Article

Income and inequality in the Aztec Empire on the eve of the Spanish conquest

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Today, Latin American countries are characterized by relatively high levels of economic inequality. This circumstance has often been considered a long-run consequence of the Spanish conquest and of the highly extractive institutions imposed by the colonizers. Here we show that, in the case of the Aztec Empire, high inequality predates the Spanish conquest, also known as the Spanish–Aztec War. We reach this conclusion by estimating levels of income inequality and of imperial extraction across the empire. We find that the richest 1% earned 41.8% of the total income, while the income share of the poorest 50% was just 23.3%. We also argue that those provinces that had resisted the Aztec expansion suffered from relatively harsh conditions, including higher taxes, in the context of the imperial system—and were the first to rebel, allying themselves with the Spaniards. Existing literature suggests that after the Spanish conquest, the colonial elites inherited pre-existing extractive institutions and added additional layers of social and economic inequality.

Exactly 500 years after the Spanish conquest of the Aztec Empire, Latin American countries stand out for their relatively high levels of economic inequality[1–3]. A large social science literature has argued that this is the long-run consequence of the extractive institutions imposed by the European elite[4–6]. But here we show that in the Aztec area, inequality levels were relatively high from well before the conquest. On the basis of the available historical and archaeological evidence, we provide an estimate of income inequality in the late Aztec Empire, which spanned most of the territory occupied by modern-day Mexico and parts of Guatemala[7–9]. High inequality was the consequence of extractive institutions meant to advantage primarily the Aztec imperial elite[9–11]. When they arrived, the Spaniards profited from the discontent that high imperial extraction had generated in many provinces, leading Mesoamerican peoples to ally themselves with Cortés in an attempt to free themselves from the yoke of the Aztecs[12].

The city of Tenochtitlan finally fell on 13 August 1521 after a long siege carried out by a small number of Spanish troops and thousands of indigenous allies. This event marks the beginning of 300 years of Spanish colonial domination. Five centuries after the fall of the most powerful empire in Mesoamerica, several questions remain concerning the level of oppression that the Aztec Empire exerted in its domains

and its possible long-term consequences. To determine the levels of inequality and of imperial extraction across the vast territories under Aztec rule, we used information about the conditions prevailing in each province to estimate their mean income per capita. We then devised a detailed social table, representative of the highly hierarchical social–economic stratification of the empire, and used it to estimate interpersonal income inequality. We found that this inequality was relatively high, especially in those provinces that suffered the most disadvantaged situation under the imperial rule—which were exactly those more likely to rebel and to ally with the Spaniards. The extractive institutions characterizing the Aztec Empire paved the ground for subsequent colonial extraction. As we argue, the relatively high levels of income inequality that came to characterize Latin America could not be considered to have been the sole consequence of the initial conditions imposed by the Spaniards (for example, through the system used to ensure an extensive supply of native labour known as *encomienda*[13]). Nor could they simply come from the predatory attitudes and institutions of the colonial elite[4,5]. Instead, colonization further exacerbated the highly extractive conditions that had come into being before the conquest and ensured their continuation for centuries thereafter.

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Results

The historical context

In 1428, the city-states of Tenochtitlan, Texcoco and Tlacopan formed the 'Triple Alliance', which established the Tenochca Empire, usually known as the Aztec Empire[8,11,14,15]. The 38 provinces that the empire ruled over were subject to a highly developed imperial tax system. This system, owing to its institutional refinement and the ability to collect taxes on a regular basis, approached a proper fiscal state of the kind that Western Europe developed from about the same period[16,17]. And yet, other characteristics of the Aztec Empire are generally considered to have been relatively less advanced, so that it is difficult and maybe improper to classify its institutions on the basis of typologies developed for Eurasian states[16].

On the eve of the Spanish conquest, the Aztec Empire was the most militarily, politically and economically powerful state in Mesoamerica[8,12]. It had a highly productive agriculture, based on a technologically advanced irrigation system and on highly developed domestication of plants. But its economy also required intensive use of human energy, lacking a wheel transport system and beasts of burden[11]. Except for those involved in the luxury goods sector and in foreign trade, the vast majority of the population was occupied in seasonal pluri-activity, and most production was household-based[11]. Some specific goods, such as *mantas* (cloths) or cocoa beans, were used as currency throughout the empire; however, in many provinces barter remained widespread[11,18,19].

In the years immediately preceding the conquest, Central Mexico experienced a tremendous increase in population and substantial economic growth[15,16]. In 1492, the Basin of Mexico had the highest population density of all the Americas[20]. Demographic pressure had increased competition for resources and pushed the Triple Alliance to expand to more remote regions. This aggressive stance was also fuelled by competition between the elites of the ruling city-states, which ultimately led Tenochtitlan to consolidate its leading position within the alliance[21–23]. Intense factional competition shaped many aspects of society[24]. The continued state of war, a tax system growing ever more extractive and pro-elite political reforms exacerbated social stratification across the empire. The nobility appropriated the land and controlled the commoners through several mechanisms[25], which led to a clear demarcation between landowning and landless classes. On the positive side, imperial expansion intensified trade and fostered market integration[26]. This, however, was largely to the advantage of the original provinces of the Triple Alliance. In many cases, the Aztec expansion led to a decline in the revenues of the provincial elites[27]. Elsewhere, the collusion between the imperial and the provincial elites generated profits for both in a win–win game resulting from the new imperial tributary system, to the detriment of the peasants[8,28].

Income levels across the empire

The relatively advanced imperial administration provides us with historical documentation sufficient to produce estimates of the income per capita. We first produced estimates of population density at the provincial level. As there exists a positive correlation between population density and per capita income that tends to be similar across ancient societies[4,29,30], we could estimate the relevant parameter and use it to infer approximate income levels from our demographic data (Fig. 1a and Supplementary Table 1a). It is generally accepted that the original variation in population density across Mesoamerica was determined by differences in land productivity[31,32]. In the more densely populated areas, greater competition among human groups led to the emergence of stronger states[24]. Stronger state institutions and the positive externalities associated with agglomeration economies generated by the physical proximity of many economic activities had a positive impact on income per capita.

In our estimate, the per capita income of the empire was about US$690 (1990 purchasing power parity (PPP)) on the eve of the conquest, or about 1.72 times the subsistence minimum. This is comparable to the income level estimated for the Euro-Mediterranean region in 150 AD, for Byzantium around 1000 AD or even for England on the eve of the fourteenth-century Black Death and India around 1600[33–35]. However, it is much lower than the $800–900 (1990 PPP) of late fifteenth-century Spain, let alone the most advanced areas of Western Europe such as North Italy and the Low Countries[36,37]. Additionally, there was substantial variation within the empire. Of the 38 provinces, the four richest (Petlacalco, Huaxtepec, Cuauhnahuac and Tlatelolco) had a per capita income of over $900 (1990 PPP) (Fig. 1a). Tenochtitlan, the imperial capital city, which enjoyed special administrative status, stood out with an income of $1,980 (1990 PPP). These estimates have to be understood as approximations, which is always the case for pre-industrial societies, and producing them required strong assumptions about the long-run relationship between population density and per capita income (Methods). However, they are informative of orders of magnitude and can be reasonably expected to properly reflect differences between each province. The per capita incomes of provinces relative to each other, not the exact province-by-province income estimates, are the most important factor when measuring inequality across the empire.

Income inequality

Archaeology has established that economic inequality was generally higher in post-Neolithic Eurasia than in the Americas. This is due to the availability of large domesticated mammals, which led to more profitable agriculture benefiting some over others and also led to the development of a mounted warrior elite[38,39]. However, even without large domesticated mammals, the societies that emerged in Central Mexico were highly hierarchical and stratified[40]. The primary social distinction in the Aztec Empire was between the nobility, the commoners and the slaves. Substantial differences also existed within each group[10]. The elite dominated the commoners by holding sole control over productive resources. Since they were not allowed to own farmland, commoners had to acquire access to it from the nobles in exchange for labour or for a part of the produce (*calpulli*/*teccalli* system). Among the commoners, the sources of economic inequality were labour specialization and chiefly the specific mechanisms through which they gained access to land[7]. Among the nobility, inequality depended on juridical status (imperial versus provincial nobility), the economic potential of their respective provinces and the extraction levels imposed locally by the imperial institutions. In particular, the taxes established by the Triple Alliance for each province were variable, depending on how the province had become part of the Aztec Empire. Those peoples that had militarily resisted the Aztec Empire suffered the highest imperial tax rates once conquered. Hence, high economic inequality in the empire was also the result of an unequal distribution of political power, similarly to what was found elsewhere[41].

On the basis of the available historical evidence, we developed social tables for each province and for the Triple Alliance cities (Methods) as well as for the empire as a whole and used them to measure income inequality by means of the Gini index (Fig. 1b and Supplementary Table 1a). For the Aztec Empire as a whole, we estimated that on the eve of the conquest the richest 1% earned 41.8% of the total income; this figure grows to 50.8% if the richest 5% is considered. As the income share of the poorest 50% was just 23.3%, this makes for a very skewed income distribution (Fig. 2). The income distribution of the Aztec Empire differs significantly from those of modern-day Mexico (Kolmogorov D statistic = 0.55, $P < 0.005$) and the USA ($D = 0.65$, $P < 0.005$). The income share of the richest was higher in the Aztec Empire. Interestingly, the income share of the poorest was also higher—but in the Aztec Empire, the 4.6% earned by the poorest 10% (a social stratum composed one third by slaves) corresponded to a situation close to mere physical subsistence, which is clearly not true for the poorest 10% of citizens of the USA even if their income share is just 1.9%. Note that the income distribution of the Aztec Empire reflects a society with a small political and economic elite and a mostly agrarian population:
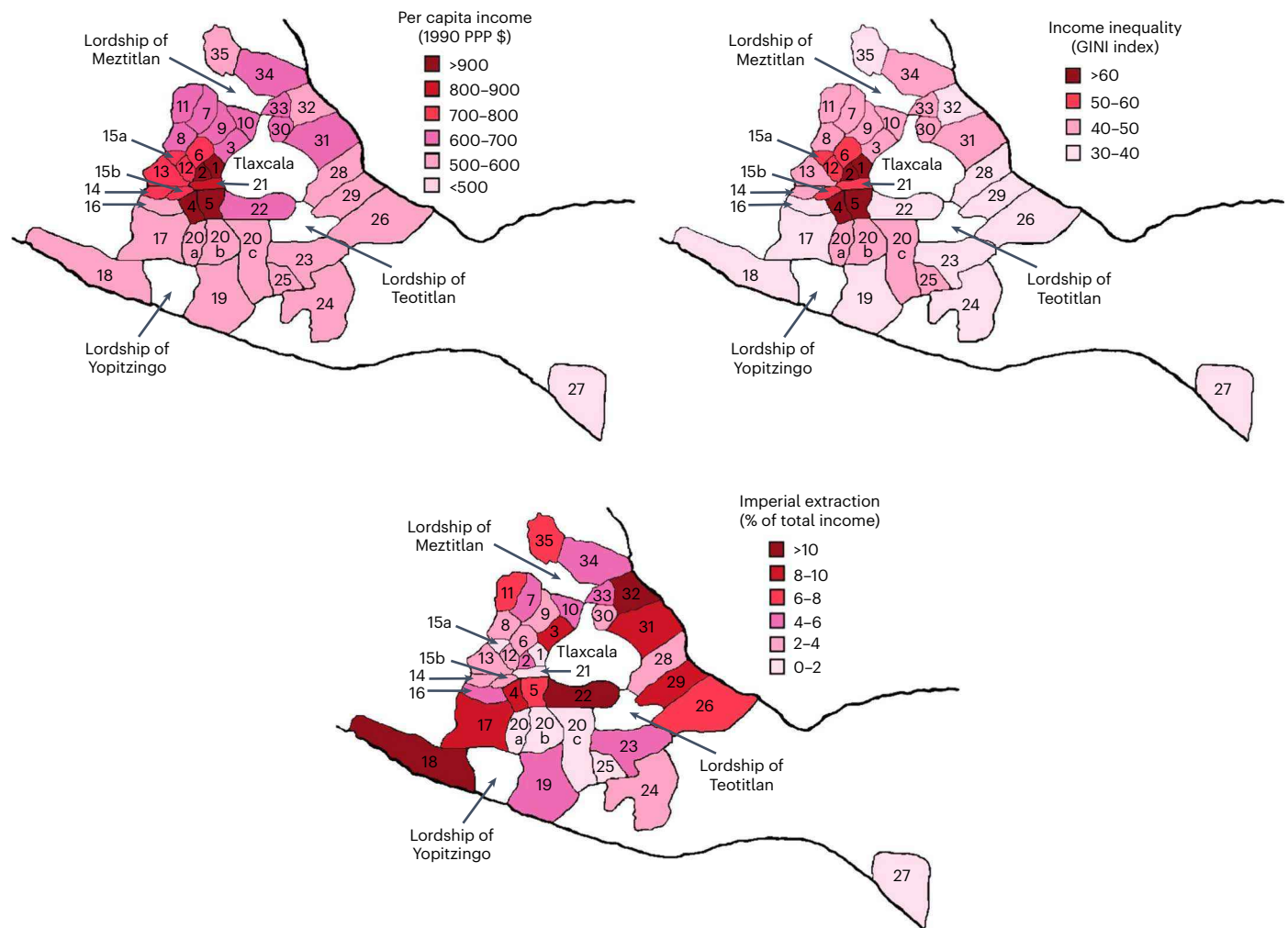
Fig. 1 | Per capita income and inequality in the Aztec Empire. a, Per capita income. **b**, Income inequality. **c**, Imperial extraction. Province IDs and boundaries according to Broda[67]. Additional details are provided in Supplementary Tables 1a and 2.

together, the nobles and all the urban 'special categories' that enjoyed relatively high incomes accounted for just 4.3% of the total population (Table 1 and Methods).

Overall, the Aztec Gini index of income inequality amounted to 50.4. This is higher than the 36–39 found in the Roman Empire in 14 AD, the 41–43 reported for Byzantium around 1000 AD and the 33–37 of England and Wales in 1290, but in line with the 50 of the northern Low Countries around 1500 and the 52 of the southern Low Countries around 1550[33,34,42–44]. However, the Aztec Empire was much poorer than the Low Countries, and hence similar Gini indexes have deeply different implications. This is revealed by inequality extraction ratios, which measure how close a society is to the maximum inequality that it could theoretically experience without pushing all of its members (except for a single super-rich) below subsistence[42,44]. With a ratio of 89%, the Aztec Empire was much closer to the boundary than the northern Low Countries (71%), which implies a social organization strongly modified in favour of a small elite. Within the empire, inequality reached even higher peaks: >60 in some of the richest provinces and almost 80 in the city of Tenochtitlan.

Importantly, these estimates are robust to some possible inaccuracy in measurement of the income levels across the empire. If we assumed a 10% lower per capita income for each province, which is a sizeable cut (leading to an estimated per capita income across the empire of about $626 (1990 PPP)), we would get a Gini index of 45.4,

quite close to our estimate of 50.4 and still high compared with the ancient polities mentioned above, except for the richest ones. The associated inequality extraction ratio of 87% is almost identical to our estimate of 89%, which means that the way in which we characterize the Aztec imperial society as a relatively extractive one would not change.

Extraction and the fall of the empire

The imperial ruling class of the Triple Alliance, the provincial ruling class and the non-ruling nobles amounted to less than 2% of the total population but concentrated 46.6% of the total income. Taken singularly, these social categories extracted 4.5%, 28.4% and 13.7% of the total income, respectively (Table 1). This might seem favourable to the provincial ruling class, but as the imperial ruling class was a much smaller group, it enjoyed a much larger per capita income: on average, almost 5 times that of the provincial ruling class and 70 times that of the non-ruling nobles. For this reason, the level of imperial extraction indicates why discontent against the empire might have arisen in the provinces and helps explain the quick formation of anti-imperial alliances upon the arrival of the Spaniards.

Also regarding this aspect, there was high variation across the empire. In some established provinces on the Gulf of Mexico coast, such as Tochpan, Cihuatlan and Tepequacuilco, imperial extraction was very high. In Cuetlaxtlan (Fig. 1c, ID 29), where (in the lordship of Cempoala) Cortés made his first alliance against the Aztecs, taxes
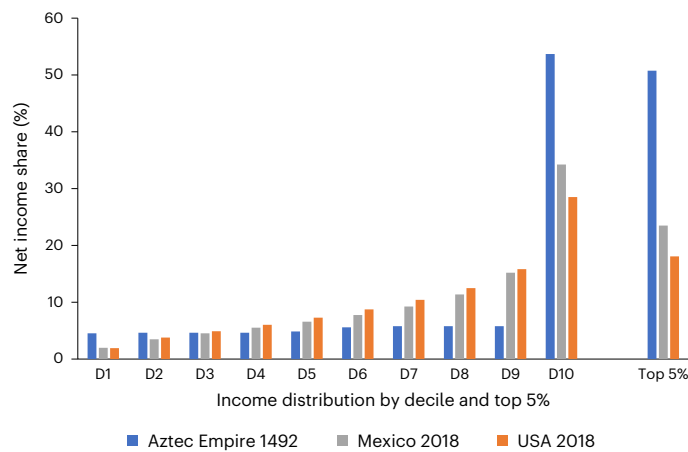
Fig. 2 | Income distribution in the Aztec Empire compared with modern American states. D1, first decile (poorest 10%); D10, tenth decile (richest 10%). The data for Mexico and the USA are from the World Income Inequality Database[68]. A Kolmogorov–Smirnov test confirms that the reported distribution of the Aztec Empire is statistically different from those of modern Mexico ($D = 0.55$, $P = 0.004$) and the USA ($D = 0.65$, $P = 0.000$).

Table 1 | Social table for the Aztec Empire as a whole

Income social group	Per capita income in minimum subsistence	Estimated population share (%)	Estimated share of total income (%)
Imperial ruling class	905.19	0.01	4.54
Provincial ruling class	183.21	0.27	28.40
Non-ruling nobles	12.88	1.83	13.68
Special Category 3	4.36	0.42	1.06
Special Category 2	3.34	0.65	1.26
Special Category 1	2.21	1.07	1.37
Commoners Level 3	1.00	43.33	25.17
Commoners Level 2	0.85	10.25	5.05
Commoners Level 1	0.80	39.06	18.12
Slaves	0.75	3.11	1.35

The point estimates were produced as the combination of province-level estimates, as per the file 'ReplicationFile1.xlsx'.

paid to the Triple Alliance amounted to 8.9% of the total income. The maximum, 14%, was touched in Tepeyacac (ID 22), which also allied with the conquerors.

Although at first the Spaniards faced resistance from certain native peoples, they soon came to enjoy the support of various cities against the Aztec Empire. Before arriving in Tenochtitlan, Cortés already had the backing of Cempoala, Huejotzingo and Tlaxcala, the latter an independent confederation and staunch enemy of the Aztecs. Later, in the Basin of Mexico, the Spaniards forged a powerful alliance with different cities that paid taxes to the Aztecs, such as the Otomies of Teocalhueyacan, as well as the residents of Texcoco, Chalco and other towns in the provinces of Petlacalco and Acolhuacan. It is interesting to note that Tlatelolco (ID 1), a city-state that supported the Aztecs until the end of their fall, suffered much lower imperial extraction than other provinces: 1.3% of the total income. The fact that the success of the Spanish conquest depended crucially on the alliance with native peoples is fully recognized by recent literature[45]. Our contribution is to show that there were strong and quantifiable economic motivations behind the revolt of some provinces against the rule of the Triple Alliance–motivations

that were themselves the result of imperial policies leading to unequal fiscal treatment across provinces.

Discussion

Overall, our estimates suggest that the Aztec Empire had a relatively high level of income inequality compared with other ancient empires, such as the Roman Empire at the beginning of the Current Era or Byzantium around the year 1000[33,42]. In fact, as revealed by an inequality extraction ratio of 89%, it was as close to the maximum inequality it could have obtained without pushing the vast majority of the population below the level of mere subsistence. We thus conclude that high inequality in Mexico was not originated by the new institutions established in colonial times, but preceded the conquest.

Our findings challenge some influential social science works that have argued that the Europeans, and especially the Iberians, unilaterally determined the institutional framework of the New World, bringing to Latin America their inefficient and/or predatory institutions[4,5]. These works share a crucial limitation: they ignore the institutional context set by the pre-conquest societies, and they consequently fail to consider how this context might have contributed to shaping the colonial institutions. Indeed, this literature, as it argues that the European institutions were responsible for generating high inequality in Latin America, implicitly suggests that they replaced relatively 'inclusive' pre-conquest institutions that would have allowed for better participation of large strata of the population in the political and/or economic life. This position is difficult to hold. High imperial extraction and certain obligations imposed by the Aztecs (for example, the provision of children and youths to be sacrificed in rituals) were deeply resented by the provinces. Thus, inequality levels almost as high as the theoretical maximum contributed to making the Aztec society less resilient against a new and unexpected threat.

Undoubtedly, the conquest, the redistribution of political power and the subsequent dramatic demographic crisis marked a radical discontinuity from the preceding situation[46,47]. Per capita income contracted to about $400 (1990 PPP) in the early colonial period, growing back to about $600 (1990 PPP) only at the turn of the seventeenth century[48]. After the conquest, Europeans brought various institutions to the Americas, but this does not exclude the possibility that pre-existing 'native' institutions transcended or merged with the colonial ones. Additionally, the existence of previous extractive institutions made it easier for the Europeans to introduce their own system of extraction, even through direct adaptation of those native institutions. Well-documented cases of pre-conquest institutions hijacked by the Europeans include the *mita*, a forced-labour system used by the Inca Empire[49]. Others have argued, in a more general way, that institutional, economic and social transformations during the colonial period were largely influenced by pre-conquest institutions[50]. However, the idea that after the conquest native peoples were simply the recipients of Spanish policies and institutions has remained prevalent among social scientists[4–6,49].

For the Aztec area, our estimates of income inequality levels provide support for the view that pre-conquest institutions were important landing strips for colonial institutions. Since pre-conquest nobles and lords were the sole owners of the farmland, the several layers of extraction previously imposed on commoners to control access to resources made it easier for the Spaniards to appropriate land and labour. The *encomienda indiana* and later the *repartimiento*, or the *cuatequil* (a forced-labour system similar to the *mita*), took advantage of these mechanisms[13,49]. Surely, for the native populations of Mesoamerica, being required to provide labour to their rulers was not a new idea introduced with the *encomienda/repartimiento* system. In addition, the Spaniards directly inherited various methods of tax collection from the Aztecs, at least in early colonial times[11,50].

Overall, the conquest shows a combination of institutional continuities and discontinuities. The highly hierarchical pre-conquest social

stratification survived in the colonial period, leaving many nobles with multiple privileges and entitled to extract a large share of the income from the commoners, to their own benefit as well as to that of the new Spanish elite. Hierarchical stratification and social–economic inequality, however, were further exacerbated by the economic activities introduced by the Spaniards—particularly mining, which had severe consequences for the well-being of the native population and contributed to its demographic collapse[46,47]. Additionally, the Spaniards introduced a new caste system based on race, which established legal differences (with crucial economic consequences) between the Spaniards, the natives, the African slaves and their descendants, the *mestizos* or other castes originating from the mixture of races. As a result, by 1790 New Spain had a Gini index of income inequality of 63.5—substantially higher than most contemporary societies and basically as high as it could have been without compromising the simple survival of large masses of the population[42]. This being said, on the basis of our findings on inequality in the Aztec Empire, and without negating the plight and terrible sufferance that the conquest caused to the native population, we argue that colonial institutions did not create high inequality in Latin America; they only exacerbated it.

Methods

Preliminary note about the sources available for studies of the Aztec Empire

A major problem encountered by any attempt to study the social–economic conditions of the Aztec Empire on the eve of the conquest is the scarcity of surviving written sources, due to the massive burning of pre-1519 documents, including tax and census records, at the hand of the Spaniards and their allies[51]. This might lead us to give excessive weight to sources produced in later, colonial periods. In the following, we make full use of the most ancient surviving documents, such as the *Matrícula de Tributos*, which is either pre-Hispanic or dates from the very first years after the conquest[52]. We also take into account the important additional information that has been produced by archaeological studies conducted in Mexico and Guatemala. We strive to make our assumptions as evidence-based as possible given the circumstances. Our assumptions are also consistent with the general literature on the estimation of inequality in ancient and pre-industrial societies.

Relationship between income and population density

To produce our estimates of per capita income in the Aztec Empire, we exploited the variation in population density among different societies. In a pre-industrial context, population density is strongly correlated with per capita income, as shown by studies that have used population density as a proxy for relative levels of development[4]. On the basis of information provided by Ashraf and Galor[53], we exploited the positive relationship between population density and per capita income. We used a sample of 66 pre-industrial societies, which included 22 distinct world areas all observed in three different years (1, 1000 and 1500 AD). The strong correlation between population density and income level in our sample is shown in Supplementary Fig. 1.

We estimated two models, using ordinary least squares (Model 1) and two-stage least squares regression analysis (Model 2), with an instrument to control for the possible endogeneity between population density and per capita income. We used information in natural logarithms for both variables. Other geographical controls were used. The logarithmic population density variable was restricted (greater than zero) for better functional form. The file 'ReplicationFile1.xlsx' contains the information used to estimate per capita income and provides the complete panel. The results of the two models are presented in Supplementary Table 3, and the estimators are very similar (0.1895 for Model 1 versus 0.1977 for Model 2). We chose Model 2 because two-stage least squares regression analysis presents advantages in the face of a possible endogeneity bias.

Estimation of the per capita income in the Aztec Empire and its 38 provinces

We first used the coefficient from Model 2 in Supplementary Table 3b to estimate the per capita income for the Aztec Empire, considering a population density of 42 inhabitants per square kilometre. This density comes from assuming a population of 7 million people within the empire, with an area of 170,000 square kilometres in 1519, which is consistent with recent historical and archaeological literature[16,20,30].

On the basis of the above, the per capita income across the Aztec Empire is obtained through equation (1):

$$\ln(ypc) = 5.8293 + 0.1977(3.7376) \tag{1}$$

where ypc is the natural logarithm of GDP per capita, and 5.8293 and 0.1977 are the estimators obtained for the constant and the natural logarithm of population density, respectively, shown in Supplementary Table 3a. The number 3.7376 is the natural logarithm of a population density of 42. The result from equation (1), $\ln(ypc) = 6.5686$, is in natural logarithm form (95% confidence interval, 6.3561–6.7195). By applying the proper exponential transformation to this result, we obtain a GDP per capita of $712 (1990 PPP). Note that this estimate for the empire as a whole constitutes just a first approximation, as we produced a more precise and slightly lower point estimate of $690 (1990 PPP) directly from the detailed income distribution obtained with the procedure described in the following paragraphs. Interestingly, our estimate of income per capita is higher than what has been produced for Latin America as a whole on the eve of the conquest[54]. However, our estimate does not refer to the whole area but just to one of its more advanced polities at the peak of its power. It is also entirely compatible with the estimated sharp drop in income per capita (to about $400 (1990 PPP)) in the immediate post-conquest decades[48]. Note that limited differences in the income estimates only marginally affect our estimates of income inequality and inequality extraction ratios (Results).

To estimate the per capita income in the 38 provinces of the Aztec Empire, we used available information about the population density in 1492[30]. This information refers to the territorial division of the current subnational administrative entities of Mexico and Guatemala (states and departments). Therefore, as a first step, we established the correspondence between the territories of today's administrative entities and those of the ancient Aztec provinces.

As a second step, we weighted the available estimates of the population density in 1492 to reflect the conditions of the 38 provinces of the Aztec Empire. We first collected information on the number of towns and locations in each Aztec imperial province in 1519 from Barlow[55]. We then weighted the population density estimate of each state or department in 1492 according to the proportion of towns identified by Barlow that could be attributed to each current state or department. For instance, the province of Tlatelolco included 11 towns, of which 9 have been identified by archaeologists. These 9 identified towns were located in two different current states: 3 in what is now Mexico City (or Federal District) and 6 in what is now Estado de Mexico. Consequently, we estimated the population density of the Aztec province of Tlatelolco (157 people per km²) as a weighted average of the population density reported for these two modern administrative areas, giving a weight of 3/9 to Mexico City (392 people per km²) and 6/9 to Estado de Mexico (40 people per km²).

As a third and final step, we produced estimates of the per capita income per province following the same procedure outlined above for the Aztec Empire as a whole. This is done in the file 'ReplicationFile2.xlsx', sheet 'PerCapitaIncome_AztecProvinces'.

The estimated per capita income and population density for each province of the Aztec Empire are provided in Supplementary Table 1a, columns A and B (both in point estimates and in 95% confidence intervals, whose standard errors, t-statistics and P values (P > |t|) are shown in Supplementary Table 1b); per capita income is also shown graphically in Fig. 1a. We also estimate the per capita income for each province in terms of subsistence minimums (Supplementary Table 1a,

column C). Note that by assigning the level '1' to minimum subsistence as defined above, we can express higher or lower income levels as multiples of 1. For example, across the empire, the imperial ruling class had a per capita income equal to 905.2 times subsistence (Table 1), which might seem like a lot—but this estimate refers to a small elite group composed of only about 600 individuals, as clarified in the Supplementary Methods.

Estimate of subsistence minimums in 1990 PPP dollars

To express the per capita income in terms of subsistence minimums, we considered an amount of $400 (1990 PPP), which is the level usually assumed for similar purposes[34,42]. We divided each term in column B of Supplementary Table 1a by $400 (1990 PPP). For instance, the per capita income in Cihuatlan is $575.2 (1990 PPP) (95% confidence interval, 510–610). To express this in terms of subsistence minimums, we divided 575.2 by 400, obtaining 1.4. It is important to note that the level we set for subsistence, $400 (1990 PPP), is higher than the level for mere physical survival, which would be $300 (1990 PPP) on the basis of the literature[34,42].

Equivalences

Supplementary Table 4 discusses the equivalences used to develop our estimates. Equivalences between cocoa beans, *mantas* and 1990 PPP dollars subsistence minimums are needed because part of the literature provides useful quantitative information expressed in the first two units of measurement. Note that we assume $1 (1990 PPP) = 2.29 cocoa beans; hence, a subsistence minimum of $400 (1990 PPP) equals 916 cocoa beans.

Estimation of social tables: social classes

Social tables providing information about the population size and the per capita income of distinct categories are often used to roughly estimate inequality levels in historical societies, particularly when detailed information about the complete income distribution is lacking[34,44]. We elaborated a full set of social tables for different areas of the Aztec Empire, based on the information provided by archaeological and historical sources.

For the 38 single provinces of the Aztec Empire, we developed social tables composed of nine distinct categories. For the city-states that formed the Triple Alliance (Tenochtitlan, Texcoco and Tlacopan), we also developed social tables with nine categories. The categories are the same for provinces and Triple Alliance city-states, except for the highest-ranking one: in the city-states, this was the imperial ruling class, while in the provinces, it was the provincial ruling class. As these two categories had different characteristics and income sources, they are kept separate. We also developed a summary social table for the whole of the Aztec Empire, which has ten categories because it includes both the imperial ruling class and the provincial ruling class (Table 1).

Our starting point was the work by Smith and Hicks[7] on inequality and social class in Aztec society, but we improved our social tables by using additional information when needed. The main social distinction in the Aztec Empire was between those who owned the land (the nobility), those who did not (the commoners) and the slaves.

The top of the social structure of the Aztec Empire was formed by the nobility, which can be further divided into three categories:

- Imperial ruling class. This social category was not considered in Smith and Hicks[7], since their study focused on the imperial provinces only. The imperial ruling class lived in Tenochtitlan and in the other two city-states that were part of the Triple Alliance (Texcoco and Tlacopan). This category had representatives in the provinces for the collection of taxes, the *calpixque*. Even though they were few in number, members of the imperial ruling class received a sizeable part of the income generated locally, through taxes.

- Provincial ruling class. This social category includes the kings and the governing councils, formed by important nobles, of the provinces that had been conquered by the Triple Alliance and had become part of the Aztec Empire. The Aztec Empire used to keep the conquered ruling groups at the heads of the respective provinces. However, the provincial ruling class had a duty to collect taxes locally and hand them over to the empire.
- Non-ruling nobles. This category includes the other nobles who owned land and who utilized it directly or indirectly through the commoners. Members of this social class also supported the ruling class in the administrative tasks of government.

The middle of the Aztec social–economic structure was composed of the commoners, who did not own land. Importantly, there were no substantial differences between commoners living in the countryside and those in urban areas. The majority of commoners were farmers (including most urban commoners), and the source of much of the inequality within the commoner class was the mechanism by which they obtained land to cultivate. However, some who specialized in more profitable activities had a social–economic status above that of the other commoners[7]. The commoners can therefore be classified into two groups: one including people with specialized occupations (further divided into three special categories) and a much larger one whose members, the *macehualtin*, were characterized by seasonal pluri-activity (further divided into three categories with different levels of income).

Special Categories 1, 2 and 3 are the categories for commoners with specialized occupations identified by the literature[7]:

- Special Category 3: guild merchants (*pochteca*) and luxury artisans. This category includes wealthy commoners who profited from the commercial economy and could accumulate considerable fortunes. People in this category worked directly for kings or high nobles and also sold their products on the market.
- Special Category 2: high priests and top warriors. This category includes those who occupied the top positions in hierarchical organizations closely linked to the state administration. Although they were not part of the nobility, they enjoyed great prestige and social influence. Note that among 'top warriors' we find not only professional soldiers but also conscripts (all males were required to serve as soldiers) who had risen in rank and prestige by capturing enemy prisoners or by performing other battlefield feats.
- Special Category 1: non-noble *calpixque* or city officials, in charge of collecting taxes in the neighbourhoods (*calpolli*).

The differentiation of the rest of the commoners (*macehualtin*) into three categories, with different levels of per capita income, is based on a range of factors, particularly the way in which they gained access to the land:[19]

- Commoners 3. This category includes commoners who had direct access to farmland, through institutions associated with their neighbourhood or village (*calpulli* and *teccalli*). These commoners were generally ancient settlers who had to pay tax (not rent) to the local ruler, who in turn sent part of the tax revenues to the Triple Alliance. Although there are geographical and institutional differences between *calpulli* and *teccalli*, in both institutional arrangements the commoners had access to land and were characterized by having lived on their land for many years.
- Commoners 2. This category includes construction workers, loaders (*tamemes*), unskilled craftsmen and other workers earning temporary salaries. Although it would be incorrect to think of these as salaried workers entirely analogous to their Western counterparts, their income came from specific payments for their services that were structurally similar to a temporary salary.

- Commoners 1. This includes *mayeques*, whose access to land was through direct dependence on a noble rather than through the institutions of *calpulli* or *teccalli*. They did not pay tribute to the supreme lord but paid rent to the nobles[56]. Historians frequently compare this institutional arrangement to European serfdom since the *mayeques* lacked freedom and self-determination. This group was generally composed of new settlers who had immigrated into a community after fleeing from other places ravaged by wars or famines. For Tenochtitlan, this category also includes the servants of both the nobility and the Great Temple (*Templo Mayor*).

Finally, at the bottom of the social pyramid were the slaves (*tlacohtin*), the lowest category in our social tables. Being a slave in the Aztec Empire was not as permanent a condition as in other historical settings and usually involved specific individuals, not their entire families. This is why slaves were a relatively small percentage of the total population.

Estimation of social tables: population per province and social class

The late Aztec Empire had a population of about 7 million, distributed as follows: 250,000 in the city of Tenochtitlan, 35,575 in the city of Texcoco, 30,000 in the city of Tlacopan and on average 175,906 people in each of the 38 provinces.

For Tenochtitlan, we obtained our estimate as the midpoint in the range of 200,000–300,000 proposed by Rojas[57,58]. For Texcoco, we obtained our estimate of 35,575 as an average between the population levels proposed in the literature[20,59]. For Tlacopan, we assumed a population of 30,000, considering the upper bound of the range provided by Denevan[20] of 10,000 to 30,000. Excluding the populations of the three city-states that formed the Triple Alliance, we were left with 6,684,425 inhabitants. Dividing them evenly among the 38 provinces, we obtained an estimated average of 175,906 inhabitants per province. The estimation of the population per social class is detailed in the Supplementary Methods.

Estimation of social tables: per capita income per social class

At the provincial level, there are two sources of income variation:

1. The per capita income level, which is estimated according to the procedure described previously.
2. The payments that each province had to make to the Aztec Empire (according to the Mendoza Codex and the *Matrícula de Tributos*).

We measured different income levels in terms of multiples of the minimum subsistence level.

The amount related to imperial extraction (which represents the income of the imperial ruling class) was subtracted from the estimated income generated by each province. This amount was different across provinces. We assumed a fixed income level for all categories of commoners and for the slaves. Subsequently, we subtracted the income of these categories from the post-tax provincial income. The obtained residual was then distributed among the non-ruling nobles and the provincial ruling class.

Imperial ruling class. The income of the imperial ruling class comes from the taxes paid by the 38 provinces. Tax payments by provinces were estimated on the basis of the literature[60,61] and reflect the value of tax paid in *mantas* (blankets). The distribution of *cargas* (loads) can be used as a proxy for the tax burden paid in each province and is reported by the Mendoza Codex[61]. Overall, these tax payments correspond to the annual income of the imperial ruling class that resided in Tenochtitlan, Texcoco and Tlacopan. Payments were made from the provinces to Tenochtitlan, and later a part was transferred to Texcoco and Tlacopan. The information on tax payment by province can be found in the sheet 'ImperialTaxation' in the file 'ReplicationFile2.xlsx'.

We assumed that the income of the imperial ruling class, coming from the tax payments made by the provinces, was distributed among the three cities as follows: 88% for Tenochtitlan, 6% for Texcoco and 6% for Tlacopan. The literature[62] has highlighted that when the Triple Alliance was formed in 1426, the distribution of taxes was 2/5 for Tenochtitlan, 2/5 for Texcoco and 1/5 for Tlacopan (originally, the alliance was formed to defeat the Tepaneca Empire, which was ultimately accomplished in 1430). However, during the rule of Moctezuma II (1502 to 1520, when Hernán Cortés arrived), the distribution of taxes was no longer proportional at all, as almost all the tax revenues went to Tenochtitlan[63,64].

Slaves. We assumed that the income of slaves reflects a minimum calorie intake of 867 grams of corn, which corresponds to $300 (1990 PPP) and 0.75 in terms of multiples of the subsistence minimum ($300 (1990 PPP) is the minimum necessary for mere physical survival; Supplementary Table 4). Note that on some occasions people gave themselves as slaves to nobles or wealthy commoners just to gain access to the minimum subsistence and avoid death by starvation.

Commoners 1. We estimated an income level for Commoners 1 of 0.8 in terms of minimum of subsistence, slightly higher than what a slave received. The *mayeques* or 'dependent commoners' have often been compared to the European serfs, as they lacked freedom and self-determination. It therefore seems reasonable to assume that members of this category were close to the minimum subsistence level: above slaves, but below salaried workers.

Commoners 2. We estimated an income level for Commoners 2 of 0.85 in terms of minimum of subsistence. This estimate is derived from a reported salary of 12.5 cocoa beans per day in 1530[65]. We assumed that the salary increased by around 30% between the period prior to 1519 and the year 1525 as a consequence of the imbalances generated by the demographic crisis and the collapse of the Aztec Empire. A 30% increase is comparable to the increase in wages observed in Europe a few years after the demographic crisis caused by the Black Death of 1347–1352. We therefore estimated a pre-1519 daily wage of about 9.62 cocoa beans per day. Note that this salary is consistent with additional information provided by the literature[18]: we know of unskilled workers who were hired for similar amounts, and those in charge of the steam baths and prostitutes charged between 8 and 10 cocoa beans. We assume that a family had seven people on average and that the economically active population was 31.4% of the total population on the basis of the available literature[66]. Therefore, for each day of work, a family would have received 21.14 cocoa beans (obtained by multiplying 9.62 by 2.198, which in turn is obtained by multiplying 7 (the size of a representative family) by 0.314 (the share of the economically active population)).

We also assumed that a year had 256 working days, considering the festivities included in the two calendars used by the Aztecs (see the Supplementary Methods regarding the estimated working days). A family would thus receive an average of 5,450 cocoa beans annually. Dividing this figure by 7 (the average size of a family), we obtained a total of about 779 cocoa beans per year per person. This is equal to 85% of the minimum subsistence level.

Commoners 3. We assumed that Commoners 3 had an income of 1 in terms of minimum of subsistence. Members of this category did not own their land, which explains why their income remained somewhat limited. Henry Hawks, an English traveller of the sixteenth century, pointed out that "the Indian lives the whole week with less than one *real*, which the Spaniard or anyone else cannot do"[18]. While this testimony refers to the post-conquest period, it seems probable that in the decades immediately following the fall of the Aztec Empire, the conditions of farming commoners were no worse than before, also considering the relative abundance of resources determined by

the demographic collapse. For Tenochtitlan, where this category of commoners was a smaller share of the population (Supplementary Methods), we assumed a slightly higher income of 1.05. For the other two cities that were part of the Triple Alliance, Texcoco and Tlacopan, we assumed an intermediate level of 1.025.

Special Category 1. For Special Category 1, we estimated an income level of 2 in terms of minimum of subsistence. On the basis of the literature[7], the *calpixque* (neighbourhood tax collectors) had an income that was between 2 and 17 times that of commoners. We assumed a conservative income level of twice that of the richest commoners, considering as a reference the size (in square metres) of houses in Yautepec, as reported by archaeological studies. For Tenochtitlan, we assumed a higher income of 4. For the other two cities that were part of the Triple Alliance, Texcoco and Tlacopan, we assumed an intermediate level of 3.

Special Categories 2 and 3. On the basis of the literature, Special Categories 2 and 3 had relatively high incomes. Considering the income levels estimated for Special Category 1 and in the absence of additional information, we made the reasonable assumption that Special Category 2 (high priests and top warriors) had an income level of 3 in terms of multiples of the subsistence minimum, while Special Category 3 (luxury artisans) had an income level of 4. For Tenochtitlan, we assumed higher income levels of 6 (for Special Category 2) and 8 (for Special Category 3). For the other two cities that were part of the Triple Alliance, Texcoco and Tlacopan, we assumed intermediate levels of income of 4.5 and 6 for Special Categories 2 and 3, respectively.

Provincial ruling class and non-ruling nobles. The income of the provincial ruling class and non-ruling nobles varied according to the province depending on two factors: the level of extraction made by the imperial ruling elite and the per capita income level of each province. In practice, the collective income of these two classes was obtained as a residual, subtracting from the total income of each province the taxes paid (as reported by the Mendoza Codex) and the income earned by the non-noble categories, which we assumed to be fixed as discussed above. Then, on the basis of the literature[7], we assumed that 75% of this residual income went to the provincial ruling class and 25% to the other non-ruling nobles. The original information relates to a sample of six landholding communities in Morelos.

Social tables and the calculation of the Gini index of income inequality across the Aztec Empire

On the basis of the information collected from the various sources mentioned above, we built a full set of social tables: (1) for Tenochtitlan, (2) for city-states associated with the Triple Alliance and (3) for the 38 provinces (Supplementary Tables 5–45). The Gini index (or any other inequality measure) for the three cities of the Triple Alliance or for each province can be calculated immediately on the basis of these tables (see the sheet 'Income&Gini_Provinces&CityStates' in the file 'ReplicationFile2.xlsx'). These tables can also be used to obtain the overall distribution across the whole of the Aztec Empire, as well as the related synthetic social table (see the sheet 'IncomeDistr&Gini_AztecEmpire' in the file 'ReplicationFile2.xlsx'). The synthetic social table is discussed below.

Income distribution and social table for the Aztec Empire as a whole

The information coming from the 41 distinct provincial and city-state social tables can be used to produce a detailed distribution of the income across the whole of the Aztec Empire. This is done by taking into account the population share of each city or province compared to the whole of the empire, rescaling the population shares presented in each local social table accordingly and finally using all the entries to build a distribution representative of the whole of the empire. This is done in the file 'ReplicationFile2.xlsx', sheet 'IncomeDistr&Gini_AztecEmpire'.

This distribution can then be used to directly calculate any possible inequality measure—for example, the Gini indexes and the top income percentiles (see the sheet 'DistributionByPercentile_Empire' in the file 'ReplicationFile2.xlsx').

It is also useful to present this information in a different way, by collapsing the complete distribution into a summary social table having the same characteristics as those developed for each specific province or city-state. This is reported in Table 1. As slaves and Commoners 1 and 2 are given the same income across cities and provinces, their estimated income is also the same in the social table for the empire as a whole. In contrast, the income of Commoners 3 and of the specialized categories, which has been assumed to be higher in Tenochtitlan, Texcoco and Tlacopan than in the provinces, is a population-weighted average. The same is true for the three categories of nobility (imperial ruling class, provincial ruling class and non-ruling nobles), whose income has been allowed to vary across each city and province.

Reporting summary
Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability
All data and replication files used in the analyses have been deposited in the OpenICPSR data repository (https://www.openicpsr.org/openicpsr/project/186521/version/V2/view) for purposes of reproducing or extending the analysis.

References
1. Prados de la Escosura, L. in *The New Comparative Economic History* (eds Hatton, T. J. et al.) Ch. 12 (MIT Press, 2007).
2. Milanovic, B. *Global Inequality: A New Approach for the Age of Globalization* (Harvard Univ. Press, 2016).
3. Bértola, L., Castelnuovo, C., Rodriguez, J. & Willebald, H. Income distribution in the Latin American southern cone during the first globalization and boom and beyond. *Int. J. Comp. Sociol.* **50**, 452–485 (2009).
4. Acemoglu, D., Johnson, S. & Robinson, J. A. Reversal of fortune: geography and institutions in the making of the modern world income distribution. *Q. J. Econ.* **117**, 1231–1294 (2002).
5. Engerman, S. L. & Sokoloff, K. L. in *How Latin America Fell Behind: Essays on the Economic History of Brazil and Mexico, 1800–1914* (ed. Haber, S.) Ch. 10 (Stanford Univ. Press, 1997).
6. Acemoglu, D., Johnson, S. & Robinson, J. A. The colonial origins of comparative development: an empirical investigation. *Am. Econ. Rev.* **91**, 1369–1401 (2001).
7. Smith, M. E. & Hicks, F. in *The Oxford Handbook of the Aztecs* (eds Nichols, D. L. & Rodríguez-Alegría, E.) Ch. 29 (Oxford Univ. Press, 2017).
8. Smith, M. E. & Montiel, L. The archaeological study of empires and imperialism in pre-Hispanic Central Mexico. *J. Anthr. Arch.* **20**, 245–284 (2001).
9. Gutiérrez, G. in *Merchants, Markets, and Exchange in the Pre-Columbian World* (eds Hirth, K. G. & Pillsbury, J.) Ch. 6 (Dumbarton Oaks, 2013).
10. Olson, J. M. & Smith, M. E. Material expressions of wealth and social class at Aztec-period sites in Morelos, Mexico. *Anc. Mesoam.* **27**, 133–147 (2016).
11. Carrasco, P. in *Historia General de México* (ed. Cosío-Villegas, D.) Ch. 4 (Colegio de México, 2000).
12. Hassig, R. *Mexico and the Spanish Conquest* (Univ. Oklahoma Press, 2006).
13. Zavala, S. La encomienda indiana. *Trim. Econ.* **2**, 423–451 (1935).
14. Carrasco, P. *The Tenochca Empire of Ancient Mexico: The Triple Alliance of Tenochtitlan, Tetzcoco, and Tlacopan* (Univ. of Oklahoma Press, 1999).

15. Berdán, F. F. in *The Encyclopedia of Empire* (eds MacKenzie, J. M. et al.) 1–8 (Wiley-Blackwell, 2015).

16. Smith, M. E. in *Fiscal Regimes and the Political Economy of Premodern States* (eds Monson, A. & Scheidel, W.) Ch. 3 (Cambridge Univ. Press, 2015).

17. Smith, M. E. The Aztecs paid taxes, not tribute. *Mexicon* **36**, 19–22 (2014).

18. Rojas, J. L. La moneda indígena en México. *Rev. Esp. Antrop. Am.* **17**, 75–88 (1987).

19. Berdan, F. F., Hirth, K. G., Nichols, D. L. & Smith, M. E. in *Rethinking the Aztec Economy* (eds Nichols, D. L. et al.) Introduction (Univ. of Arizona Press, 2017).

20. Denevan, W. M. *The Native Population of the Americas in 1492* (Univ. Wisconsin Press, 1992).

21. Smith, M. E. in *Empires: Perspectives from Archaeology and History* (eds Alcock, S. E. et al.) Ch. 5 (Cambridge Univ. Press, 2001).

22. Smith, M. E. & Berdan, F. F. in *Aztec Imperial Strategies* (eds Berdan, F. F. et al.) Ch. 1 (Dumbarton Oaks, 1996).

23. Brumfiel, E. M. Aztec state making: ecology, structure, and the origin of the state. *Am. Anthr.* **85**, 261–284 (1983).

24. Brumfiel, E. M. & Fox, J. W. *Factional Competition and Political Development in the New World Paperback* (Cambridge Univ. Press, 2003).

25. Smith, M. E. *Aztec City-State Capitals* (Univ. Press Florida, 2008).

26. Berdan, F. Late Postclassic Mesoamerican trade networks and imperial expansion. *J. Glob. Stud.* **8**, 14–29 (2017).

27. Smith, M. E. in *Empires: Perspectives from Archaeology and History* (eds Alcock, S. E. et al.) Ch. 5 (Cambridge Univ. Press, 2011).

28. Smith, M. S. The role of social stratification in the Aztec empire: a view from the provinces. *Am. Anthr.* **88**, 70–91 (1986).

29. Boserup, E. *Population and Technological Change: A Study of Long-Term Trends* (Univ. Chicago Press, 1981).

30. Maloney, W. F. & Valencia Caicedo, F. The persistence of subnational fortune. *Econ. J.* **126**, 2363–2401 (2016).

31. Parsons, J. R. *Prehistoric Settlement Patterns in Texcoco Region, Mexico* (Museum of Anthropology & Univ. Michigan, 1971).

32. Brumfiel, E. M. in *The Early Mesoamerican Village* (ed. Flannery, K. V.) Ch. 8 (Academic Press, 1976)

33. Milanovic, B. An estimate of average income and inequality in Byzantium around year 1000. *Rev. Inc. Wealth* **52**, 449–470 (2006).

34. Milanovic, B. Income level and income inequality in the Euro-Mediterranean region, c. 14–700. *Rev. Inc. Wealth* **65**, 1–20 (2019).

35. Broadberry, S., Custodis, J. & Gupta, B. India and the great divergence: an Anglo-Indian comparison of GDP per capita, 1600–1871. *Exp. Econ. Hist.* **55**, 58–75 (2015).

36. Fouquet, R. & Broadberry, S. Seven centuries of European economic growth and decline. *J. Econ. Perspect.* **29**, 227–244 (2015).

37. Prados de la Escosura, L. *Growth Recurring in Preindustrial Spain: Half a Millennium Perspective* Working Paper No. 177 (EHES, 2020).

38. Kohler, T. A. et al. Greater post-Neolithic wealth disparities in Eurasia than in North America and Mesoamerica. *Nature* **551**, 619–622 (2017).

39. Bogaard, A., Fochesato, M. & Bowles, S. The farming–inequality nexus: new methods and evidence from western Eurasia. *Antiquity* **93**, 1–15 (2019).

40. Smith, M. E. in *Archaeological Views from the Countryside: Village Communities in Early Complex Societies* (eds Schwarts, G. & Falconer, S.) Ch. 10 (Smithsonian Institution Press, 1994).

41. Scheidel, W. *The Great Leveler: Violence and the History of Inequality from the Stone Age to the Twenty-First Century* (Princeton Univ. Press, 2017).

42. Milanovic, B., Lindert, P. H. & Williamson, J. G. Pre-industrial inequality. *Econ. J.* **121**, 255–272 (2011).

43. Van Zanden, J. L. Tracing the beginning of the Kuznets curve: Western Europe during the early modern period. *Econ. Hist. Rev.* **48**, 643–664 (1995).

44. Alfani, G. Economic inequality in preindustrial times: Europe and beyond. *J. Econ. Lit.* **59**, 3–44 (2021).

45. Restall, M. *Los Siete Mitos de la Conquista Española* (Ediciones Paidós, 2004)

46. Livi-Bacci, M. The depopulation of Hispanic America after the conquest. *Pop. Dev. Rev.* **32**, 199–232 (2006).

47. Livi-Bacci, M. The demise of the American Indios. *Pop. Dev. Rev.* **37**, 161–165 (2011).

48. Arroyo Abad, L. & van Zanden, J. L. Growth under extractive institutions? Latin American per capita GDP in colonial times. *J. Econ. Hist.* **76**, 1182–1215 (2016).

49. Dell, M. The persistent effects of Peru's mining mita. *Econometrica* **78**, 1863–1903 (2010).

50. Gibson, C. *Los Aztecas Bajo el Dominio Español, 1519–1810* (Siglo XXI, 1978).

51. Sanders, W. T. in *The Native Population of the Americas, 1492* (ed. Denevan, W. M.) Ch. 4 (Univ. Wisconsin Press, 1992).

52. Batalla Rosado, J. J. The scribes who painted the Matrícula de Tributos and the Codex Mendoza. *Anc. Mesoam.* **18**, 31–51 (2007).

53. Ashraf, Q. & Galor, O. Dynamics and stagnation in the Malthusian epoch. *Am. Econ. Rev.* **101**, 2003–2041 (2011).

54. Williamson, J. G. Five centuries of Latin American income inequality. *Rev. Hist. Econ.* **28**, 227–252 (2010).

55. Barlow, R. H. *The Extent of the Empire of the Culhua Mexica* (Univ. California Press, 1949).

56. Carrasco, P. Los mayeques. *Hist. Mex.* **39**, 123–166 (1989).

57. Rojas, J. L. in *The Oxford Handbook of the Aztecs* (eds Nichols, D. L. & Rodríguez-Alegría, E.) Ch. 15 (Oxford Univ. Press, 2017).

58. Rojas, J. L. *Tenochtitlan, Capital of the Aztec Empire* (Univ. Press of Florida, 2012).

59. Smith, M. E. in *The Oxford Handbook of the Aztecs* (eds Nichols, D. L. & Rodríguez-Alegría, E.) Ch. 14 (Oxford Univ. Press, 2017).

60. Gutiérrez, G. in *Merchants, Markets, and Exchange in the Pre-Columbian World* (eds Hirth, K. G. & Pillsbury, J.) Ch. 6 (Dumbarton Oaks, 2013).

61. Rojas, J. L. & Batalla, J. J. Los números ocultos del códice Mendoza y la matrícula de tributos. *Rev. Esp. Antrop. Am.* **38**, 199–206 (2008).

62. Berdan, F. La organización del tributo en el imperio azteca. *Est. Cult. Náhuatl* **12**, 185–196 (1976).

63. Gibson, C. in *Handbook of Middle American Indians* (eds Ekholm, G. F. & Bernal, I.) Ch. 15 (Univ. Texas Press, 1971).

64. Carrasco, P. *Estructura Político-Territorial del Imperio Tenochca: La Triple Alianza de Tenochtitlan, Tetzcoco y Tlacopan* (Fondo de Cultura Económica, 1996).

65. Borah, W. W. & Cook, S. F. *Price Trends of Some Basic Commodities in Central Mexico, 1531–1570* (Univ. California Press, 1958).

66. Rojas, J. L. Cuantificaciones referentes a la ciudad de Tenochtitlan en 1519. *Hist. Mex.* **36**, 213–250 (1986).

67. Broda, J. in *Economía Política e Ideología en el México Prehispánico* (eds Carrasco, P. & Broda, J.) Ch. 4 (Centro de Investigaciones Superiores del Instituto Nacional de Antropología e Historia, 1978).

68. *World Income Inequality Database* version 31 May 2021 (United Nations University World Institute for Development Economics Research, 2021).

Author contributions

G.A. and A.C. contributed equally to the work and were involved in all tasks.

Competing interests

The authors declare no competing interests.

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Sampling strategy	not applicable - we work on the entirety of the Aztec Empire
Data collection	not applicable - no new data were collected for the purpose of this study
Timing	not applicable - no new data were collected for the purpose of this study
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