de Mendoza y Luna
1613	Lima	silk-finishers	1752	Juan de Mendoza y Luna
1613	Lima	candle-makers	411	Juan de Mendoza y Luna
1616	Lima	saddlers, harness-makers and leather-workers	2112	Francisco de Borja
1616	Lima	dyers	2498	Francisco de Borja
1632	Lima	hatters	928	Luis Geronimo Fernandez de Cabrera y Bobadilla
1633	Lima	silver-smiths	802	Luis Gerónimo Fernández de Cabrera y Bobadilla
1634	Lima	blacksmiths and locksmiths	877	García Sarmiento de Sotomayor
1636	Lima	tailors and jewelers	3356	Luis Jerónimo de Cabrera
1640	Lima	gold-drawers	1211	Pedro de Toledo y Leyba
1652	Lima	ribbon-makers	444	García Sarmiento de Sotomayor
1766	Lima	firework-makers	1216	-
1778	Lima	silver-smiths	3922	-
1779	Lima	mattress-makers	4218	-
1780	Lima	rope-makers	1289	-
1785	Lima	butchers	793	-
1785	Lima	tallow chandlers	816	-
1785	Lima	potters, white-smiths, munition-makers and pewterers	836	-
1786	Lima	chocolate-makers	775	-
1787	Lima	chocolate-makers	742	Pedro José de Zárate
1787	Lima	bakers	1670	Teodoro de Croix
1788	Lima	butchers	537	-
1789	Lima	butchers	1794	-
1792	Lima	shoemakers	2744	-
1797	Lima	embroiderers	840	-
1799	Lima	tallow chandlers	4430	-
1801	Lima	button-makers	595	Marquis of Santa Maria (Mayor)

Table 2: Overview of digitised ordinances from Peru, 1557 – 1801

Notes: Please see notes of Table 1.
Source: Ordinances are from the published edition in "Documentos".

4.2 The Economic Significance of Guild Ordinances: Uncovering Producer Preferences

The economic significance of guild ordinances cannot be overstated. At first glance, ordinances might seem purely normative. They stated only what was supposed to happen, not capturing the reality on the streets of Mexico and Peru. Why should they be investigated if they were negligible legal documents to which nobody adhered? In fact, their very existence testifies to their importance to all parties, since they were expensive to lobby for, draft, and issue, and people do not invest time and money in trying to secure valueless privileges. On top of that, much qualitative evidence in historical studies supports the view that they had real economic effects, even when they were not perfectly enforced (see Ogilvie (2019), esp. chapters 3 and 4). Hence, ordinances reveal the preferences of producer-interest groups, such as craft guilds (e.g., Córdoba de la Llave 2016, 85; Ehmer 2005, 62; Menjot 2014, 49). Furthermore, these legal documents provide a deep insight into the colonial economic structure (Vásquez 1938a, 5) and are "the most complete expression of educational-professional ideas of those years" (9). This is further strengthened by the observation that most ordinances came into being as a response to a certain state of affairs, which is usually mentioned in the introduction to the ordinance. Moreover, the repetition of specific words and phrases across many guilds would emphasise common producer preferences, while their omission would suggest changes to those preferences. To sum up, ordinances can disclose which economic concepts producers desired or aimed to prevent.

Critics may point out that ordinances were not unilaterally enacted by craft workers. The political authorities could rescind or append regulations. Modifications by the municipal government generally sought to reduce the privileges granted to craft guilds. The viceroy requested changes to "guarantee the interest of the Crown by modifying or suppressing" regulations that were deemed harmful (F. Quiroz Chueca 1986, xix). The authorities intervened more decisively when the vital supply of the city was at risk (e.g., bakers, 1787; butchers, 1789; see Table 2). All in all, revisions nearly always subdued the wishes expressed by guild members (xix). As a result, the final draft can be interpreted as the lower bound estimate for the actual producer preferences of craft guilds.

4.3 Primary Source Description

Both collections of reprinted source material also comprise ordinances that were not related to craft guilds, but to other forms of colonial labour. For example, the Mexican compilation contained sales regulations regarding chicken and black honey (Vásquez 1938b, 45, 47–8). Similarly, Lima's city council issued two general labour ordinances in 1594 and 1785 (207–17). I omitted these documents. As a general rule, I included all ordinances which unequivocally refer to a specific craft guild.

The original primary material is stored in Mexican and Peruvian archives. The collected

ordinances from Peru are preserved in the *Archivo General de la Nación*, *Archivo Municipal de Lima*, and in the *Libros de Cabildos de Lima*. The Mexican compilation does not indicate where the original material can be located. However, I was able to track down most of the ordinances it contains in the *Archivo Histórico de la Ciudad de México*. This archive has three volumes (431 to 433) in its city council collection, covering the period from 1546 to 1757. Upon confirmation, copies of an ordinance were made and disseminated to other facilities, such as the *Archivo General de Indias* in Seville.[1] Hence, the hand-written sources can be consulted in various places.

As explained in Subsection 4.1, the creation of a guild ordinance entailed a written exchange between the political authorities and the craft representatives. The Peruvian compilation provides a plethora of such correspondence and in rare cases even initial drafts that were sent to the viceroy (e.g., mattress-makers 1779, Lima; see Table 2). By contrast, the Mexican compilation only contains final drafts. Occasionally, the confirmation and proclamation statements were provided. It is unknown whether the compiler excluded any correspondence or initial drafts from the Mexican compilation.

Published editions of primary sources are always based on transcriptions carried out by a compiler, which may lead to subtle variations from the original manuscript. F. Quiroz Chueca (1986) provides reassurance concerning the authenticity of the Peruvian compilation by explaining that "these ordinances are certified copies made by the city council's notary of the originals he had in sight, as it appears to be in each case" (xiii). The spelling rules strengthen the impression of authenticity, as they were typical for the colonial era. In contrast, the Mexican compilation displays modern spelling rules and does not make any formal declaration concerning the accuracy of the transcription.

4.4 Sample Bias in Archival Research

There exist additional guild ordinances for both Mexico and Peru, which I was unable to collect. This potentially introduces sample selection bias and may affect the reliability of my results. In what follows, I will assess the representativeness of the sample.

Out of the 54 collected guild ordinances, 52 governed economic activity in either Mexico City or Lima. Evidently, the sample selection was not randomised, as there existed other urban centres in the viceroyalties of New Spain and Peru. However, as these were the capitals of the respective viceroyalties, they served as role models for other urban centres within their administrative region (xi). Under the assumption that Mexico City and Lima are representative of the craft guild system in New Spain and Peru, the question arises if the collected ordinances are representative of the cities themselves. The Peruvian compilation is not exhaustive (xxxii), but the author states that he reproduced all accessible ordinances to build a foundation for further study (xiii–xiv). For Mexico, there exists another compilation. Unfortunately, I discovered this after the data collection

[1] I obtained this information by visiting the archive in Seville.

phase of this dissertation project, so I was not able to incorporate it into the textual analysis (see del Barrio Lorenzot 1920). In 1790, Nieto Sánchez (2018) counted 54 guilds in Mexico and only 21 in Lima (183). Most likely, there exist ordinances in archives around the world that are yet to be found. Nevertheless, the 54 collected ordinances should capture a substantial share of the Latin American craft guild system. In summary, I have not found any evidence that explicitly undermines the representativeness of the sample, but I am not able to completely check the claim that it is representative of all the guilds in these two cities or their respective viceroyalties.

5 Data Preparation

This section discusses the methodology used to construct the text data set used in my analysis. Initially, I will explain the process of digitising ordinances that have been typeset, which I carried out using optical character recognition (OCR). Then, I will describe how I corrected errors stemming from the OCR pipeline and adjusted for old Spanish spelling using large language models.

5.1 Optical Character Recognition

Optical character recognition converts textual images into editable text data. Put simply, it can transform images of hand-written documents into machine-readable computer text.

Initially, I manually scanned every guild ordinance to create tagged image files (tif).[2] Then, I created one folder for every guild ordinance. Each folder contained the scanned tif files associated with that document. To further preprocess the image files, I used the programming language Python.[3] The initial scans were not perfectly aligned because they were part of a hardcover book. In addition, scans were surrounded by visually tainted white paper. Using Python, I automatically de-skewed and cropped all images. As the compilation was typeset by a printer, there were tiny ink spills on each page. I therefore had to convert every image to grayscale and apply a Gaussian blur for noise reduction. A binary threshold created an inverted binary image with white text on a black background. Image dilation and erosion further removed noise and separated characters that were overlapping due to ink spills. Finally, the image was resized to be twice the size of the original scan.

After preprocessing the images, I used "pytesseract", which is a Python binding for Google's open-source and widely-used Tesseract-OCR engine (e.g., Smith 2007). Put simply, all images were converted into txt-files. Next, txt-files within the same ordinance folder were concatenated into a single txt-file. Now, every ordinance was represented by one txt-file. Then, all ordinances were merged into a CSV-file, creating a text data set. For each row, the variable `text_data` captured the full text of a guild ordinance. Lastly, I added the variables `country`, `century`, and `guild`.

5.2 Adjusting for Changes in Spelling over Time

Spanish spelling changed across the centuries (e.g., Penny 2002). Optical character recognition yielded a high accuracy, but there were still some spelling errors and false-positive characters that were not in the original document. As an economic historian, I am primarily interested in the semantic value of the ordinances as opposed to their linguistic properties. Therefore, I

[2] Under UK law, a copyright exception is made for text and data mining for non-commercial research. See https://www.gov.uk/guidance/exceptions-to-copyright.

[3] I used Python version 3.11.4 available on python.org.

decided to transform the old Spanish spelling to modern spelling while simultaneously correcting inaccuracies that had arisen in the OCR pipeline. I achieved nearly perfect results by employing large language models.[4]

Large language models are a rapidly evolving branch within NLP. To solve the task at hand, I chose "Generative Pre-trained Transformer 4" (GPT-4). The model scored 165/170 on the verbal section in the Graduate Record Examination (GRE), placing it at the 95^{th} percentile. The model also ranked in the top 10% on the US bar exam (OpenAI 2023, 5).

As input, I always provided the same prompt (Figure 2) paired with the obtained ordinance from the OCR process. Large ordinances had to be split into smaller chunks as they were too large for the input to be processed all at once. In old Spanish, a few pairs of letters were commonly interchanged by the original clerk or scribe. For example, "v" was used instead of "b", "z" for "c", and "y" for "i". I checked a number of GPT-4-corrected guild ordinances with the original edition, and the results were impeccable (Figure 3). This is further corroborated by state-of-the-art research published in May 2023: "GPT-4 models demonstrate strong performance in grammatical error correction as defined in a sentence revision task" (Coyne *et al.* 2023, 8).

I am fully aware that transforming data must be undertaken with tremendous caution. Nevertheless, the GPT-4-corrected ordinances yielded the desired results. The sentence structure remained completely the same while the old spelling was updated. To reiterate, I am not interested how the Spanish language changed. The semantic content of the ordinances, which shaped economic activity, is at the core of the questions I am investigating in this dissertation. As I applied this GPT-4-correction to every ordinance, all of them are similar — at least with regard to spelling. Differences between ordinances should therefore be due to distinct sentence structure or varying semantic content.

> I input text data that was generated with OCR. There are some errors as the OCR was not able to recognise all characters correctly. The text data is written in very old Spanish. You should correct spelling errors. You should also remove characters that were most likely not in the original text document and are false-positives. You can impute single words. This means that if a word is false, you should correct it. You should transform old words into modern Spanish spelling. You should never change the sentence structure or rearrange words within a sentence. The input is as follows:
>
> [Ordinance text generated by OCR]

Figure 2: GPT-4 prompt for correction of inaccuracies and spelling adjustment

Notes: This prompt was always paired with a digitised ordinance provided by the OCR pipeline as input for GPT-4. The model corrected residual spelling errors from OCR and transformed old Spanish spelling into their modern equivalents. The output is demonstrated in Figure 3.

[4]The use of artificial intelligence for the textual analysis was officially approved by the History of Faculty and the Director of Graduate Studies on 17 August 2023.

Input from OCR pipeline:

Y ten que los dichos behedores ni algunos dellos pueda hazer ni haga exa men a ninguno de los dichos ofigiales sí no fuere con asistencía del dicho excrivano de cavildo...

GPT-4 output:

Iten que los dichos veedores ni algunos de ellos pueda hacer ni haga examen a ninguno de los dichos oficiales si no fuere con asistencia del dicho escribano de cabildo...

Scan of compilation:

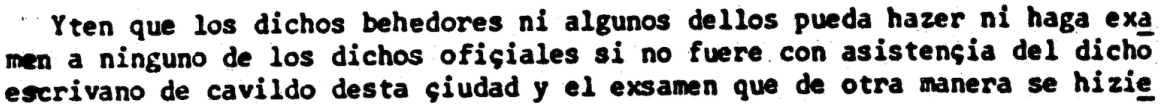


Figure 3: GPT-4 output to correct inaccuracies and spelling adjustment to modern Spanish

Notes: GPT-4 corrected spelling errors, coloured in green. Old Spanish words were transformed to modern Spanish, coloured in red.

6 Methodology

This section breaks down the NLP methods I applied to the digitised primary material. It provides the necessary background knowledge for a solid understanding of the advanced NLP algorithms. Because it focuses on the methodology, it only briefly alludes to established concepts within economic history.

For the textual analysis, I split the data into two parts: first, a *regulations* text data set, which only includes the main body of the ordinances, i.e. the listed regulations; and second, an *introduction* text data set containing all the introductions. Initial drafts, confirmation letters, and correspondence between the authorities and guild members were discarded.

6.1 Topic Selection

Due to the rich information in each ordinance, I decided to focus on six topics:

(a) Entry Barriers

(b) Human Capital

(c) Markets

(d) Enforcement

(e) Religion

(f) Introduction

The main aim of the textual analysis is to unveil the aspirations of producers who were members of Latin American craft guilds. The first four topics clearly affected the local economic activity, as discussed above in Section 2. Additionally, I consider the guilds' relationship with religion, since Catholic belief universally influenced the socio-economic fabric of Latin America. The first five topics were investigated using the *regulations* text data set. Lastly, I analyse the *introduction* data set to support the argument whether ordinances came into being as a response to a certain state of affairs.

For every topic, I selected a set of associated words (Table 3). While reading large parts of the ordinances, I noticed that these legal documents were frequently written in a similar manner. They repeatedly used the same words and phrases to discuss a specific topic. A few examples are displayed in Figure 4. The methods I describe below focus on analysing those characteristic sets of words, making it possible to draw general conclusions about each of the six topics under analysis.

Entry Barriers	Translation	Human Capital	Translation	Markets	Translation
*negro**	black	*carta de examen*	mastership certificate	*precio*	price
*mulato**	mixed	*aprendizaje*	apprenticeship	*valor*	price
mestizo	mixed	*aprendiz*	apprentice	*calidad*	quality
*indio**	native	*aprender*	learn	*tienda pública*	public workshop
cautivo	prisoner	*enseñanza*	teaching	*suficientemente*	sufficient
esclavo	slave	*examinado*	examined	*cantidad*	quantity
mujer	woman	*examinados*	examined	*tienda*	workshop
		examinarse	to be examined	*fabricada*	produced
				taller	workshop
Enforcement	**Translation**	**Religion**	**Translation**	**Introduction**	**Translation**
pena	penalty	*cofradía*	confraternity	*fraude*	fraud
multa	fine	*confraternidad*	confraternity	*buen uso*	good use
peso	peso	*hermandad*	brotherhood	*buen régimen*	good governance
incurra	incur	*cofrade*	brother	*beneficio del público*	public benefit
pagar	pay	*patrón*	saint	*engaño*	deception
juez	judge	*bautizo*	baptism	*desorden*	disorden
denunciador	informer	*iglesia*	church	*desengaño*	frustration
veedor	inspector	*Jesús*	Jesus	*beneficio común*	common good
cabildo	city council	*devoción*	devotion	*daño*	harm
ayuntamiento	city hall	*condenación*	condemnation	*fraudes*	fraud
		cristiana	Christian		

Table 3: Selected words for each topic

Notes: I chose these words for each topic as they frequently occurred in stereotypical phrases across many ordinances. Associated excerpts from the *regulations* data set are depicted in Figure 4.
*These Spanish terms are used in this dissertation in a historical context, reflecting the language and classifications of the ordinances under study.

Entry Barriers:

"...Iten, que ningún negro ni mulato no pueda usar ni use los dichos artes arriba declarados, ni algunos de ellos, aunque sean libres..." (silk-weavers 1584, Mexico City)

[...Item, no black nor mixed may use the arts stated above even if they are free...]

Human Capital:

"Iten ordenamos y mandamos que ninguna persona pueda ser admitida al examen del dicho oficio sin que primero haya sido aprendiz y oficial de maestro examinado por lo menos tiempo de dos años, para que en ellos aprenda el dicho oficio..." (gold-drawers 1640, Lima)

[Item, we order and command that no person can be admitted to the exam of this guild without having been apprentice and journeyman of an examined master for at least two years, ensuring that this person learns the craft of this guild...]

Markets:

"Iten, que cada año se haga postura del precio de las dichas ceras por el Corregidor y fieles ejecutores, informándose muy particularmente de cómo corre y la cantidad que hay" (candle-makers 1618, Mexico City)

[Item, that every year a price assessment of the wax may be made by the municipal officials, informing themselves how it runs and the available quantity of wax...]

Enforcement:

"...incurran en pena de diez pesos..." (hatters 1561, Mexico City)

[...a penalty of ten pesos is incurred...]

Religion:

"...cuya cofradía se halla fundada y aprobada..." (mattress-makers 1779, Lima)

[...whose confraternity is found to be established and proven and tested...]

Introduction:

"...se hiciesen ordenanzas y el cabildo las admitió y corrigió en la forma que están para que vuestra excelencia se sirviese de estatuirlos por ordenanzas en beneficio común..." (gold-drawers 1640, Lima)

[...the ordinances were made and the city council admitted and corrected them so that your excellency might see fit to establish them as ordinances for the common good...]

Figure 4: Phrases relating to a specific topic, containing selected words

Notes: Words that were selected to represent a topic are coloured in red. Own translation.
Source: See respective ordinances in Table 1 and Table 2.

6.2 Word Presence Analysis

To examine the prevalence of each topic within the Latin American craft guild system, I took inspiration from Mocarelli (2008). First, a binary variable captured whether a specific word or phrase was mentioned in a particular ordinance i. Mathematically:

$$\texttt{specific\_word\_or\_phrase}_i = \begin{cases} 1 & \text{if } \textit{specific\_word\_or\_phrase} \in \text{ordinance}_i, \\ 0 & \text{if } \textit{specific\_word\_or\_phrase} \notin \text{ordinance}_i \end{cases}$$

For example, if *precio* was mentioned anywhere in the Mexican bakers' ordinance of 1622, the variable `precio` would take on the value 1 in the respective row. This was done for all words associated to the topics presented in Section 6.1. This made it possible to calculate how many ordinances mentioned a specific word. This is a straightforward method for quantifying the importance of an economic concept for the Latin American craft guild system.

6.3 Topic Indices

The importance of a topic across the centuries can cast light on the development of producer preferences. In what follows, I will explain the step-by-step construction of a topic index to analyse the *regulations* text data set.

Initially, I begin by elucidating how the relative frequency of a single word w is computed within an ordinance i. Later on, individual word frequencies are added to calculate a topic frequency, and finally aggregated across `country` and `century`.

To obtain the relative word frequency of w in a given ordinance i, the number of times word w appears in ordinance i is divided by the total word count of the ordinance. Mathematically,

$$\text{word\_frequency}(w) = \frac{\text{Number of times word } w \text{ appears in ordinance } i}{\text{Total number of words in ordinance } i}$$

Suppose that word $w = \textit{aprendiz}$ is mentioned 20 times within the Mexican silk-weavers' guild ordinance in 1584. In total, this ordinance consists of 1019 words. The word frequency would then be calculated as follows:

$$\text{word\_frequency}(\textit{aprendiz}) = \frac{20}{1019} = 0.0196 \approx 2\%$$

The word frequency represents how often word w occurs relative to all words within a particular guild ordinance. In the example above, roughly 2% of words take on the form $w = \textit{aprendiz}$.

Nonetheless, a topic t does not only consist of a single word w. It can include up to N words or phrases. To demonstrate the construction of an index, I will use topic $t = \textit{religion}$ as an example.

$$\{w_1, w_2, \ldots, w_N\} \in t$$
$$\{\text{cofradía}, \text{Jesús}, \ldots, \text{cristiana}\} \in religion$$

To compute the importance of topic t, the individual frequencies of all words within that topic are summed up. Mathematically,

$$\begin{aligned}\text{topic\_frequency}(w_1, w_2, ..., w_N) &= \sum_{i=1}^{N} \text{word\_frequency}(w_i) \\ &= \text{word\_frequency(cofradía)} + \cdots + \text{word\_frequency(cristiana)}\end{aligned}$$

The topic frequency ranges from 0 to 1 and represents the proportion of an ordinance that mentions words related to topic t. For each of the topics except the introductory material, a topic frequency was calculated for all 54 guild ordinances. Subsequently, the mean topic frequency was computed by `country` and `century`.

6.4 Part-of-Speech Tagging

Part-of-Speech (PoS) tagging is a branch of NLP which assigns a word to its grammatical category, facilitating analysis of changes in sentence structure. Using Python, every word in the *regulations* data set was classified into its grammatical category (e.g., noun; verb). Afterwards, the grammatical distributions were aggregated by `country` and `century`. Changes in the distribution of grammatical categories indicate a difference in sentence structure.

6.5 Doc2Vec

The central hypothesis to be explored in this dissertation is whether Spanish craft guilds were transplanted differently in different societies in Latin America. Using Doc2Vec, I can test this hypothesis quantitatively. Doc2Vec is an off-the-shelf neural network, which makes it possible to assess the similarity between textual documents by transforming them into high-dimensional vectors. This section explains how the Doc2Vec algorithm was used to analyse the *regulations* data set. At the end, I briefly introduce a dimensionality reduction technique which I used to visualise the high-dimensional output vectors.

Doc2Vec transforms a text document into a mathematical representation. A multidimensional vector captures the semantic essence of the guild ordinance and is located in the "document embedding space". Consequently, Doc2Vec generates 54 vectors, each located somewhere in the document embedding space. Every vector has the same dimension, although the length of the initial guild ordinance may differ. Vectors of ordinances with similar content should be close to

each other in the embedding space. By contrary, ordinances that focus on distinct themes should be more distant.

How does Doc2Vec learn a meaningful mathematical representation of a textual document? Suppose there is a fictitious guild ordinance including only one sentence:

> Ninguna persona pueda tener tienda, si no sea examinada.
>
> ---
>
> Translation: Nobody can own a workshop without being examined.

During data processing, all words are reduced to their root form and converted to lower case. Stop words and punctuation is removed.

> ninguno persona poder tener tienda si no es examinar

Before delving into the computation of the optimal document vector, every single word must be vectorised using Word2Vec. Initially, each word vector is randomly initialised. For illustration purposes, the vectors are only 2-dimensional.

$$\text{ninguno} = \begin{bmatrix} -0.1 \\ 0.5 \end{bmatrix}, \quad \text{persona} = \begin{bmatrix} -0.3 \\ 0.4 \end{bmatrix}, \quad \dots, \quad \text{examinar} = \begin{bmatrix} 0.1 \\ -0.1 \end{bmatrix}$$

At this point, the word vectors are useless as they were initialised randomly. They are now gradually adjusted in an iterative learning process. One way of achieving this, is by predicting the context for a given word. Suppose the context size is set to two and the word tienda is selected.

> ninguno persona poder tener tienda si no es examinar

The context window is coloured in green, while the target word is in red. Word2Vec computes the probability that tener and tienda co-occur given their initialised word vectors. Intuitively, the probability is higher if the vectors are closer to each other. If the probability is low, then the error is high, thereby adjusting the word vector of tienda using backpropagation. This is done for all combinations between the target word tienda and the respective context words (poder tener si no). Consequently, the vector representation of tienda is updated several times, depending on the context size. In one epoch, the Word2Vec algorithms slides over the whole text corpus, executing the described procedure for each word.

At the beginning, 54 document vectors are also randomly initialised.

$$\text{ordinance}_1 = \begin{bmatrix} -0.7 \\ 0.5 \end{bmatrix}, \quad \text{ordinance}_2 = \begin{bmatrix} -0.7 \\ 0.8 \end{bmatrix}, \quad \dots, \quad \text{ordinance}_{54} = \begin{bmatrix} 0.3 \\ -0.6 \end{bmatrix}$$

Crucially, the document vectors and word vectors are updated simultaneously. Suppose that ordinance_1 is the fictitious ordinance. At the target word tienda, its context words and the document vector are averaged to generate a single vector.

$$\text{averaged\_vector} = \frac{\text{poder} + \text{tener} + \text{ordinance}_1 + \text{si} + \text{no}}{5}$$

Analogously, the probability that the target word tienda and the averaged vector co-occur is predicted. If the prediction is far off, then the error is very large, leading to a substantial adjustment of the document vector ordinance_1. At the same time, the word vectors are updated employing the previously explained procedure. As the target word changes, a new word vector is adjusted. However, the same document vector is adjusted based on the context words of every target. If the target word originated from a new ordinance, then the document vector switches respectively. Iterating multiple times over the text corpus pushes each document vector to its optimal mathematical representation. After hundreds of iterations, the document vectors should capture the thematic content, the contextual relationships, and even the sentiment of the underlying guild ordinance.

The presented approach describes the essence of Doc2Vec. Nevertheless, there are small variations and more detailed nuances. In conclusion, the main takeaway of this algorithm should be that it generates a document vector for every guild ordinance. Vectors should be close to one another in the document embedding space if the underlying text concerns similar themes.

In Python, I applied Doc2Vec on the *regulations* data set. The dimensionality of the document vectors was set to 20, which is common practice. The context window was set to 5 to capture a broad context around a word. Rare words with fewer than 5 occurrences across the entirety of the text data set were omitted. The algorithm ran for 750 epochs. This means the presented procedure was applied 750 times for every word within the 54 ordinances. Finally, the document vectors are visualised using principal component analysis (PCA), an established dimensionality reduction technique in economics (e.g., R. Diamond 2016).

6.6 Sentence Classification with Large Language Models

Every sentence in the *regulations* data set was also classified into one of the presented topics. Furthermore, I introduced the category "product quality" focusing on the manufacturing process. If the sentence did not match one of the categories, it was classified as "Other". Using Python, I implemented this approach by connecting to GPT-4 via OpenAI's API. There are two reasons why I opted for artificial intelligence. First, classifying each sentence by hand would have taken months. With GPT-4, this can be carried out much faster. Second, the strong performance of the model leaves no room to doubt the reliability of the results (OpenAI 2023, 5).

Initially, all guild ordinances were concatenated. Then, the sentences were separated from each other. Every sentence was combined with the same prompt and sent to GPT-4 (Figure 5). The model outputs numbers associated with the respective topic. In the end, every sentence in the *regulations* data set was classified into one or multiple categories. From this point onwards, pie charts could easily be produced, illuminating the relative share of each topic within all the Latin American ordinances in the sample under analysis.

Prompt and example sentence:

Classify the following Spanish sentence based on the categories below:

0: Sentence mentions any form of discrimination, e.g., excluding specific people, such as "negros", "mulatos", or "indios" from the guild, or from being promoted or owning their own shop independently.

1: Sentence mentions any form of human capital, such as education, apprentices, apprenticeships, or craft examinations within the guild.

2: Sentence mentions product quality, perhaps by detailing the manufacturing process.

3: Sentence mentions anything related to economic markets, possibly mentioning prices, supply, or similar market concepts.

4: Sentence mentions any form of punishment, fines, or authorities enforcing the ordinances.

5: Sentence refers to any form of religion, confraternities, or brotherhoods.

6: Sentence does not fit into any of the above categories.

If a sentence falls into multiple categories, list all relevant numbers in ascending order (e.g., 04, 234). Only provide numbers as output.

Sentence to classify: "Ningún negro puede ser admitido al oficio de herreros, pena de 50 pesos."

GPT-4 output:

04

Figure 5: Prompt to classify a sentence with GPT-4.

Notes: The algorithm did this automatically for every sentence in the *regulations* text data set. The displayed prompt is an English translation of the original Spanish prompt.

Reproducibility is a central tenet for ensuring the reliability of results. The "temperature" parameter can be modified when connecting to GPT-4 inside a Python environment. This hyperparameter ranges from 0 to 1 and governs the randomness of the model's output. Setting the temperature parameter to 0 ensures that the large language model behaves deterministically (Miotto *et al.* 2022, 3). In theory, the output should always yield the same given an identical prompt. In practice, I ran the presented procedure multiple times and observed small deviations up to 0.5 percentage points per category. I suspect that two independent researchers would differ by a larger amount as humans are less consistent than large language models. To conclude, large language models provide reliable results and offer unprecedented methods for the analysis of historical text data.

7 Results

This section presents the results of the textual analysis. Findings are illustrated sequentially, mirroring how their respective methodologies were explained in Section 6. The large sample size paired with the NLP analysis yielded a vast array of results, for which reason I focus on the most preeminent ones. Before delving into the core analysis, a brief sample overview is important, to obtain an intuitive feeling about the underlying word distribution.

In total, the 54 digitised ordinances used 96,391 words to formulate their guild laws (Table 4), most likely capturing the conveyed producer preferences. The 33 Peruvian ordinances contained 59,678 words, whereas the 21 Mexican legal documents included 36,713 words. Consequently, the average word count per ordinance is almost identical for both countries, yielding 1,785 words for the whole *regulations* data set. The number of words pooled across centuries steadily increases. Figure 6 reveals that the Mexican compilation includes more ordinances issued in the earliest century, while there are more Peruvian ordinances for the subsequent colonial era. In the sixteenth century, ten Mexican ordinances were issued while only three could be collected for Peru. This reverses for the eighteenth century in which Peru represents the largest bulk with 16 ordinances as opposed to 5 from New Spain. One result is particularly noteworthy. The six Mexican ordinances issued in the seventeenth century include merely 4,804 words. In the following century, only five ordinances appear in the sample, but they account for 19,849 words. Coming back to Table 1, the Mexican ordinances in this century were all substantially longer, spearheaded by the silver-smiths in 1746, which needed 8,382 words to cover all their regulations. All in all, an awareness about the word distribution helps to contextualise the upcoming results.

	16th Century	*17th Century*	*18th Century*	**Σ**
Mexico	12,060	4,804	19,849	36,713
Peru	6,629	25,832	27,217	59,678
Σ	18,689	30,636	47,066	96,391

Table 4: Word count by `country` and `century`

Notes: Total word count of the *regulations* text data set. Separated by `country` and `century` to show the word distribution. Lima's button-makers ordinance was issued in 1801, but was included in the eighteenth century.

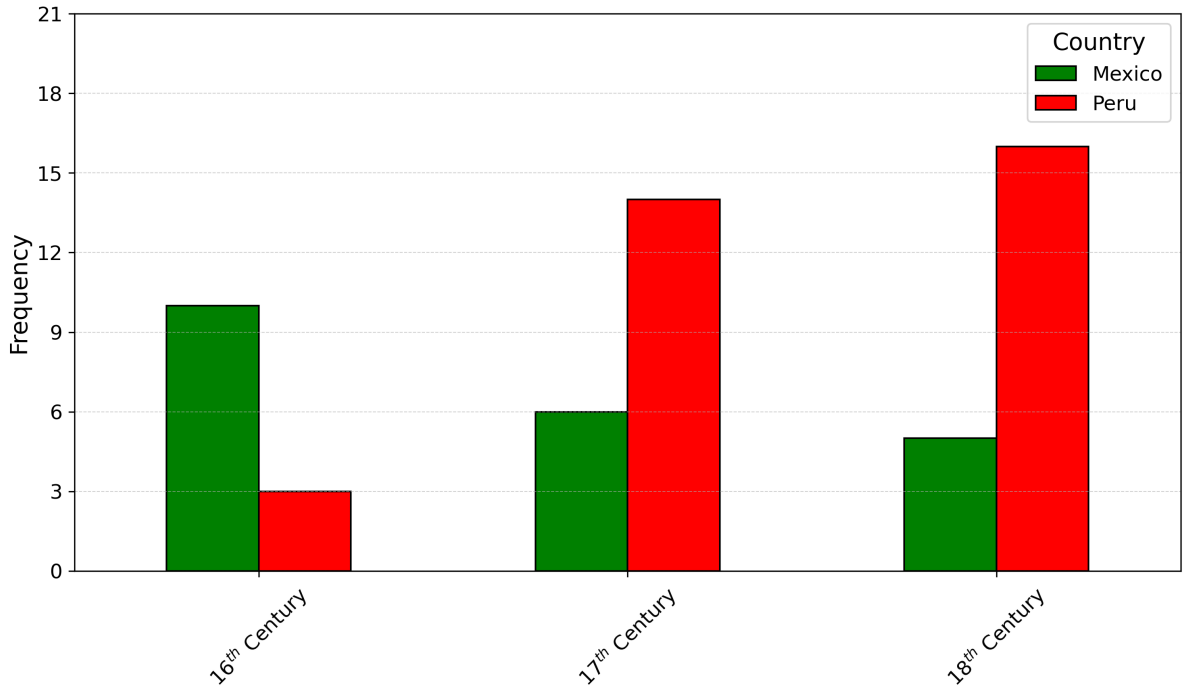


Figure 6: Number of ordinances collected by `country` and `century`

Notes: Please see text for more information.

7.1 Word Presence Analysis

Figure 7 shows how many of the 54 ordinances mentioned each of the selected words, grouped by topic. Commencing with entry barriers, black people (*negros*) were addressed in 25 ordinances, and were thus mentioned more frequently than indigenous people (*indios*, 13 occurrences) or other marginalised groups. Women were referred to in 6 out of 54 ordinances, five of them being from Peru. In summary, 60% of all ordinances mentioned at least one of the words related to entry barriers.

Words affiliated to human capital were registered in 39 ordinances. In 37 of them, the concept of being examined (*examinado*) played a role. Mastership certificates (*carta de examen*) were explicitly highlighted in only 22 or roughly 40% of documents. Apprentices were directly addressed 19 times. By contrast, apprenticeships (*aprendizaje*) were almost never directly referred to with the exception of the Peruvian silver-smiths in 1778.

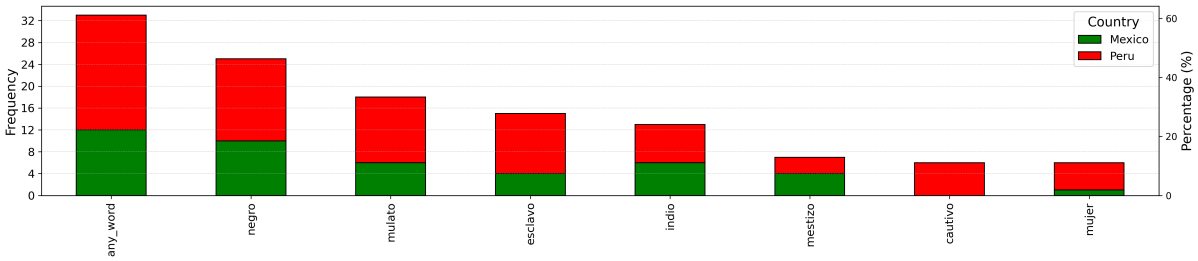
Market-related words were mentioned in 49 of 54 ordinances. In particular, workshops were referenced 37 times as *tienda*, but only twice regarding its synonym *taller*. 50% of the sample reported on prices (*precio*). Its old Spanish synonym *valor* was noted in 14 ordinances. Roughly 44% touched on quantities (*cantidad*) and quality (*calidad*). The remaining words were barely reported.

Words related to the guild enforcement were prevalent across the complete sample. 47 ordinances mention penalties (*pena*), followed by the contemporary currency *peso* with 43 counts. Most other words also appeared frequently. Synonyms for penalty (*pena* ↔ *multa*) and for the

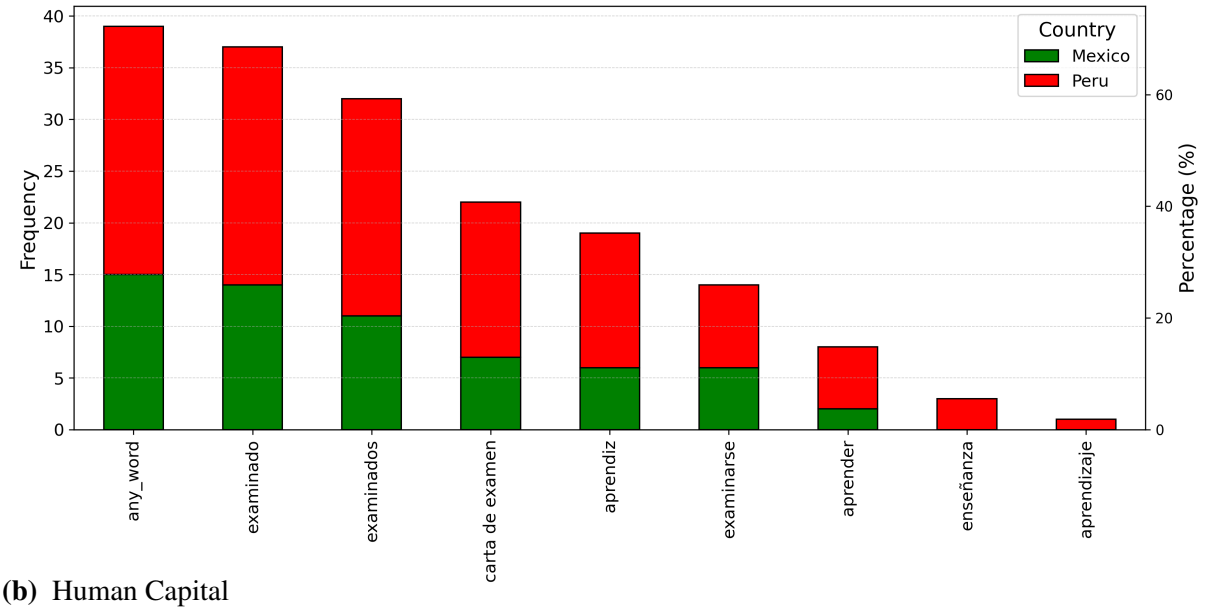
city council (*cabildo* ↔ *ayuntamiento*) occurred in 8 to 12 ordinances. In conclusion, all selected words with regard to enforcement were widely used across the whole sample.

By contrary, most religious words occurred seldom, but at least 28 ordinances mentioned some word related to religion. For example, the most frequent word *cofradía* was only mentioned in 14 of those 28 ordinances. It follows that half of the sample mentioned religious words, but usually in various forms. Moreover, religious concepts were clearly more pronounced in Peru, even tough the visualisation does not adjust for the different sample size between both countries.

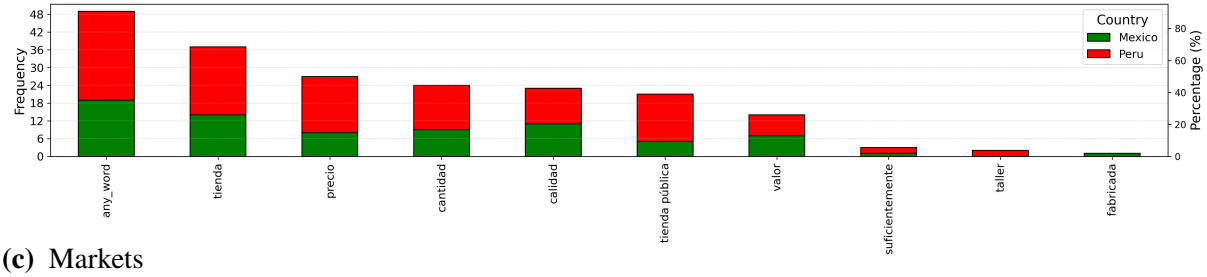
Finally, less than 31 ordinances introduce their guild laws by referring to harm, fraud, or for the public benefit. In particular, fraud is mentioned in five introductions of which four are Mexican. By contrary, Peruvian guilds state the public good, common weal or good custom of the guild in their introduction.



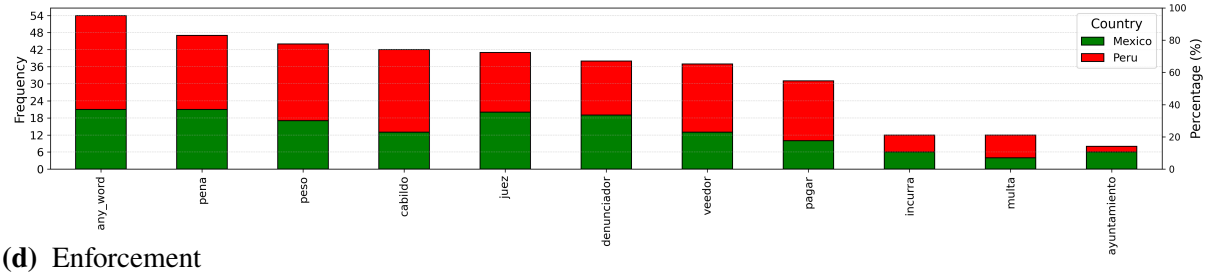
(a) Entry Barriers



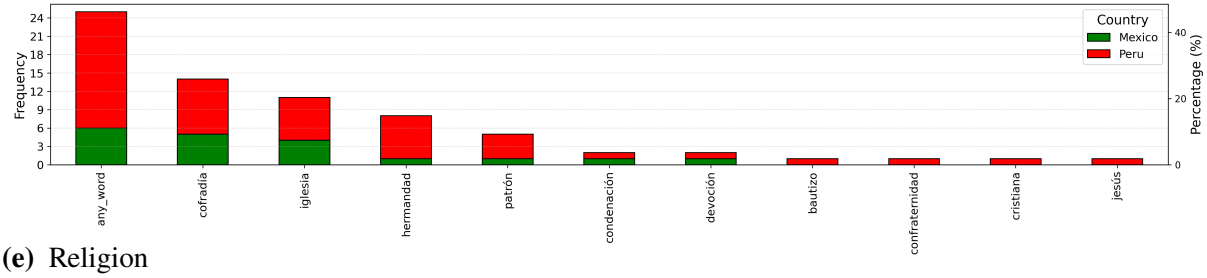
(b) Human Capital



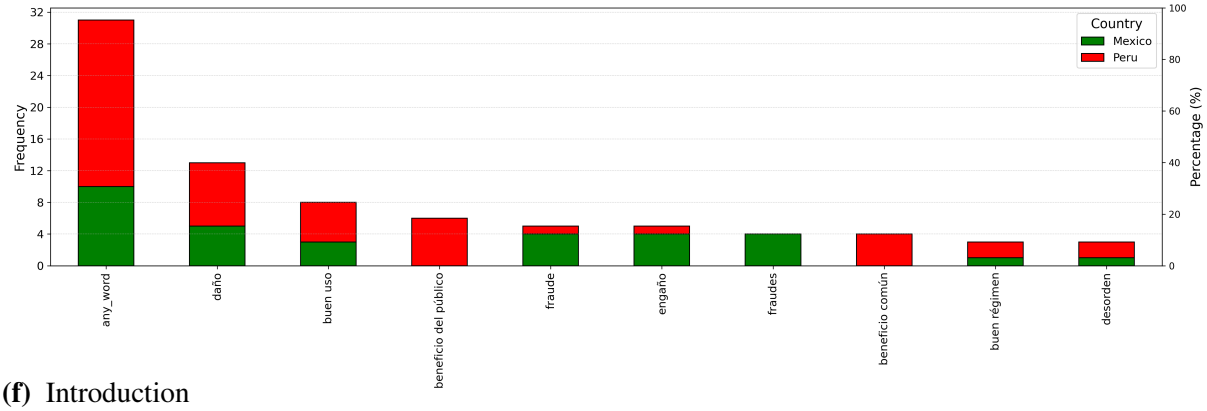
(c) Markets



(d) Enforcement



(e) Religion



(f) Introduction

Figure 7: Word presence analysis by topic

Notes: Bars are separated by `country` and indicate in how many ordinances a specific word occurred within the *regulations* text data set. The first column "any_word" always indicates how many of the ordinances mentioned at least one of the topic words. Nouns also included their plural forms. Verbs included their conjugations. Word recognition was case-insensitive, meaning variations in capitalisation were not differentiated.

7.2 Topic Indices

Topic indices measuring relative importance across centuries were computed. In addition to overall indices for Latin America, the indices are disentangled by `country` (Figure 8).

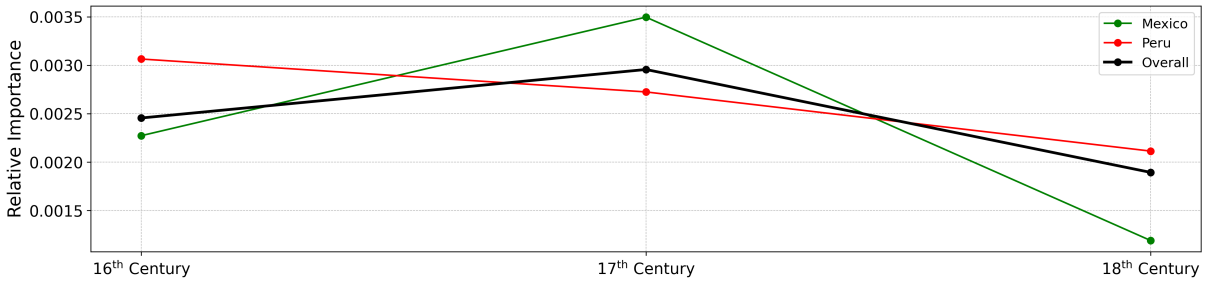
There is no overall trend discernible regarding guilds' entry barriers. On a country level, Peru's entry barriers declined continuously. In contrast, Mexico's entry-barrier-index was lower than Peru's in the sixteenth and eighteenth century, but had a sharp peak in between.

Overall, the human capital index declined over time. While Mexico had a higher starting point, Peru's human capital index slightly increased in the seventeenth century, but then declined in tandem with Mexico.

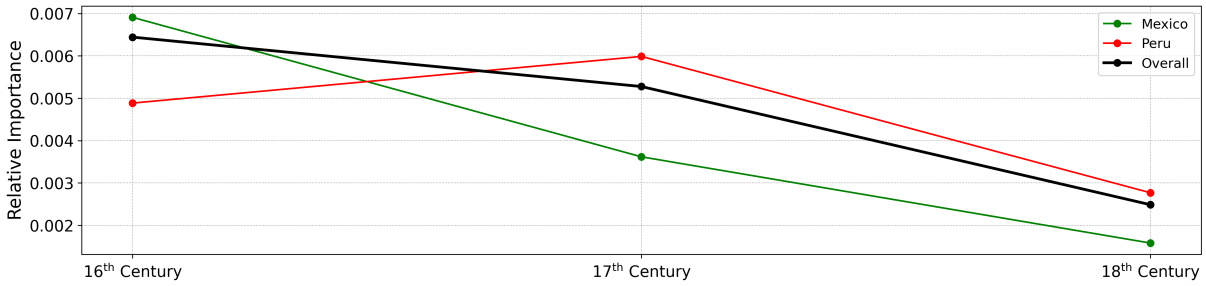
Words relating to markets occurred more often in newer ordinances. The country indices start at a fairly similar point, diverge drastically for the seventeenth century with Mexico peaking more sharply. Then the pattern finishes similarly to the sixteenth century, but at a higher overall level.

The enforcement index is almost identical for both countries. In the sixteenth century, roughly 4.5% of all words match the selected enforcement words. This declines almost linearly, more than halving the relative importance of enforcement by the eighteenth century.

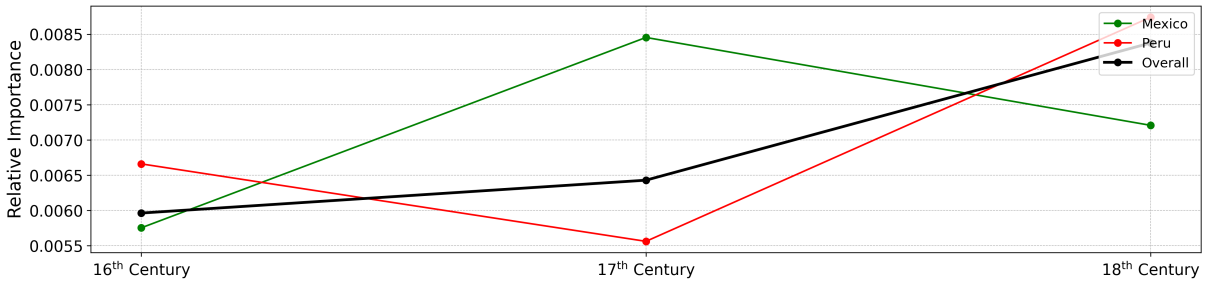
The results of the religion index highly support previous findings in the word presence analysis. In the sixteenth century, Mexico and Peru are on the same level. This changes radically for the seventeenth century, revealing Peru's fixation on religion. By the eighteenth century, the difference has declined but is still observable.



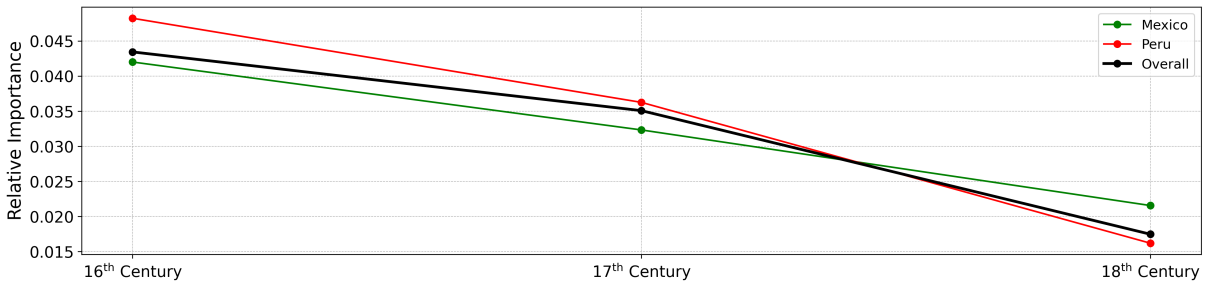
(a) Entry Barriers



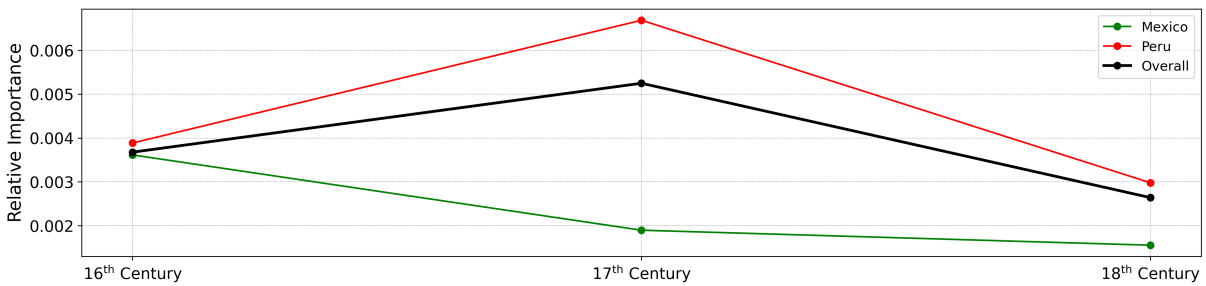
(b) Human Capital



(c) Markets



(d) Enforcement



(e) Religion

Figure 8: Topic indices on the *regulations* text data set

Notes: Topic indices across `century`. In addition, separated by `country`.

7.3 Part-of-Speech Tagging

Part-of-Speech distributions were computed to analyse syntactic variation in the Spanish language across `country` and `century` (Figure 9).

The distributions of Mexico and Peru display an identical pattern. Every grammatical category occurs almost equally often in both countries, with the exception of nouns, proper nouns, and punctuation. Close to 20% of all words in Peruvian ordinances were nouns compared to roughly 15% for Mexico. In exchange, Mexico's use of punctuation and proper nouns was more pronounced.

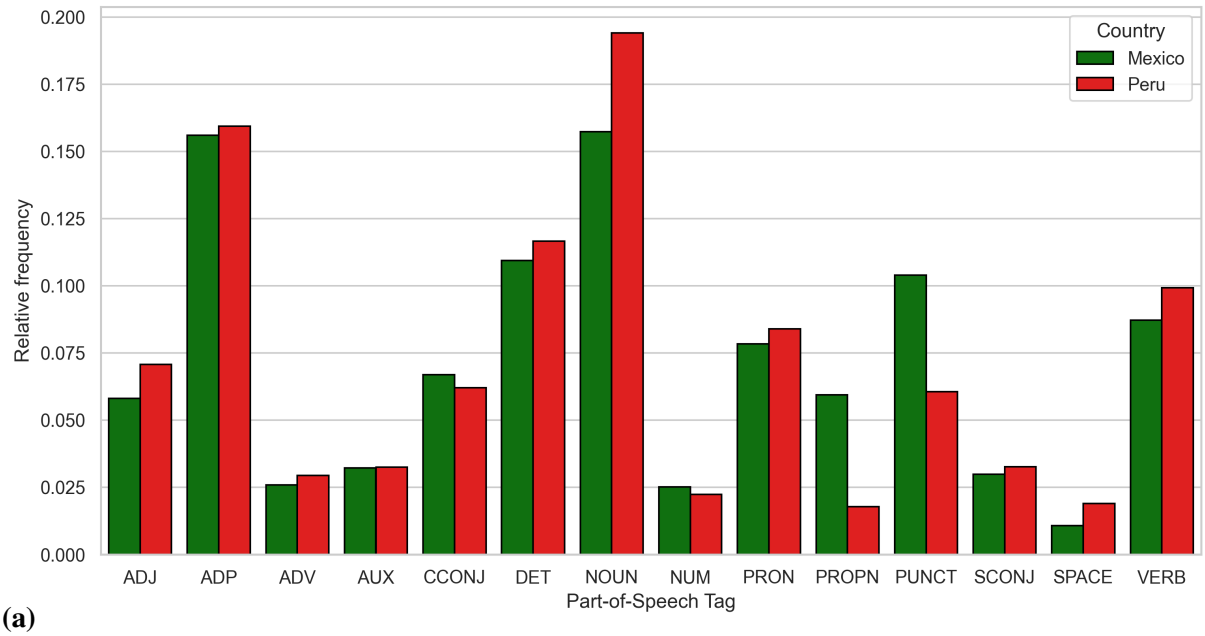
Across centuries, the distributions are fairly similar. Within each century, the words used were most frequently nouns, followed by adpositions, determinants, verbs, pronouns, and others. Adpositions became more widespread over time while the share of verbs declined from a bit more than 10% to about 8.75%. However, neither a trend nor an anomaly is clearly discernible.

7.4 Doc2Vec

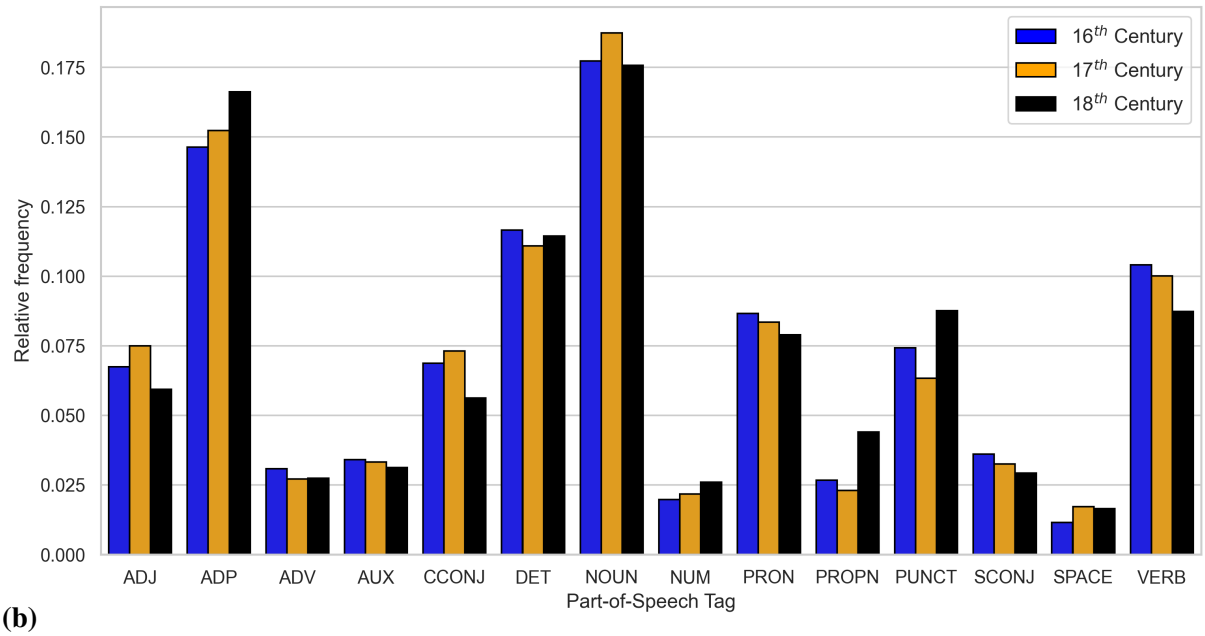
Doc2Vec returned 54 high-dimensional document vectors, capturing the semantic essence of the underlying ordinance. The vectors are visualised in a 2-dimensional plot using PCA (Figure 10). Each of the 54 dots appertains to a `country` and `century`.

In Figure 10a, I coloured the vectors by `country`. The coloured point clouds are almost linearly separable. Mexico's guild ordinances cluster in the top-left while Peru's are located in the bottom-right.

The second plot is exactly the same as the first one, but the points are coloured by `century` (Figure 10b). There is clear variation along the first principle component, meaning that ordinances from the sixteenth, seventeenth, and eighteenth centuries cluster respectively from left to right. Intuitively, in the 20-dimensional embedding space, ordinances vary across centuries along the direction of highest variability among the learned document vectors. In summary, the ordinances differ semantically across time.



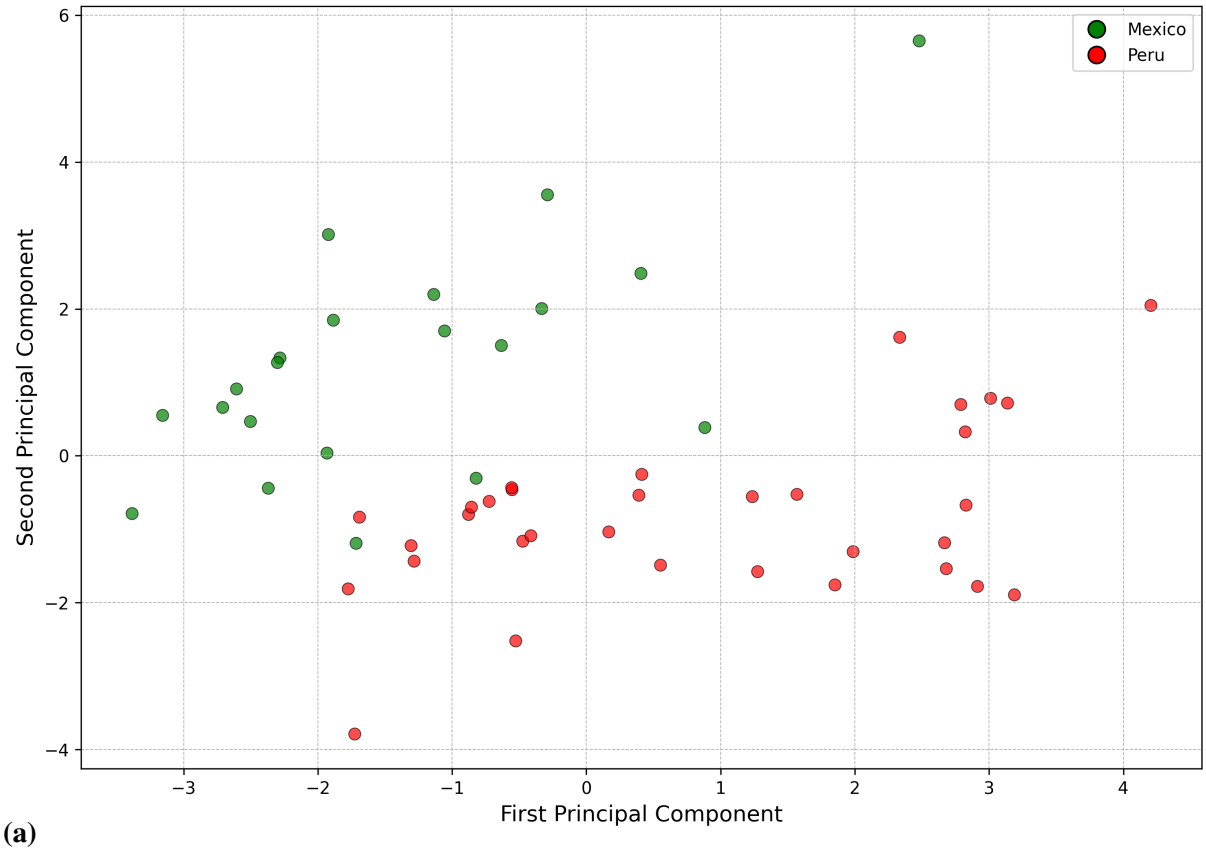
(a)



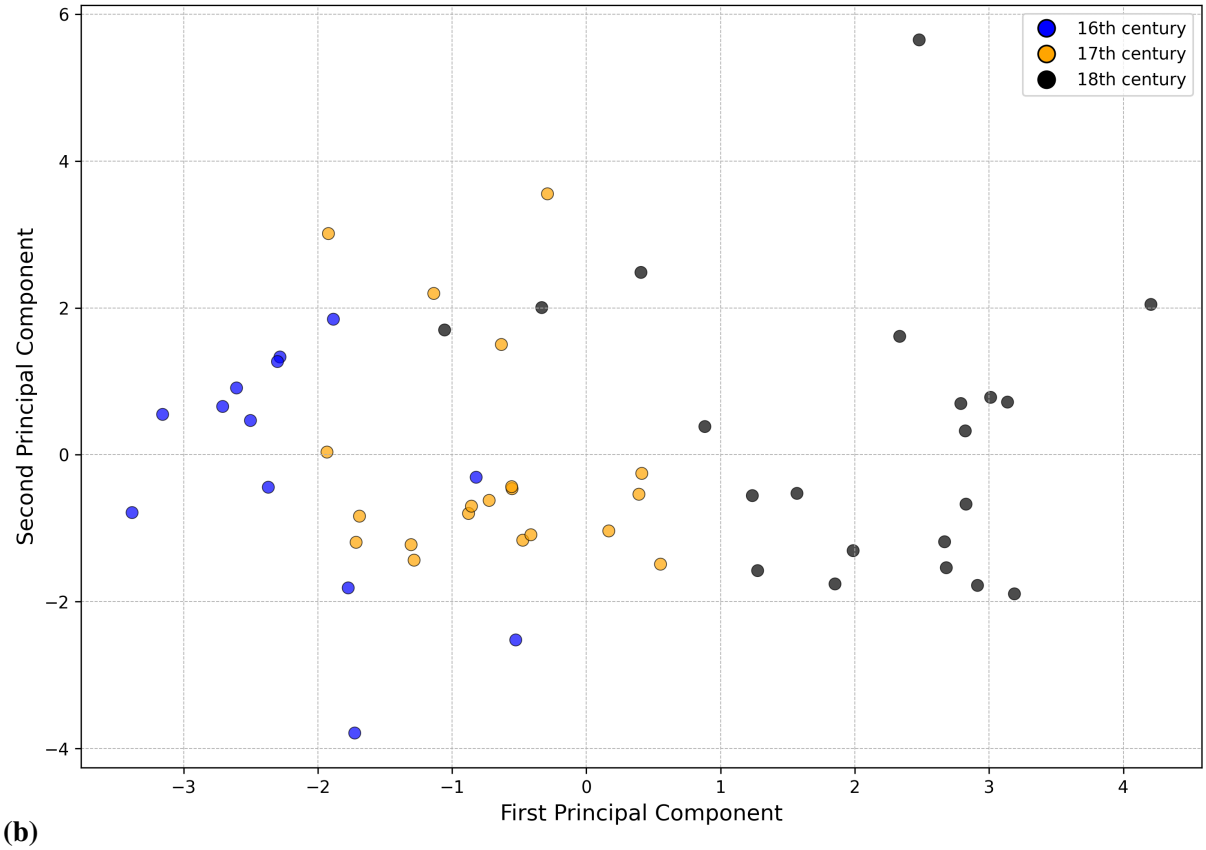
(b)

Figure 9: Part-of-Speech distribution on the *regulations* text data set

Notes: Separated by `country` (Figure 9a) and `century` (Figure 9b). The bars are adjusted for differences in word counts and displaying relative frequencies. The abbreviations used are: ADJ = Adjective; ADP = Adposition (prepositions and postpositions); ADV = Adverb; AUX = Auxiliary verb; CCONJ = Coordinating conjunction; DET = Determiner; NOUN = Noun; NUM = Numeral; PRON = Pronoun; PROPN = Proper noun; PUNCT = Punctuation; SCONJ = Subordinating conjunction; SPACE = Space; VERB = Verb.



(a)



(b)

Figure 10: Doc2Vec output of the *regulations* text data set visualised with PCA

Notes: Figure 10a colours the vectors by `country`. Figure 10b colours the vectors by `century`.

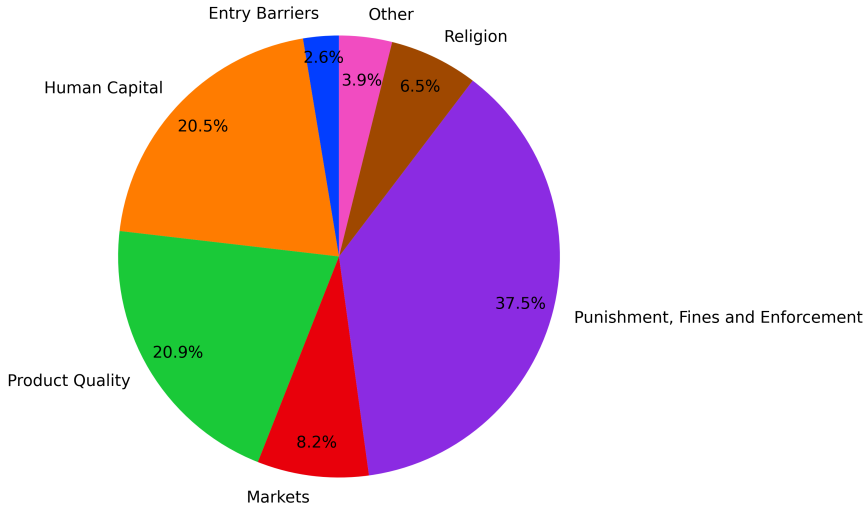
7.5 Sentence Classification with Large Language Models

Every sentence in the *regulations* text data set was classified into one or multiple categories using GPT-4. The results were aggregated to produce pie charts by `country` and `century` (Figure 11).

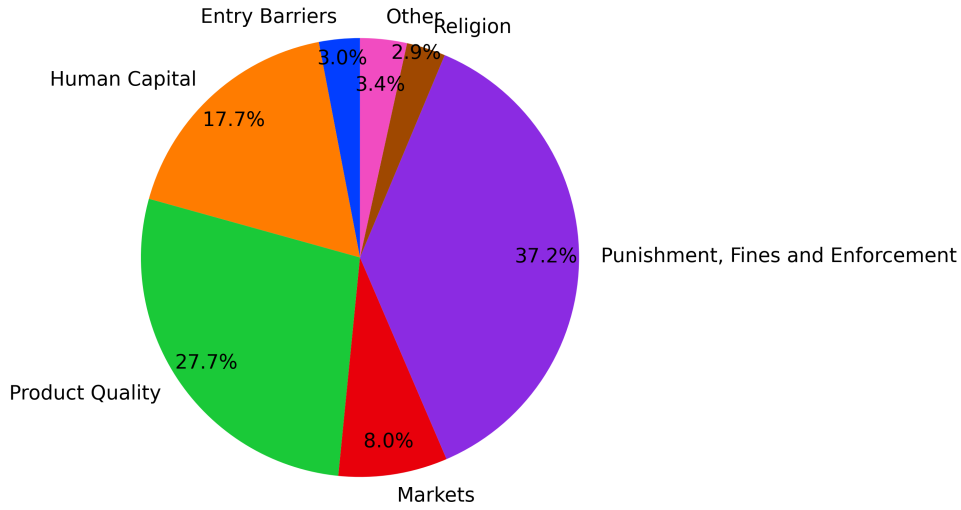
37.5% of all classifications referred to punishments, fines, and enforcement. 20% of the text was concerned with human capital and another 20% with product quality. 8.2% of all classifications were made with regard to market concepts. Religion accounted for 6.5% and entry barriers had the smallest share with 2.6%. The algorithm assigned 3.9% of all classifications to none of the socio-economic categories, but to "Other".

There are two substantial differences between Mexico and Peru (Figure 11b and Figure 11c). Mexico's ordinances allocated more than ten percent more sentences to product quality than Peru. By contrast, Peru devoted almost three times as much attention to religion with 8.5%, compared to 2.9% in Mexico. This is in line with results on religion in previous algorithms. In addition, human capital was slightly more pronounced in Peru. The remaining categories display negligible differences.

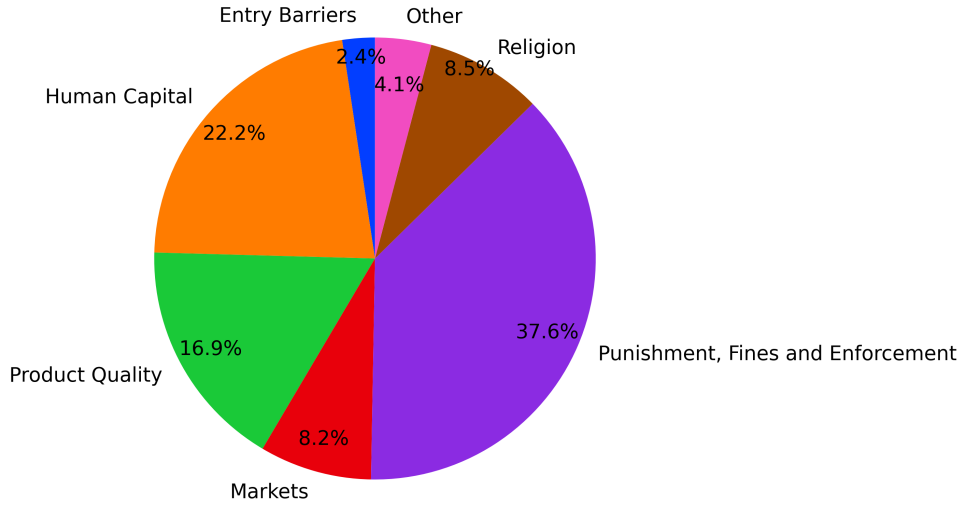
From the sixteenth to the seventeenth century, the share of religion increased from 3.7% to 9.8%. Punishments, fines and enforcement lost significance from 44.6% to 34.7%. Human capital slightly increased by four percentage points to 24.1%. The remaining categories stayed around three to six percent (Figure 11d and Figure 11e). In the eighteenth century, there are two major developments (Figure 11f). First, the share of "markets" increased sharply from previously 3.8% to 13.7%. Second, the share of religion was halved to about 5.2%. Additionally, human capital declined to slightly below its initial level in the sixteenth century.



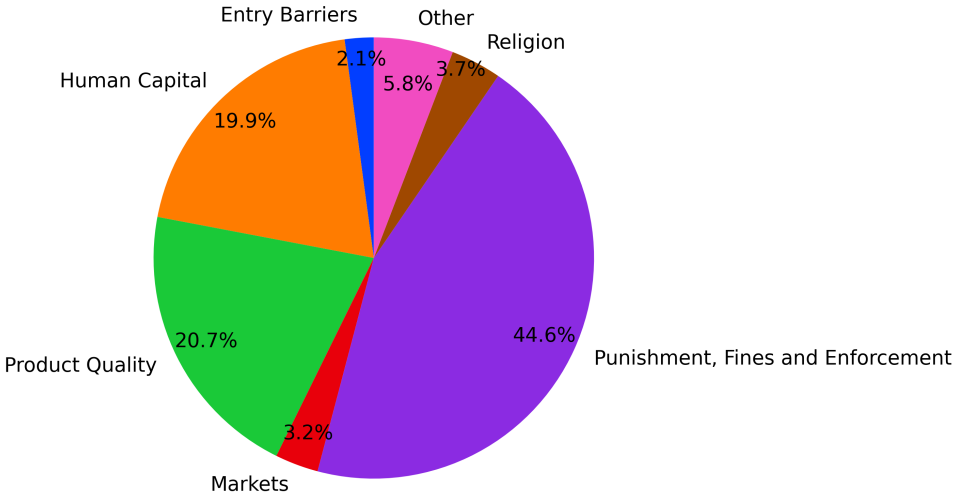
(a) Latin America: GPT-4 classification results



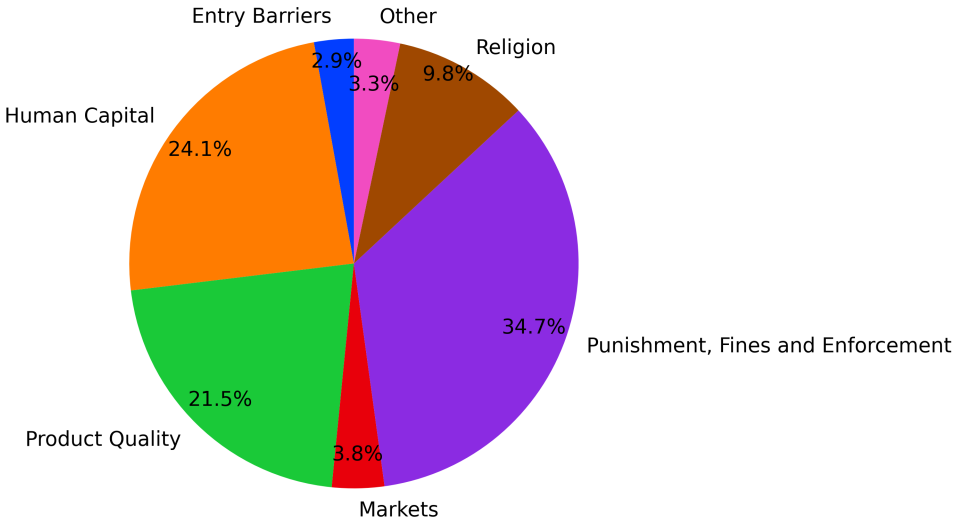
(b) Mexico: GPT-4 classification results



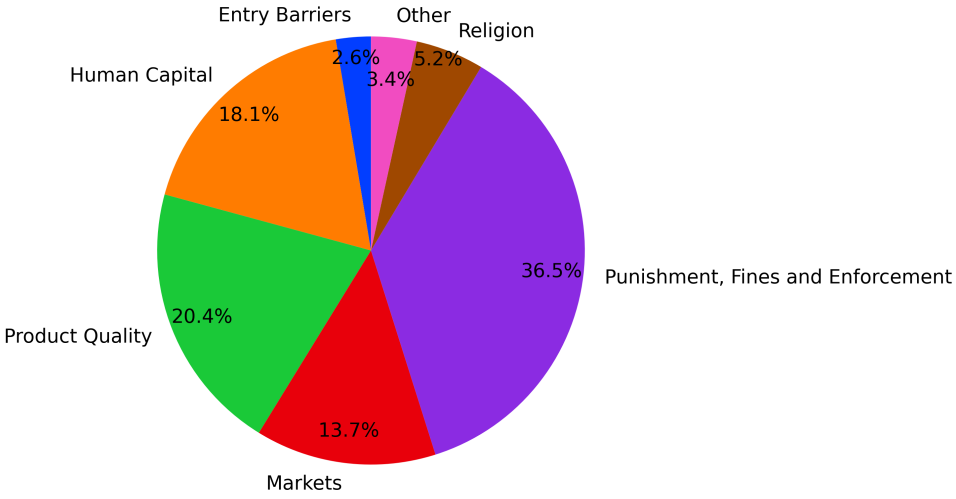
(c) Peru: GPT-4 classification results



(d) Sixteenth century: GPT-4 classification results



(e) Seventeenth century: GPT-4 classification results



(f) Eighteenth century: GPT-4 classification results

Figure 11: GPT-4 classification results on the *regulations* text data set

Notes: Every sentence was classified in one or more categories using GPT-4. All classifications were pooled and then aggregated by `country` and `century`.

8 Discussion

Spanish craft guilds were transplanted differently across Latin America. This hypothesis is quantitatively corroborated by the various algorithms that were applied to the *regulations* data set. In particular, the Doc2Vec approach reveals a semantic distinction between Mexican and Peruvian ordinances. Why was the same institution transplanted differently? Most likely due to the unique institutional and social matrices of both countries, which led to complex interaction effects with the exported Spanish craft guild system. In addition, the results provide answers about the composition of the Latin American craft guild system and its development. In the forthcoming discussion, I dissect how the overall institutional and social matrices can explain why the results between Mexico and Peru differ, what other economic factors may have influenced the development, and the core features of the Latin American craft guild system.

Quality regulations were substantially more pronounced in Mexico than in Peru. Does this simply imply that Mexican guilds were more conscientious in providing high quality goods for the safety of the consumers? Not necessarily, as real wages were much higher in Mexico than in Peru, at least from 1690 until 1800. In fact, Mexico's real wages were as high as in some regions of northwest Europe, while Peru's were only slightly above the subsistence level (Abad, Davies, *et al.* 2012, 156). Equally, GDP per capita was much higher in Mexico than Peru from 1650 to 1800, being 30% higher in 1700 (Abad and van Zanden 2016, 1192). Hence, Mexican consumers were able to afford high quality-price combinations, whereas Peruvians spent most of their money on essential goods. Simultaneously, the difference in incomes may have allowed Mexican craft guilds to entrench their monopolies by depriving consumers of low quality-price combinations. By means of their ordinances, Mexican guilds intended to prohibit the production of "shoddy" goods, which they claimed defrauded consumers (Gies 1995, 74). The word presence analysis underpins this observation empirically as Mexican ordinances addressed the issue of fraud in their introductions more often than their Peruvian counterparts (Figure 7f). An additional factor may be urbanisation. Surprisingly, Peru had a higher urbanisation rate than Mexico from 1550 to 1750. However, Mexico had more cities with a population of over 5,000 and those were located closer to each other, while Lima was the only urban centre in its vicinity (Abad and van Zanden 2016, 1198). Perhaps Lima's guilds did not need to protect their monopolies with quality regulations as there was no strong rural competition. By contrast, Mexico's urbanised landscape may have incentivised guild members to explicitly set minimum product standards in order to suppress low quality-price competition, potentially undermining their monopoly. Lastly, the secondary literature also points to the negligence of Peruvian guilds regarding the manufacturing process (F. Quiroz Chueca 2021, 69). These differences may have been the consequence of higher income levels and more urbanisation, but then the question arises what were the causes of those factors? At least with regard to real wages, Abad, Davies, *et al.* (2012) explain that the indigenous population declined more drastically in New Spain throughout the sixteenth century (160). A smaller labour force raised income per capita, which in turn may have enabled consumers to buy

high quality-price combinations, perpetuating the guilds' monopolies.

Religion is the other major difference between the two Latin American countries. All methods point in the same direction: Peruvian guilds had a closer relationship with Catholic belief. As stated, Peru's population was only living slightly above the subsistence level. Consequently, economic hardship was rampant, which may have accentuated the charitable role of the guilds' confraternities. Moreover, Mexican Spaniards did not feel as threatened by religious syncretism (J. L. González and O. E. González 2007, 99–100). Franciscans were more influential in Mexico. Conversely, Peru had a larger share of Dominicans (Prien 2012, 66). The Church may have had stronger political support in Peru compared to New Spain. A counter-argument might be that some viceroys served in both viceroyalties (Table 1 and Table 2). In light of this, the highest political authorities were most likely not inherently different. At this point, the complexity of the institutional and social matrix should become completely evident. It is impossible to discern a multi-causal explanation, as most outcomes were simultaneously determined. Why did Dominicans dominate the Viceroyalty of Peru? Was it because of their strong commitment to social justice due to lower income levels? These new questions emerge from the finding that religion was more important for Peruvian than for Mexican craft guilds.

In Subsection 3, I concluded by asking "Why else should the same Spanish institution have developed differently in Mexico and Peru?". As demonstrated, the interaction effects within the respective institutional matrices most likely affected the immediate outcomes after the Spanish conquest. However, there are other factors that are worth to be mentioned. First, the pre-existing indigenous empires may have influenced the Spanish settlement patterns. For example, "the Inca possessed far more gold and silver than the Aztecs" (Restall and Fernández-Armesto 2012, 33). At the same time, Peru was more difficult to reach than Mexico. It is widely recognised that settlement patterns affected the nature of the transplanted institutions (e.g., Acemoglu *et al.* 2001). Second, geographical variation may also contribute to the construction of specific institutions (e.g., J. M. Diamond 1999, 358). The Viceroyalty of New Spain was far further north than the one of Peru. Presumably, as the Incas possessed more gold than the Aztecs, their environment was richer in natural resources. In summary, these factors are not part of the post-conquest institutional matrices, however, they can be seen as exogenous factors affecting the formation of a new socio-economic fabric.

The Latin American craft guild system was not a static institution throughout the colonial era. The topic indices as well as the GPT-4-classification analysis unquestionably reveal changes over time. Above all, market concepts became more important (Figure 8c and Figure 11). Why did this happen and more importantly, what does it mean? Referring back to the literature review, there are reports that the industrial production was expanding in Mexico (Gies 1995, 30). In eighteenth century Peru, the commercial sectors tried to penetrate the monopolistic measures of Lima's craft guilds. Even the countryside posed an increasing threat as wheat was grown in the coastal and central highland valleys (F. Quiroz Chueca 2021, 70–1). Therefore, I interpret the increase in market-related concepts as an attempt to curb non-guilded competition.

Guild enforcement continuously declined across the centuries (Figure 8d and Figure 11). There are two possible explanations for this. First, guilds' institutional stronghold became so pronounced that they could forego enforcement mechanisms within their ordinances to a certain extent. Second, ordinances were the lower bound estimates regarding the guilds' producer preferences. Most likely, the political authorities more heavily constrained the guilds' privileges to allow for market liberalisation. The latter is in line with the previous findings on the increase in market-related concepts, as well as the secondary literature (F. Quiroz Chueca 1986, xvii). In fact, the Mexican labour market became more liberalised in the later centuries (Abad, Davies, *et al.* 2012, 155). Guilds may have lost their edge on enforcement, but tried to compensate by concentrating on market mechanisms to protect their monopolies.

One may criticise that the Doc2Vec results simply reflect language variation between both countries and across centuries. This claim does not hold, as the spelling of all ordinances was transformed to modern Spanish using large language models (Subsection 5.2). Additionally, the Part-of-Speech analysis did not yield any noteworthy differences between the sentence structure across all subsets (Figure 9). Given the same linguistic properties, Doc2Vec must have captured semantic and contextual differences between the guild ordinances. In relation to the presented results, Doc2Vec probably captured variation across the concepts of "markets" and "enforcement" along its first principal component. This could explain why the ordinances cluster with regard to `century` along this axis (Figure 10b). Analogously, the distinction between the countries may be due to differences in product quality and religion. I conducted several robustness checks by using different hyperparameters. This means that I trained the algorithm for a different number of epochs, experimented with the context size, and initialised a different document vector size. The general pattern of the Doc2Vec output did not change. Moreover, the GPT-4-classification results further support the other findings. The sentence classification task is more coarse and not as granular as learning exact mathematical representations with Doc2Vec. Hence, the results of GPT-4 would not have been altered even if there was remaining language variation.

It is crucial to point out that the results of the word presence analysis and the topic indices have more concrete limitations. I selected words based on my historical judgement concerning whether they are representative of a particular topic. Subsequently, the algorithms only checked whether those specific words occurred in a given ordinance, and in the case of topic indices, they were normalised and aggregated. The results are very tangible, as for example, 47 out of 54 ordinances mentioned the word *pena*. However, this does not tell anything about the context and sentiment of the selected words. Illustratively, guilds did not use words associated to entry barriers more or less frequently in the late colonial era. Perhaps, they eased entry barriers for black and mixed ethnicities, but this would not have been captured by both methods. To conclude, I included this elementary analysis to showcase very tangible results before applying the more abstract Doc2Vec and GPT-4 analysis. Put all together, they yielded mutually reinforcing results.

Overall, the results allow for general conclusions about the Latin American craft guild system. At least 37.5% of all sentences in the *regulations* data set were related to punishment,

fines, or enforcement mechanisms (Figure 11a). This clearly indicates that craft guilds placed a high importance on compliance with their legally mandated producer preferences. By contrast, apprenticeship was only explicitly mentioned in a single ordinance. Even apprentices were seldom directly addressed, suggesting that human capital investment was not the guilds' main concern, resembling the findings on Italian guilds (Mocarelli 2008, 10–1). However, the word *examinado* appeared in most ordinances, indicating the importance of guild masters, who were formally examined. Therefore, the prevalence of human capital may have been to restrict the pool of masters benefitting from the guilds' monopoly, and not to pass on craft specific knowledge from one generation to another. All in all, the Latin American craft guilds displayed similarities to their European rent-seeking counterparts (e.g., Ogilvie 2019).

To conclude, the textual analysis on craft guild ordinances yielded a large amount of robust and insightful results about the Latin American craft guild system. Many further implications cannot be discussed here, as the space constraint prevents me from doing so within the context of a 15,000-word dissertation. Nevertheless, the main findings suggest that the same Spanish institution was transplanted differently into the institutional and social matrices of Mexico and Peru. Moreover, the analysis revealed various developments throughout the colonial era. These observations were corroborated by a state-of-the-art NLP analysis, yielding unique quantitative insights, which are consistent with pre-existing qualitative research but pose new questions to explore.

9 Conclusion

Through a novel and state-of-the-art textual analysis, this dissertation provided robust quantitative evidence supporting the hypothesis that the Spanish craft guild system was transplanted differently across Latin America, influenced by the unique institutional matrices encountered by the Spanish conquerors. The inspected primary sources were legal documents that were drafted by guild members, modified by the political authorities, and ultimately ratified by the viceroy. These ordinances can be seen as the lower bound estimates for the producer preferences of economic agents who belonged to craft guilds. For Mexico and Peru, I collected and digitised two ordinance compilations, respectively. Then, I applied recently-developed large language models and other NLP algorithms to analyse a guild *regulations* text data set comprising approximately 100,000 words. The quantitative results are unique within the guild literature and also cast light on the whole Latin American craft guild system as well as its development throughout the colonial period.

Mexican and Peruvian craft guilds differed with respect to quality regulation and religion. As Mexico's income level was substantially higher, consumers may have been willing to pay more for high quality-price combinations, creating less pressure against the guilds' monopoly. Possible other causes include the geographical distribution of urban centres, exacerbating downwards pressure on prices, and creating more protection against low quality-price combinations. The religious fixation of Lima's guilds cannot be straightforwardly explained. Subsistence wages may have amplified the charity status of guild confraternities. This could have resulted in distinct settlement patterns, leading to a higher share of Dominicans in the Viceroyalty of Peru. The Latin American craft guild ordinances more frequently addressed market-related concepts in the late colonial era, in possible reaction to growing industrial production. At the same time, guilds' emphasis on enforcement and penalties receded, suggesting declining support by political authorities for granting exclusive producer privileges. Craft guilds substituted ordinance text on enforcement for market concepts, possibly to further uphold their monopolies. Lastly, the textual analysis processed the heterogeneous ordinances to provide a simplified but general overview of the Latin American craft guild system, underlining the significant importance of penalties, fines, and enforcement. In this regard, I was able to improve the methodology of Mocarelli (2008) while focusing on Latin American craft guilds.

From a theoretical perspective, the observed differences between Mexico and Peru are attributable to the complex interaction effects within the respective institutional and social matrices. Exogenous factors may also have indirectly influenced the transplantation of Spanish craft guilds by impacting the entire socio-economic fabric. The observed patterns within the quantified text data serve as an indicator to measure the effect of the wider institutional matrix on the institution of craft guilds. The question remains: how exactly all of those institutional components interacted with one another and, more importantly, if there is a causal explanation why the same exported institution differed across Latin America.

The presented NLP methodology has tremendous potential for future historical research. I am a firm believer that qualitative data must be transformed into tangible quantitative evidence to test the major questions in economic history. Natural language processing enables researchers to provide more objective results and not to rely solely on a qualitative analysis. Nevertheless, qualitative research will always remain indispensable as it tells us where the historical data resists simplification due to the immense complexity of the underlying phenomon. As such, I am convinced that economic history will become even more interdisciplinary as the barriers and reservations towards novel computer-intensive methods are falling quickly.

In conclusion, the findings of this dissertation serve as an important reminder that humanity must consider the surrounding institutional structure when transplanting the humanly-devised constraints of one society to another. This dissertation has provided a new method to quantify institutional transplantation. NLP algorithms are better able to capture the complexity of institutions compared to overly simplistic zero-one models. The methodology can be readily applied to other regions and time-periods, providing an innovative and productive approach for analysing the effects of institutional transplantation.

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