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## **Elite violence and elite numeracy in Africa from 1400 CE to 1950 CE**

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### **Abstract**

How can we trace early African development? The share of rulers' known birth year has been identified as an indicator of elite numeracy in African regions since 1400, and the share of murdered rulers allows us to gain insights into interpersonal violence behaviour of African elites. From this emerges a dynamic picture of quantitative African history: the absence of elite violence and high elite numeracy developed jointly in sub-Saharan Africa. Some African regions, such as today's Ethiopia and Angola, took the lead in early development but also experienced severe declines. Development in Africa was, on average, later than in Northwestern Europe.

## Introduction

Several recent studies have argued that human capital formation among elites is crucial to economic development. Squicciarini and Voigtländer (2015) studied elites during the Industrial Revolution in France and observed that motivated engineers and bold entrepreneurs were able to create innovative firms that employed new technologies. Similarly, Baten and van Zanden (2008) observed a strong correlation between advanced human capital and income growth in several European countries. They measured the human capital of the elite based on the consumption of books. The most skilled elites were able to create growth-promoting institutions, which resulted in the successful development of trading cities and merchant economies in Northwestern Europe that would soon stimulate global trade. However, these studies were limited to Europe, and the “Great Divergence” between Europe and Africa could not be studied until now, mostly due to the unavailability of evidence of elite human capital.

In the case of Africa, this lack of evidence also implied that dynamic developments in the continent’s past were often overlooked as many scholars and the general public perceived it as a consistently poor region throughout history. Several recent studies have drawn a more nuanced picture, albeit primarily focused on the colonial period and later (Austin 2016; Frankema and van Waijenburg 2012).<sup>1</sup> Ehret (2014) also challenged the stereotypical idea of a stagnant continent by pointing to substantial socio-economic transitions as well as developments in agriculture, commerce and state formation in pre-colonial African history. However, to understand the Great Divergence between Europe and Africa, it is important to develop measures of elite human capital development in order to allow us to study a much

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<sup>1</sup> Frankema and van Waijenburg (2012) demonstrated that African wages in British colonies (1880–1965) “were well above subsistence level and that they rose significantly over time”.

more dynamic picture of Africa, where the race for greater welfare and development was more dramatic and characterized by upward and downward trends.

These two strands of literature motivated our study to contribute to the assessment of elite human capital. We assess, in particular, the following three hypotheses that correspond to the work plan of our study:

Hypothesis I: One important component of elite human capital are the numerical abilities of elite groups. We hypothesize that a newly developed indicator based on the birth year of rulers, as reported in historical sources, could serve as a proxy indicator for elite numeracy in sub-Saharan Africa, as this was recently applied to 34 European regions from the Northwest to the Caucasus and Asia minor (Keywood and Baten 2020). Our definition of elite refers primarily to the political elite, while the studies on European elites cited above referred to commercial elites and engineers. However, many studies have shown that these two elite groupings were closely related via family ties and that there were frequent externalities from one group to the other, especially during the medieval and early modern periods (Kocka 1975).

Hypothesis II: Similarly, we hypothesise that the number of rulers who were killed (regicide) will allow us to approximate the propensity for violence among the elite, at least in the relatively well-documented regions of sub-Saharan Africa (on Europe, see Eisner 2011).

Hypothesis III: We hypothesize that, in general, higher levels of elite violence were associated with a lower or stagnant formation of elite numeracy, similar to what has been argued in the European case (Keywood and Baten 2020).

The setting in which we assess these hypotheses will be sub-Saharan Africa from approximately 1400 to the mid-20th century. This world region – containing 49 countries and more than one billion inhabitants – provides an enormous variety of developments that can be used for confirming or rejecting the above hypotheses. The *longue durée* that we quantitatively cover here guarantees discoveries for the first time for this continent.

What is our empirical measurement strategy? As indicated in Hypothesis I, we estimated the long-term development of numeracy among the elite. We relied on proxy indicators as the strategy through which to trace these trends. Commonly used elite human capital indicators were not available for the early periods of African history. Therefore, we used a new proxy indicator for African history, which could trace the developments of interest, at least in a highly approximate way: we considered the share of rulers for whom a birth year was reported in standard biographic sources. For most rulers, the years of reign were reported as well as important wars during their<sup>2</sup> reign. The birth year of the ruler was not always known or processed. We argue that a ruler's birth year was regularly reported and entered into historical chronologies only if elite bureaucracies around the ruler were capable of easily processing numerical information. Otherwise, it was simply forgotten or not recorded. This indicator has been successfully applied to study European, South Asian and Middle Eastern elite numeracy (Keywood and Baten 2020; Gust and Baten 2021; Baten 2021). Below, in our discussion of potential biases, our findings indicate that they did not invalidate our proxy indicator for elite numeracy.

Another main measurement project was the approximation of elite violence (Hypothesis II). This was achieved by using a similar proxy indicator, namely, the share of rulers who were killed in battle or during other occasions of interpersonal violence, typically by murder at the hands of family members or a competing nobility (see Keywood and Baten 2020; Eisner 2011 on Europe and Dincecco et al. 2019 on conflict in Africa). Studies on the well-documented European continent found that this can serve as a proxy indicator for violence among the elite group as a whole. While this strategy measures the murder of rulers, external effects on the kingdom's elite were also very likely. The wider elite was also affected by the fear of becoming victims of violence when the ruler was killed – murder, particularly

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<sup>2</sup> As there were few female rulers, we shall use the male pronoun hereafter.

of a central figure, created an atmosphere of fear in society (on recent evidence of the external effects of murder, see Baten et al. 2014). Moreover, after the repeated killings of rulers – both in battle and non-battle situations – specific value systems often developed, which defined violent elite members as persons of honour who would react with violence if their honour was doubted (Keywood and Baten 2020). While most inhabitants of wealthy modern societies consider nowadays “blood revenge” outdated and unimaginable, the contemporaries of medieval Europe considered it imperative. It was closely related to the “culture of honour”, which led aristocrats to die in duels even as late as the 19th century as they attempted to exact revenge for insults or violence against their relatives.

As a preview of our results, we confirm Hypotheses I and II: that these indicators did serve as informative proxy variables in African economic history over the *longue durée*. The relationship between elite violence and elite numeracy was also confirmed (Hypothesis III).

What was the mechanism behind the relationship between elite violence and elite numeracy (Hypothesis III)? Cummins (2017) argued that one microeconomic mechanism might be that if the risk of being killed was high, and, consequently, life was short, the elites would not invest in numerical education. Moreover, among the wider elite, the returns on human capital were more substantial if market institutions could be based on trust, and trust usually develops in the absence of high levels of violence (Nunn and Wantchekon 2011). If the elites around the ruler were plagued by fear of violence and a “culture of revenge”, this would result in underinvestment in human capital (Keywood and Baten 2020). As an additional variable, we should consider income, taking into account the possibility that more economically developed kingdoms saw a rise in elite numeracy (due to higher returns on human capital) and a decrease in violence. In a richer kingdom, potential tax revenues could allow for better-protected rulers. Unfortunately, income variables were not available in a reliable quality for different African regions before the late 19th century. One substantial change in African incomes might have resulted from the slave trade, providing higher

incomes to centralized economies and economically destroying especially non-centralized societies, but we did not find significant differences. In the European case, the role of income has been studied, with the finding that urbanization and climate-based income proxies turned out to be insignificant (Keywood and Baten 2020).

Studying this for the first time in the African setting, we contribute to the literature on the “Great Divergence” of development levels between continents (Broadberry 2016). The Great Divergence concept is usually applied to the East Asia–Europe divergence because China was technologically ahead of Europe in the early medieval period, with Europe later diverging from China and achieving rapid income growth (Broadberry 2016). Below, we refer to evidence that Africa was not far behind Europe around 1400 in terms of the important development component of constraining elite violence; however, there was a divergence in the early modern period when Europe began reducing elite violence at a faster pace. This had implications for elite numeracy, although African elites were, on average, less numerate. Interestingly, though, we found that some African regions were ahead of some European regions in elite numeracy (see our Abyssinia-Eastern Europe comparison).

Measuring and comparing elite numeracy formation in Africa and Europe provides important insights for development as numerical skills are crucial for economic growth. Hanushek and Woessmann (2012) argued that math and science skills were crucial for economic success in the 20th century. They observed that such skills outperformed simple measures of school enrolment in explaining economic development. Baten and Juif (2014) found that today’s math and science skills were already determined by numeracy in the early 19th century, which could be estimated using age-heaping techniques.<sup>3</sup>

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<sup>3</sup> We also contribute to the study of early African developments such as the slave trade (Nunn and Wantchekon 2011).

We do not claim to have found causal relationships between elite violence and elite numeracy for the African case, and as such, we avoid causal language and speak of “relationships” and “correlations” between the two variables (except where we discuss the hypotheses of other scholars on topics such as slavery). However, two earlier studies on Europe and the Middle East used instrumental variable approaches to assess the causality of the relationship between regicide and elite numeracy (Keywood and Baten 2020; Baten 2021). They found that the direction of causality was from elite violence to elite numeracy, which led us to believe that it was probably similar in the African case.

### **1. Measuring elite numeracy: basic method and data sources**

Our indicator of elite numeracy is the share of birth years known for various rulers in a given century or country. The idea is that if the birth year of a ruler is added to the chronologies of kingdoms, a certain level of numerical sophistication of the ruling elite would be required. This evidence does not necessarily measure the numeracy of the ruler himself but, rather, that of the governmental and bureaucratic elite around him and, by implication, that of the elites of the country in general.

The data sources included a variety of biographical works. A very valuable basis for identifying the rulers and dynasties on which we needed to collect information was the standard *opus magnus* of Truhart on regents. Truhart’s (2002) list of rulers is the backbone of this dataset and provides the largest number of sources. In Table 1, we show a snapshot of Truhart’s work. For example, for the ruler Nimi ne Mpangu Lukeni lua Mwemba, who ruled from 1568 to 1587 – and who adopted the Portuguese name Alvaro I – a birth year is known. In contrast, for his son of the same African name (and the Portuguese name Alvaro II), no birth year is known, neither for the other three rulers mentioned in Table 1. The record

indicates that Nimi ne Mpangu Lukeni was killed at the end of his rule, but no violent event was indicated in the deaths of his successor and two predecessors.<sup>4</sup>

We counterchecked these cases with a large number of underlying geographical and historical studies to ensure that rulers whose death was not reported as a killing received sufficient attention (Appendix A). For example, their place of death was often mentioned. For the Sahel, Northeast and East Africa (we excluded North Africa proper), Bosworth's (1967) standard on "Islamic dynasties" was very helpful.<sup>5</sup> We only included cases for which information on at least four rulers was available, though fortunately, for many countries and centuries, there was information on many more rulers.

We included both pre-colonial kingdoms and rulers of less centralized units and listed all of the approximately 2,000 principality–century units in Appendix A. We included all the African leaders mentioned in the sources, even if the polities they ruled were relatively small. A large number of them lived in a capital, but the size of this capital was often no more than a village (with notable exceptions being Mwanza Kongo and Timbuktu). We did not include European rulers or governors or post-colonial presidents and ministers, but we included the dynasties of Arabic origin on the east coast as these often became "local dynasties" soon after arrival. Elite numeracy on the east coast was no different from that of the interior (Appendix B). We performed a selectivity analysis by principality and larger territorial units (modern countries). The larger units were necessary to identify regions in which there might have been cultural obstacles to reporting birth years.

We studied African regions in which the birth year of rulers was recorded at any time before 1800 (see Table 2; on the aggregation by country, see Appendix L). We observed that,

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<sup>4</sup> To be precise, death events might also have indicated an accident, but from the qualitative biographical sources, we know that this seldom occurred in any of the ruler lists (see Keywood and Baten 2020).

<sup>5</sup> We also drew on historical collections such as [www.worldstatesmen.org](http://www.worldstatesmen.org).



in roughly half of the territories of modern countries, birth years were recorded at least once. All African regions (West, East, Centre and South) were covered, and for at least some of the countries, there was evidence of recorded birth years. This indicates that reporting birth years was not limited to certain regions or principalities near European trading posts. Inland regions in modern Niger, Botswana, Sudan and Uganda also reported the birth year of rulers before 1800, which is an important counterargument against the view that numeracy only resulted from European contact. One region with relatively low documentation was the area between Nigeria, Cameroon and the Congos. Interestingly, their direct neighbours – the regions in Benin (Empire of Dahomey) and Ghana (Ashanti) in the West and Angola in the South (Ba-Kongo) – had quite remarkable levels of elite numeracy.

We performed a selectivity analysis at the principality level (see section 4.1) and observed that comparing (a) surviving principalities between the 14th/15th century and later with (b) all principalities yielded very similar results. The time series of both groups were highly correlated (correlation coefficient 0.92,  $p = 0.000$ ).

In summary, as more traditional indicators of education (such as literacy or enrolment) were not available for Africa, the “ruler birth year known” proxy allowed us to trace elite human capital for periods and world regions for which no other indicators were available. We could assess the validity of this indicator using insights from neighbouring world regions. Most notably, Buringh and van Zanden (2009) attempted to trace European elite education by counting the number of monastery manuscripts and relating this to the population of the respective countries. Keywood and Baten (2020) reconstructed the share of known ruler birth years for European countries. In Figure 1, we document the substantial correlation between these two proxy measures of elite numeracy between 700 and 1500 CE for eleven European countries over several centuries. Even though there was a certain amount of variation, which

resulted in some observations being located further away from the regression line, the correlation was, nevertheless, highly significant.<sup>6</sup>

One possibility for assessing the quality of elite numeracy estimates for Africa was to compare them with the numeracy estimates for the general population. These estimates were recently provided by Cappelli and Baten (2021), who collected evidence on the 18th and early 19th centuries based on (1) early census data available for a small number of countries and (2) slave registers in Havana. Both sources contained substantial age heaping, allowing us to estimate basic numeracy: free people who were asked by early census officials for their age (e.g., in Senegal and South Africa), as well as slaves, often stated rounded ages, for example, the age of 30, when they did not know their exact age. It is interesting that the personnel of the port authorities in Havana, where slaves were registered, hired translators who understood the local African languages because they wanted to make sure that the slaves' statements were appropriately recorded. This indicates that most of them responded to questions on age themselves rather than through a slave trader (Cappelli and Baten 2021 assessed the potential selectivity of slaves, see Appendix D. See also Cappelli and Baten 2017.) If we correlate our new evidence regarding elite numeracy during the 18th century with the age-heaping-based estimates of general numeracy, we obtain a correlation coefficient as high as 0.66 ( $p = 0.0136$ ,  $N = 13$ ).

Cappelli and Baten (2021) also estimated overall numeracy in late 19th century Africa; thus, we can make comparisons for this period as well. Again, in calculating the correlation

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<sup>6</sup> Moreover, Cummins (2017) developed a heaping-based indicator of elite numeracy for European nobility. He analysed which excess share of birth years mentioned in European nobility genealogies was based on numbers ending with 0 or 5. This concept is similar to the age-heaping concept (A'Hearn et al. 2009) and can inform us about trends and regional differences of elite numeracy in Europe. This rounding-based indicator correlates strongly with the share of known birth years. Similar comparisons can be performed for China (Appendix C).

coefficient for the 19th century, we obtained 0.60 ( $p = 0.0113$ ,  $N = 17$ ). Studying this in a scattergram depicting the 19th century, we found a group with high general and elite numeracy (Namibia, Eswatini, Botswana, Liberia, South Africa and Madagascar) in the upper right section and a group characterized by low numeracy (Ghana, Guinea, Nigeria and Benin) in the lower-left section (Figure 2). Ethiopia, which was an outlier, had a much higher elite numeracy than population numeracy. This makes sense because Ethiopia had a very long imperial history in its Abyssinian centres, with high elite numeracy. The population numeracy estimate included this region, plus the newly acquired territories of low numeracy in the South and East, which were added to the Ethiopian Empire in the 19th century.

In summary, we found a very strong correlation for both the early modern period and the 19th century. This indicates that the elite numeracy indicator had a reasonable measurement quality for this period and that the inequality of numeracy between the elites and the general population was relatively similar in most countries.

## **2. Potential biases of the “ruler birth known” indicator**

We now discuss the various ways in which the “ruler birth known” indicator might suffer from potential biases (see also Keywood and Baten 2020). First, sometimes, rulers’ biographies are written years after their death, and we may not know the exact sources on which the information was based. One might imagine that the research tradition in a country might have contributed to more detailed and complete chronologies of rulers’ birth year. For example, in Europe, the historiography of countries with strong universities, such as England, France and Germany, might have benefited over the last two centuries from scholars who created detailed accounts of the medieval chronologies of their countries. However, and this was somewhat surprising to us, England and other European countries had fewer known birth year values in the Middle Ages than today’s Iraq (Baten 2021). Similarly, we show below that Russia, with its remarkable university system during the 20th century, had slightly lower elite

numeracy in the 16th century than Imperial Abyssinia. Therefore, these findings are not compatible with the view that the research intensity of the last few centuries might have influenced estimates of medieval elite numeracy.

A second potential source of bias is the destruction of city archives (such as in Timbuktu) or the forgetting of orally transmitted ruler lists, which might have resulted in loss of knowledge. However, royal chronologies were normally copied and learned by many oral transmitters.<sup>7</sup>

Third, and this might be one of the most challenging potential biases, the birth year of more famous rulers might have been better known. We could imagine that the famous dynasties of Mali, Benin, Ba-Kongo, etc. might have attracted more attention and, hence, more detail in their biographies (Thornton 2003). However, this reasoning does not apply to some of the most famous rulers of world history for whom there is no documented birth year. Charlemagne's birth year, to take a European example, is unknown. In the African context, the birth years of the famous Abyssinian rulers or those of the kingdom of Ba-Kongo are relatively well known, which would support this "fame bias". We can somewhat control for this bias by adding a variable for the famous kingdoms of Asante, Benin, Abyssinia, Ba-Kongo, Kuba, Mali and Songhai. We will control for the potential bias variable "fame bias" in the main regressions below.

Fourth, we look at contact bias. One important issue for interpreting the trends of elite numeracy is how ruler lists and political events were recorded in Africa. Was it perhaps only European priests and missionaries who recorded them, and in places where they did not

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<sup>7</sup> Moreover, we will observe below that there was sometimes a decline in the known ruler birth values. If the destruction of city archives or loss of oral knowledge had been a core determinant of this indicator, we would have expected a lower value for the earliest centuries, followed by an increase, and not a decline in later centuries (on declining elite numeracy in several European countries, see Keywood and Baten 2020).

appear, were the ruler lists not recorded? Although it is true that European priests, missionaries and travellers did write about African political events, many scholars have argued that Africa developed its own recording and calculating systems. Some have even argued that writing systems themselves and important mathematical–astronomical developments originally came from Africa. Millennia before CE, writing systems had already developed around the Sahara, not only in Egypt but also in the Sahel zone as well as in Nubia and Meroe. The “Old Nubian” script developed as a descendant from ancient Napatan and Coptic between 800 CE and 1500 CE and was based mainly in the kingdom of Makuria (in central Sudan, see Oliver and Atmore 2001, p. 20). This reflects the fact that Ethiopia adopted the innovation of writing systems (and, later, the Timbuktu region), whereas other African regions did not have the preconditions to adopt them. The Ethiopian written language Ge’ez is one of the oldest ones still in use anywhere in the world. Ge’ez (800 BCE to the present) and Sabean, which was used between 700 BCE and 600 CE, were derived from the Proto-Saharan writing system. Arabic scripts and their derivatives were used in Eastern Africa even as far south as today’s Madagascar (Simon 2006). In the thinly populated regions of central and southern Africa, writing systems developed later. In some of the southern societies, specialized priests passed on knowledge about earlier rulers to subsequent generations through oral transmission. For example, in the Mutapa kingdom (details below), the *mhondoro* priests formed a powerful religious elite. They were responsible for recording the names and reign stories of the Mutapa kingdom and its preceding principalities (Stewart 1989, p. 738).

Among mathematical and astronomical advances are the famous writings of early scholars, which survived in libraries in Timbuktu (Stewart 2018). Moreover, the numerical abilities of children, youth and adults were trained using traditional games. For example, the Gebet’an or “Mancala” game has been used since at least 700 BCE (excavation in Yeha, Ethiopia) and is still in use today (Natsoulas 1995). This is a counting board game that forces

players to develop strategies for capturing more stones on the board than their opponent. However, the southern part of Africa was not purely dependent on oral traditions for ruler lists, which were later recorded by Europeans, but also developed recording systems that were partly based on the adoption of Arabic script (Sorabe in Malagacy, see Simon 2006; see also Appendix E).

In conclusion, we do not believe that European trade contact or Christian missionary activity exclusively determined elite numeracy, although they were contributing factors in some cases.<sup>8</sup> In contrast, the Kingdom of Ba-Kongo, which had relatively high numeracy, and Abyssinian rulers had already established a strong and specialized government prior to contact with Europeans. Because of their high elite human capital and state capability, these states might have been more open to trading contact with Europeans and accepting of their religion if it suited them. We will include a variable for “European contact” in our regressions below.

### **3. Measuring elite violence**

One important potential correlate of elite numeracy is elite violence: if the risk of being killed was high and life was short, elites would not invest in numerical education (Cummins 2017). Eisner (2014) has argued that the complex interaction between more education and less violence in a society sets a “swords to words” process in motion in which

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<sup>8</sup> One important counter-example of European contact not leading to records of more ruler birth years is the Empire of Wolof, which was an important empire that traded intensively with Europeans. After some hostile exchanges with Europeans, trade with Portugal increased rapidly from the 1480s onwards. European contact was so close that a Wolof ruler was threatened by his family because they accused him of being too open towards the Portuguese, and he fled to the Portuguese court in Lisbon (McLaughlin 2008). Interestingly, in spite of the intensity of the contact, the Empire of Wolof did not develop a high level of elite numeracy, although other kingdoms in the interior of Senegambia did.

increasingly more potential conflicts are solved with words rather than swords (see Elias 1969). Keywood and Baten (2020) collected evidence on thousands of rulers in Europe, documenting a decline in the rate of regicide – the share of kings and other rulers who were killed – in Europe. The victims of their own families and competing nobility who were killed in interpersonal violence as well as rulers killed in battle declined between the early medieval period and the era around 1800 (see Keywood and Baten 2020). Similarly, Cummins (2017) found that increasingly fewer members of European nobility were killed in battle after the late Middle Ages. Baten et al. (2021) found that his evidence regarding the nobility was closely correlated with regicide, suggesting that regicide was an indicator of violence among the broader political elite.

Keywood and Baten (2020) compared evidence on regicide and homicide for several European countries and found very similar trends (Figure 3). Moreover, deviations from the general downward trend often occurred at similar times, indicating that the relationship was not spurious. For Africa, we adopted a similar strategy as Keywood and Baten (2020) by tracing the number of rulers who were killed either in battle or through other interpersonal violence, mostly due to conflicts about who should rule. Interestingly, the development in Africa was very different from Europe: for a large part of the period, interpersonal violence increased among ruling houses in Africa (see below).

In the regression analysis, we included only the highest quality data available. For example, we included only those country–century units in which the known birth year rate was above zero, as zero might not only have indicated lower elite numeracy but could also be a result of poor or lost documents or perhaps the influence of a different cultural system for recording time and age. Including only the best documented cases might have introduced a certain selectivity towards the more developed regions and periods. We could analyse, however, whether we selected only the most developed countries: we assessed whether their

inclusion correlated with higher urbanization in 1800. In Appendix F, we found no substantial selectivity.

#### **4 Trends of elite numeracy**

What are the general trends of elite numeracy in Africa, and what patterns can we observe? West Africa had quite low and stagnant elite numeracy until the 17th century (Figure 4). During the 18th century, several West African kingdoms developed higher elite numeracy. We see a modest development of elite numeracy in principalities in today's Benin, Guinea, Sierra Leone and Senegal, all of which were also important ports and kingdoms involved in trade. Furthermore, in the West African interior, some kingdoms developed early elite numeracy, such as those in what is today Niger.

We observe a different pattern of development in Eastern Africa, which had early numeracy development from the 14th/15th century. This was mostly because of Abyssinia, but this early success story was soon followed by the Mutapa Empire (in today's Zimbabwe, Mozambique and Zambia, countries that are part of East Africa according to the UN definition), the Ma-Kololo kingdom in today's Zambia (originating in today's Botswana) and the Imerina kingdom in central Madagascar. Madagascar is an interesting case as its textile industries were most competitive in all of East Africa during the early-modern period (Clarence-Smith 2014), and during the early 19th century, the Imerina kingdom tried to initiate the Industrial Revolution with limited, though not negligible, success (Campbell 2005). We will describe the histories of Mutapa and Abyssinia below as case studies.

We expected the development of early elite violence in the coastal regions of what is today Tanzania as their principalities were founded by Islamic traders who played an active role in long-distance trade even around 1700. Traders from Cape Delgado (at the border between modern Tanzania and Mozambique) and Kilwa (today Tanzania) brought slaves to Arabia and the Persian Gulf region (Vernet 2013, p. 2). However, we observe zero elite



numeracy in either the coastal or interior regions of Tanzania until the beginning of the 19th century (Appendix B). This might have resulted from the fact that elite numeracy declined in many Islamic polities during the early modern period, as Baten (2021) observed for principalities in the Middle East.

In the southern part of Africa, we can identify a set of late success stories in the 18th century (Figure 4). We observe that these regions, located in what is today Botswana, South Africa, Eswatini and Namibia, had numeracy rates of between 0.2 and 0.3 during the 18th and 19th centuries, which were very high values for Africa during this period.

Finally, Central Africa had a very dramatic story of an early increase and decline after the 16th century, which can be best told by considering the case study of Ba-Kongo, as we do in the following section. However, first, we need to discuss the potential of source survival bias at the principality level. Clearly, small African kingdoms were reported more frequently in the sources available for the 19th century, whereas only the most notable and long-lived ones were reported for the 14th and 15th centuries (Appendix A). How important was the resulting source survival bias for the trends in African regions? In what follows, we compare trends among African regions, including (a) only the principalities for which long-run data were available from the 14th/15th century and were constantly under the same name of the principality (Figure 4, Panel B) with (b) all principalities (Panel A). We observe that the changes over time were actually very similar and that the two series – one based on all principalities and the other based only on the long-term survivors – were highly correlated (corr. coeff. 0.92,  $p = 0.000$ ).<sup>9</sup> Naturally, the level of elite numeracy of the principalities that existed under the same name from the 14th/15th century onwards was higher, which represents a selection of exceptionally stable polities (without much change in names).

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<sup>9</sup> This correlation applies to the level of African regions and centuries as units. If we calculate the correlation based on the modern countries and centuries as units, the noise is naturally higher, but the correlation coefficient is still as high as 0.73 ( $p = 0.000$ ).

Overall, 43% of the principalities that we could include existed in the 14th/15th century. As a robustness test, we also considered only the African polities that survived from the 17th century onwards under the same name, which were even more correlated with the full data set, and the elite numeracy level was between the full data set and that of the survivors from the 14th/15th century onwards (Appendix G).

Of course, we need to be aware that long-term survivors were a very special selection of polities. However, it is interesting that the trends of this selective special group and the total number of polities on which evidence is available appear very similar. We present both the whole picture of the narrow selection of polities and the broad panorama of polities (plus, in Appendix G, the more modestly selective group of survivors from the 17th century onwards).

Next, we look into important case studies, namely Ba-Kongo, Imperial Abyssinia, Sawa and Mutapa. Thornton (2001) described the “literate rulers” of Ba-Kongo who themselves documented events from approximately 1500, along with their capitals, in today’s Angola. During the early 16th century, all relevant documents were written exclusively by the elites of Ba-Kongo, for example, letters by the famous ruler who was known under his adopted Portuguese name of Alfonso I. The early literacy of these African rulers and their surrounding elites was well documented in early 16th century sources. During the early 17th century, Ba-Kongo teachers from Mbanza Kongo (/Sao Salvador) translated the Portuguese catechism of Marcos Jorge (Thornton 2001). This translation was then published in 1624 by Mateus Cardoso. It is clear that elite numeracy and the adoption of writing systems and numerical tools went hand in hand. This kingdom was able to adopt it, while others were not.

The literacy of the Ba-Kongo elites corresponds with our findings of a remarkably high elite numeracy of 20 per cent, both in the early and late 16th century (Figure 5, Panel A). It was not by chance that this region produced elites with very high numeracy and literacy early on. Mbanza Kongo was a substantial urban agglomeration (some estimates report

100,000 inhabitants in the early 17th century) that helped to avoid “tyranny of distance” effects that prevented early human capital formation in other African regions (and elsewhere, see Grafe 2012). The population density in the capital was a consequence of the fact that the Ba-Kongo state of the 15th century was highly organised. The resulting reduction of interpersonal violence in the 15th century allowed a more advanced level of local and interregional trade (Figure 5, Panel B).

The kingdom of Ba-Kongo was actively participating in enslaving other Africans mainly from its eastern neighbours during the 16th century. However, after invasions from these eastern neighbours into Ba-Kongo during the late 16th century and subsequent internal and external conflicts in the 17th and 18th centuries, the Ba-Kongo population itself was enslaved, leading to the usual adverse effects. In Figure 6, we observe the highest level of elite violence in the late 16th and 17th centuries, after which Ba-Kongo lost its leading role to its neighbours and declined in elite numeracy. While we expected that the slave trade had a mostly negative effect, we acknowledge that there might have been an initially different effect that was later reversed.

Another focal point of early success – and our second case study – is Abyssinia (in modern Ethiopia), where a strong increase in elite numeracy took place in the 14th/15th and 16th centuries, following a value of zero from earlier centuries (Figure 6, Panel A). Before this period, the country had been Christian for a millennium, but only in the 14th/15th and 16th centuries did we observe a strong increase in elite numeracy rising to approximately 35 per cent in the 16th century and then undergoing a slight decline in the 17th century.

What kinds of events triggered the increase in elite numeracy during this period? We found that, before the increase in numeracy, some early Abyssinian rulers were primarily interested in military success, as they were leading a large number of wars against Islamic and Pagan neighbours (Henze 2000). During this period, elite numeracy was low. For example, Nevayas Christos arrested Egyptian merchants in the 12th century and created an institutional

setting that had adverse effects on economic development. Consequently, he became famous for his military success, not for founding libraries or schools (Tamrat 1972; Henze 2000, p. 67). In contrast, David I (1382–1413) became famous for reviving book printing in Abyssinia and initiating the printing of Christian books such as *Miracles of Mary*, which was originally printed in Arabic (addressing neighbouring Arabic principalities), and *The Book of the Gospels* (Budge 1928). We can interpret David’s behaviour as being compatible with a type of Abyssinian ruler who contributed to the increase in early numeracy, but this was not initiated by the introduction of Christianity, which took place long before.

However, during the 16th and 17th centuries, elite violence reached a peak, and at the same time, the increase in elite numeracy began to stagnate, followed by a slight decline (Figure 6). In the 18th and 19th centuries, violence remained high. This was “the era of judges” (referring to “the era of judges” in the Bible), a period of decline. During this period, Abyssinian rule was highly fractionalized between different principalities. There were a large number of conflicts between these principalities, with ethnic groups invading from the South and East, including the Oromo ethnicity (Henze 2000). The emperor was essentially powerless and was restricted to his capital of Gondar.<sup>10</sup> These two early African success stories demonstrate that while high elite numeracy could be observed in sub-Saharan Africa, violent shocks initiated periods of stagnation or decline.

One of the Oromo kingdoms, which were among the enemies of Abyssinia, was the kingdom of Sawa. In the 15th century, many of the Oromo kingdoms were Christianized, and the kingdom of Sawa was also affected by this development (Henze 2020). Elite violence was

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<sup>10</sup> In the early 19th century between approximately 1800 and 1840, the conflict between different regions of the Abyssinian Empire and the various Oromo kingdoms was at its peak in terms of their negative relationship with human capital. Reid (2011, pp. 44-45) described the situation as military terrorism, which especially affected non-combatants, including women and children who were caught and either murdered or sold into slavery.

low while elite numeracy was high during this early period.<sup>11</sup> However, when conflicts rose in Abyssinia in the 16th and 17th centuries, elite violence in Sawa also increased, and elite numeracy fell dramatically. This kingdom is one of the examples demonstrating a correlation between the two variables of elite violence and elite numeracy.

Finally, a case study of the border between Eastern and Southern Africa addresses the Kingdom of Mutapa. The Mutapa kingdom developed in the 15th century, centred on what is now Zimbabwe, Mozambique and Zambia. Many of its founding myths relate its emergence to the previous Kingdom of Zimbabwe, although the geographic centres of rule were not identical (on this and the following, see Stewart 1989; Oliver and Atmore 2001). In Portuguese maps of the 16th century, most of Southern Africa was assigned to this empire, which also included important gold mines and allowed the Portuguese to develop the ivory trade. The Mutapa kingdom was a highly developed early African state with a differentiated political elite system.<sup>12</sup> While the king was an absolute monarch, he had a counselling body of nine ministers called the “King’s wives”, although in reality, almost all were male. However, the senior wife of the king had a strong influence on the government. The Mutapa Empire flourished in the 16th century, with a high elite numeracy value and low elite violence (Figure 7), which was not the case in the 14th/15th century period during its formation era (higher elite violence, lower elite numeracy). After some limited contact with the Portuguese during the early 16th century, direct relations between the Mutapa Empire and Portugal were established in the 1560s. After the baptism of the Mutapa ruler, Muslim merchants initiated violent protest, leading to the killing of the Jesuit missionary. The Portuguese saw this as a legitimate reason to militarily attack and seize gold mines and ivory trading centres – but only with temporary success as the Mutapa Empire was still sufficiently well organised. This

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<sup>11</sup> The small number of cases (N = 20) does not justify a separate figure.

<sup>12</sup> It was also called the Mutapa Empire, a title fitting in the context of the 16th and early 17th centuries.

gradually changed during the 17th century due to internal and external conflict with the Portuguese, the rise of the neighbouring Butwa and the emerging Rokwi kingdom. Elite violence increased, and elite numeracy began declining. In the 18th century, most of the territory was lost, and a civil war after 1759 dealt the Mutapa kingdom a final blow, after which it was reduced to a minor principality. During the 18th century, elite numeracy returned to zero, during which time, the killing of rulers was not recorded, which does not necessarily indicate low elite violence as several civil and external conflicts are recorded for this period (Stewart 1989; Oliver and Atmore 2001).

Given the various experiences of these African polities, we need a regression analysis to study whether the negative relationship between violence and numeracy observed for Mutapa, Sawa and partly for Ba-Kongo (with some lags) was typical, or cannot be confirmed.

## **5. Trends of violence in African regions**

In Figure 8, we provide evidence of violent developments in Africa for the four main regions. The indicator is the share of rulers who were killed either in battle or due to interpersonal killing, mostly by neighbours or competing nobilities. In general, we observe an initial increase in different centuries, observable in both East and West Africa, although not statistically significant, as indicated by the confidence intervals. The maximum regicide levels in West Africa were reached in the 16th century, with a violence rate of about 10 per cent of the rulers who were killed. This corresponds with the very low level of elite numeracy observed for West Africa during the whole period before the 18th century. Central Africa had a relatively low rate of elite violence in the 16th century, peaking in the 17th and 18th centuries. Again, this corresponds with the initial peak in elite numeracy and the subsequent decline in Central Africa. Moreover, there was an increase in violence in 19th-century Southern Africa. This corresponds with a historiography of the Mfecane, which took place in Southern Africa during the 19th century. However, in comparison with the higher rates in

Central Africa during the 17th and 18th centuries, the Mfecane was a relatively modest event in terms of elite violence, though perhaps not in terms of overall violence (see Appendix H). In general, towards the 19th and 20th centuries, we observe a decline in violence, which was similar in other world regions (Keywood and Baten 2020, Baten 2021). Nevertheless, Africa is quite distinct from other world regions, such as Europe, because, during the early modern period, many regions experienced an upward trend in violence (see below). In Appendix I, we compare elite violence and elite numeracy for individual rulers and observe a correlation between the two variables in two of three cases.

## 6. Econometric analysis

We estimated the following model:

$$EN_{ct} = \alpha + \beta_1 EV_{ct} + X'\gamma + \mu_t + \nu_c + \varepsilon_{ct},$$

where  $EN_{ct}$  captures elite numeracy in century  $t$  in country  $c$ . As we did not have enough observations for the 14th century, the 14th and 15th centuries were combined as one temporal unit.  $EV_{ct}$  is the main variable of interest: elite violence in country  $c$  in century  $t$ .  $X'$  is a vector of additional potential explanatory variables, namely, European contact, slavery, precolonial centralization and fame bias;  $\alpha$  is a constant; and  $\varepsilon$  is the error term.<sup>13</sup>

Nunn and Wantchekon (2011) argued that sub-Saharan Africa was plagued by the Atlantic, Saharan, Indian Ocean and Red Sea slave trades and that this could have affected elite numeracy. However, the slavery variable could be seen as a “bad control” (i.e., endogenous). We estimated different versions of the regression, some of which exclude this variable. However, had we left out this variable completely, we would be at risk of omitted variable bias. For example, the Atlantic slave trade has a strong exogenous component that

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<sup>13</sup> We treated each country–century observation with equal weight here, not weighed by the number of rulers or underlying population because a few populous countries would have driven the results.

should not be omitted completely. Thus, in some other specifications, we included them in order to use the Odysseus-type navigation strategy between the Scylla of bad controls and the Charybdis of omitted variable bias.

Importantly, the slave trade might have been an ambivalent variable because some centralized kingdoms might not have suffered as much if they had succeeded in playing an active role in trade with and the enslavement of neighbouring populations from more interior places. Thus, we added the interaction term of slavery intensity and centralization.<sup>14</sup>

We also added the variable of European contact to our regressions. Thus, we included the view that contact learning could have played a role (see Appendix J for details). As another control, we included “fame bias” to take into account the famous kingdoms of Ashanti, Benin, Ba-Kongo, Abyssinia, Kuba, Mali and Songhai.

In eight regression analyses, we identified the potential correlates of elite numeracy (Table 4). We chose the standard model selection strategy to first assess a bivariate regression of elite violence and elite numeracy (column 1) and then added time fixed effects (column 2), region fixed effects (column 3) and time and region fixed effects (column 4). Finally, we added more control variables such as European contact in columns 5, 7 and 8, “fame bias” in columns 6 to 8 and slavery and centralization in column 8. We observed a consistently significant negative relationship between elite violence and elite numeracy. The coefficient was not small as the standard deviation of elite violence was 0.061 (Table 3), and multiplied by the coefficient of 0.839, as indicated in column 1, we obtained a standard deviation effect of 0.051, or a 5.1 per cent higher rate of elite numeracy. This accounts for more than 40% of the standard deviation of elite numeracy, representing an economically substantial amount.

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<sup>14</sup> For example, as mentioned above, the centralized kingdom of Ba-Kongo as well as Ashanti, Benin and Dahomey were actively participating in enslaving other Africans, mainly from their more decentralized neighbouring regions where the population was preyed upon (e.g. the Igbo).



We observe that the fame bias variable was not significant and not consistently positive. The European contact variable had a positive (though insignificant) coefficient, but its inclusion did not invalidate the elite violence variable, which was our main variable of interest.

We observe in column 8 an insignificant (even negative) coefficient for the slavery–centralization interaction term, and centralization itself had an unexpected negative sign. These astonishing results were driven by the fact that more centralized West African kingdoms had lower elite numeracy, and less centralized Southern African kingdoms had higher elite numeracy. Moreover, our time-variant measure for slavery intensity certainly contained measurement error. However, completely omitting these variables when estimating the elite violence–elite numeracy relationship would have been a greater fault (for the instrumental variable analysis of slavery: see Appendix K).

Assessing spatial autocorrelation is a crucial test for any relationship because earlier studies have found that not controlling for it might invalidate important results (Kelly 2020). Similar to temporal autocorrelation, in which the previous period might have an impact on the current behaviour of a variable (independent of the explanatory variables), the behaviour in a region might be influenced by the behaviour in an adjacent region (again, independent of explanatory variables). We calculated Conley standard errors to take this into account (Hsiang 2010).<sup>15</sup> We applied this method using a wide range of plausible bandwidths for distances of 250, 1000, 2000, 3000 and 4000 kilometres. We intentionally assessed the Conley standard errors for such a wide range of geographic distances in order to assess the robustness of our

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<sup>15</sup> For panel data, in which temporal autocorrelation might also play a role, Hsiang (2010) developed another method that also controls for heteroscedasticity (see notes to Table 5 for details).

results.<sup>16</sup> We found that spatial autocorrelation did not invalidate our general results as all six bandwidths resulted in standard errors for elite violence, thereby implying statistical significance at usual levels.

We broke down the relationship in Table 6 into the share of rulers who were killed during a war as opposed to those who died a violent death arising from interpersonal violence during times of peace. To measure this, we included information on whether a ruler's violent death occurred during a time of conflict with other states (see Brecke 1999; Besley and Reynal-Querol, 2014). We compared the time of conflict with our regicide variable and observed the relationship of regicide with elite numeracy during both violent conflicts and nonviolent periods.

To check whether the results could potentially be driven by a small number of outliers, we considered a scattergram of regicide and elite numeracy (Figure 9). There was a relationship between elite violence and elite numeracy, which was not driven by single outliers. In general, we found very high elite violence levels in regions such as Angola in the 17th century and in Mali in the 16th century. We also found low estimates of elite numeracy for these observations, but quite the opposite was true for South Africa in the 18th century, Botswana in the 19th century and many Southern African countries in the 20th century. All these high numeracy observations coincided with a relatively low level of violence among the elite. Some other kingdoms were positioned more towards the centre of the figure. There were some deviations to the lower left and some countries such as Senegal in the 18th and 19th centuries with a lower level of elite numeracy than we had expected from the elite violence level recorded.

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<sup>16</sup> In our case, the distance between Lomé in Ghana and Porto-Novo in Benin was 220 kilometres, which might justify the shortest difference. Our longest distance was almost the distance between Pretoria in South Africa and Mogadishu in Somalia.

Liberia in West Africa represents an exceptional case during the 19th century as it was an unusually successful country in terms of elite numeracy. A substantial number of African Americans from formerly enslaved families migrated from the United States to Liberia and formed the elite of this newly created independent state (Akpan 1973). It can be debated whether this form of elite immigration created “black colonialism”, as Akpan described it. While this exceptionalism might imply that the case of Liberia should be omitted from the analysis, it would also result in bias if we removed the high elite numeracy cases of African development as “untypical” of Africa. In our view, we cannot justify omitting successful African developments in general and focusing only on unsuccessful cases. Thus, we performed analyses that both included and excluded Liberia and found that the main results did not depend on it.<sup>17</sup> In general, the scattergram demonstrated a negative relationship between violence and elite numeracy across periods and regions.

In sum, we found a substantial negative correlation between elite violence and elite numeracy, even controlling for time fixed effects, region fixed effects, time and region fixed effects and additional control variables such as fame bias and European contact.

## **7. Comparison of Africa and Europe**

Trends in elite numeracy can also be used in intercontinental comparisons. We were curious about how the most successful African principality of the early modern period, Imperial Abyssinia, compared with the least successful regions of Europe of the same period (Figure 10). We found that the East African “success case” of Abyssinia was above Eastern European levels of elite numeracy in the 16th century, with Eastern Europe overtaking Abyssinia later on. Therefore, we can observe that elite numeracy was higher in certain parts

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<sup>17</sup> In seven specifications, regicide remained significant, with a coefficient of substantial size, even if Liberia was excluded (results available from authors).

of Africa than in Eastern Europe during that period. Otherwise, Northwestern Europe (the United Kingdom, the Netherlands and Belgium) was far ahead of both regions, which Keywood and Baten (2020) found to be the result of the relatively low level of elite violence. They found that Europe, on average, started with approximately 10–40 per cent in the sixth century but reached values close to 100 per cent only after the 18th century. In contrast, Africa started experiencing a substantial increase in elite numeracy only during the 18th and 19th centuries (Figure 4, “All Africa”). Could the difference between Europe and Africa be related to elite violence? This reasoning is supported in Figure 11, as violence in Africa increased until the 17th century and only then began to decline, while Europe had a continuous decline in elite violence after the 14th century. In the 17th century, Africa had a level of elite violence of around 16 per cent, while Europe’s rate was only seven per cent. This difference is statistically significant, but in other centuries, the difference was not statistically significant.

## **8. Conclusion**

For the first time, we were able to trace the long-term development and regional differences in elite numeracy and elite violence for African regions in the period from 1400 to the 20th century. To do this, we composed a new data set based on two core concepts of economic and human development, namely, elite numeracy and elite violence. For the former, the share of rulers’ known birth years was identified as a suitable indicator, but we critically assessed it for the economic history of Africa. Among several biases that could have affected this measure, one issue was that African elite knowledge of birth years developed only when Europeans brought literacy and the idea of chronological recording by year. However, we found that this hypothesis ignored that writing and a substantial part of number system knowledge were actually first developed in Africa around the Sahara (in societies such as Ethiopia, around the urban centres of Timbuktu and Gao and in the Sudanese kingdoms) and

were later easily adopted in Angola and the southern region. In contrast, other African societies were hindered by military and interpersonal violence and other factors. We found that for 20 of 39 countries, rulers' birth year was recorded even before 1800 (Table 2) and that the new elite numeracy indicator correlated strongly with existing overall population numeracy estimates for later periods, further justifying its application (Figure 2).

Second, we used the percentage of murdered rulers to gain insight into interpersonal violence among the elite in African societies from 1400 onwards. We found that the absence of violence and high elite numeracy developed jointly in sub-Saharan Africa. Consequently, Hypotheses I through III were confirmed.

Moreover, we observed in an intercontinental comparison that elite violence in Europe declined earlier, and consequently, elite numeracy began to increase earlier. In Africa, this was not the case, which was at least partly caused by the slave trade, as we saw in several case study descriptions in this article.

We discussed case studies such that of Imperial Abyssinia, which developed high elite numeracy in an early period but entered stagnation and slight decline during the 18th and early 19th centuries. The second case study of Ba-Kongo found that this kingdom developed elite numeracy abilities during the 15th and 16th centuries. However, the early advantages of Ba-Kongo declined in the 17th century during a period of increasing violence. Finally, the highly developed early African state of Mutapa flourished in the 16th century, with high elite numeracy and low elite violence. In correspondence with the other cases discussed herein, this trend was reversed in the 17th century with increasing elite violence and declining elite numeracy. In addition, many other African societies were hindered in developing elite numeracy because of military and interpersonal violence or other retarding factors. In summary, the two new measures of elite numeracy and elite violence allow for a much more dynamic picture of quantitative African history, with some regions taking the lead in early development and others falling behind.

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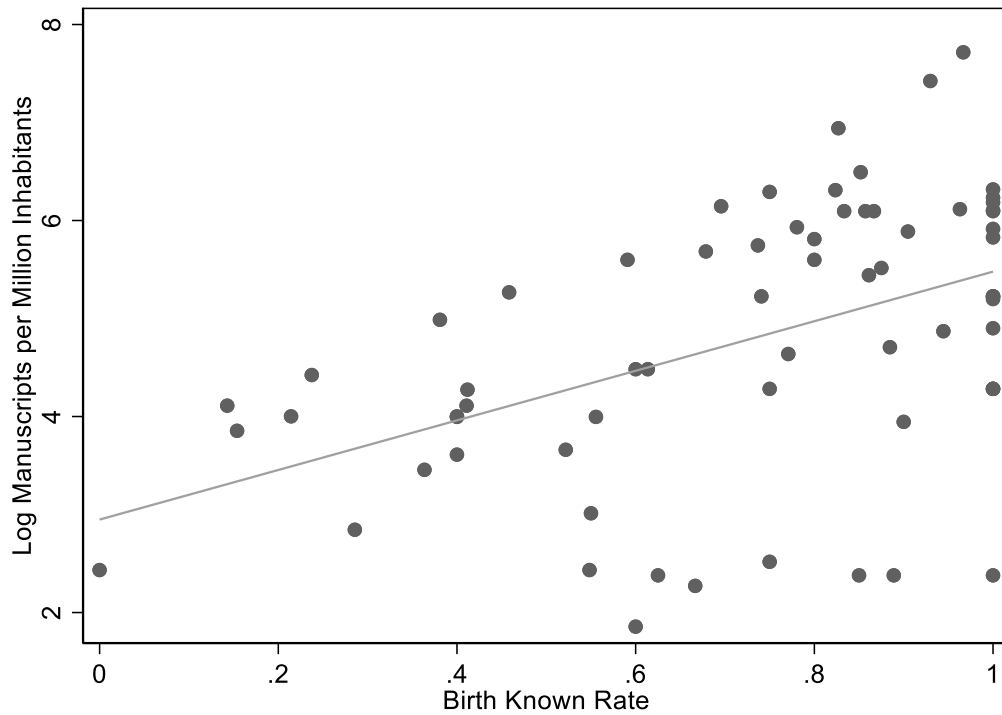
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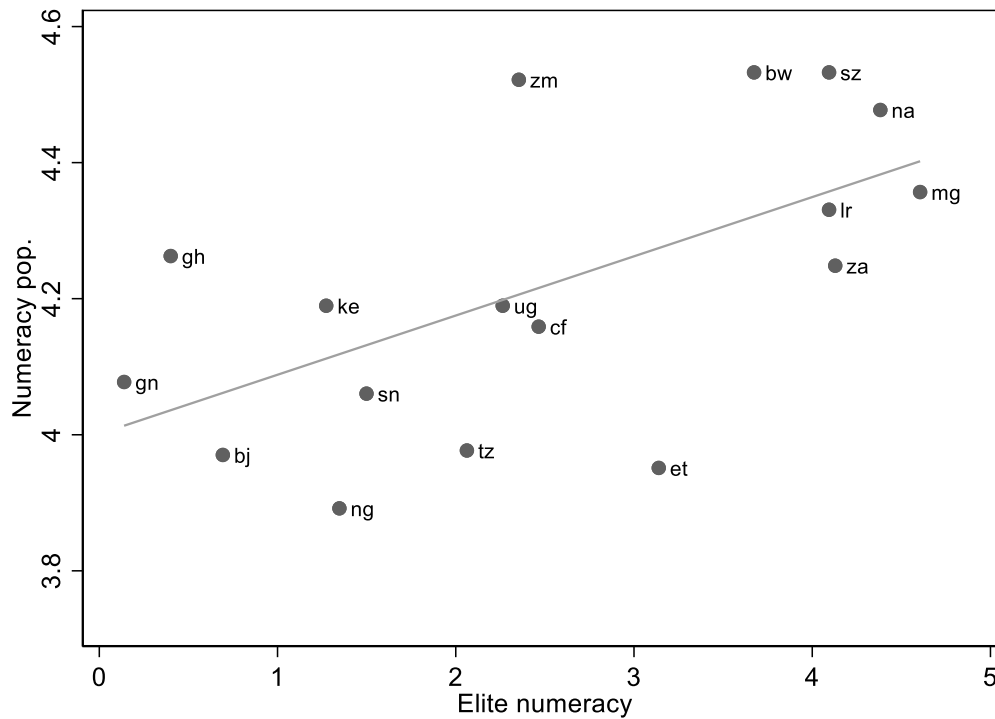


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Figure 1: Manuscripts vs “Birth Known Rate” (11 European countries, 700-1500 CE)



Note: In this figure, we compare the number of monastery transcripts per million inhabitants (Buringh and Van Zanden 2009) with the share of known ruler's birth years for 11 European countries between 700 and 1500 (Figure modified, using Keyword and Baten (2020)).

Figure 2: Comparison of population and elite numeracy in 19<sup>th</sup> century Africa

Note: We compare the overall numeracy of the population as estimated by Cappelli and Baten (2021) for the period around 1900 with the elite numeracy estimates for the 19<sup>th</sup> century as explained in this paper. The two-letter abbreviations follow the ISO-2 standard, for example, ZA=South Africa, SD=Sudan, etc., for the full list see Table 2. Both population and elite numeracy values are in logs of percent. We included only country-and-century units with at least one birth-year-known case before 1800 (see Table 2) in order to ensure sufficiently high measurement quality. On the aggregation by modern country, see Appendix L.

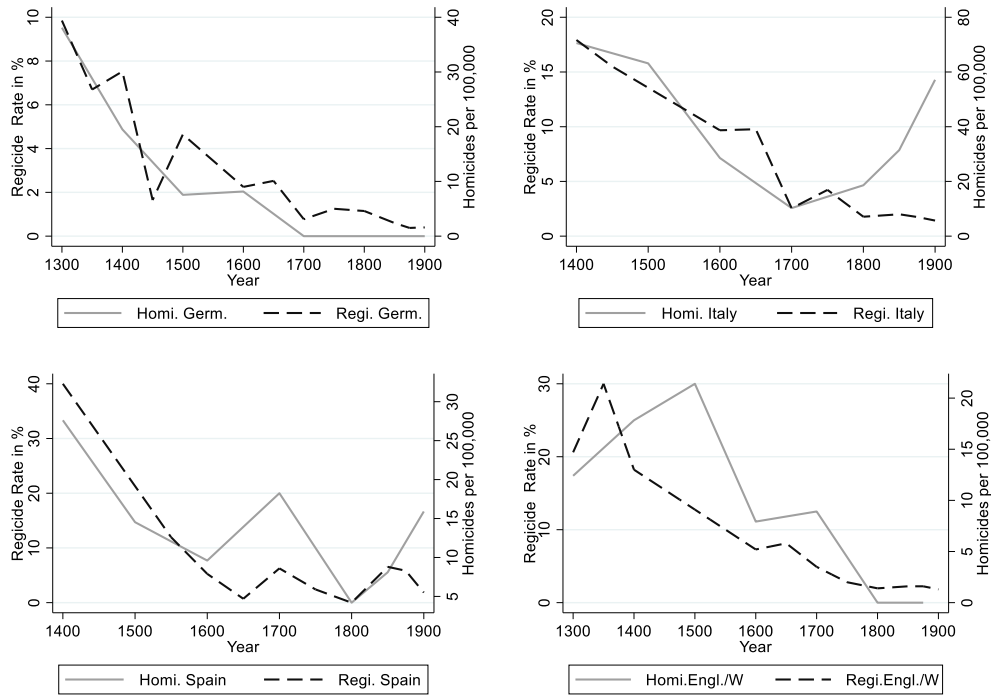


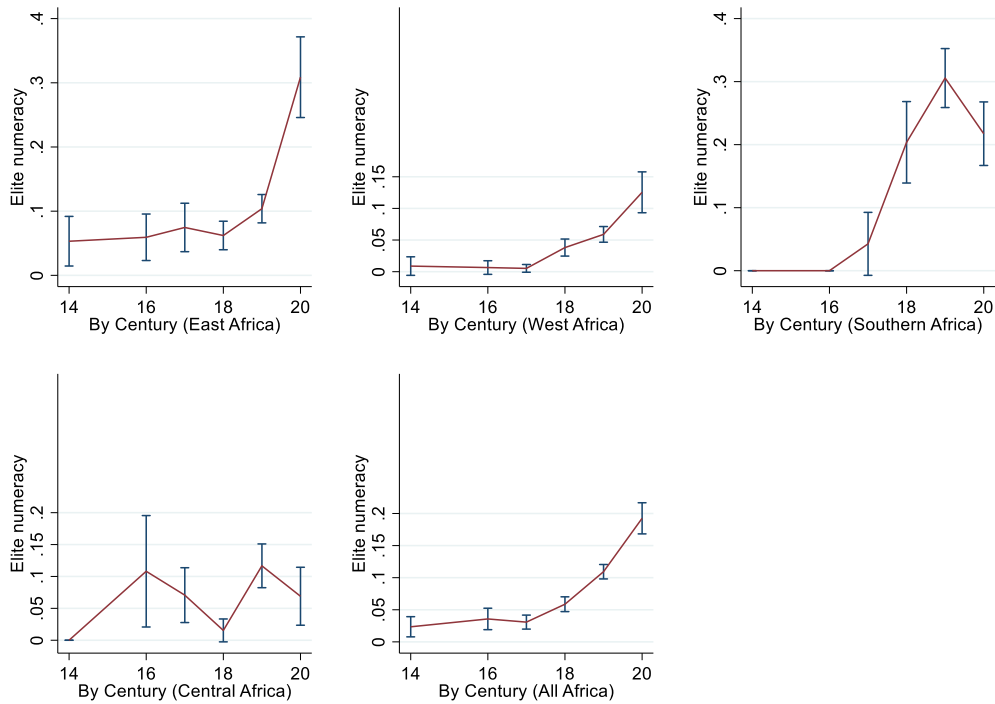
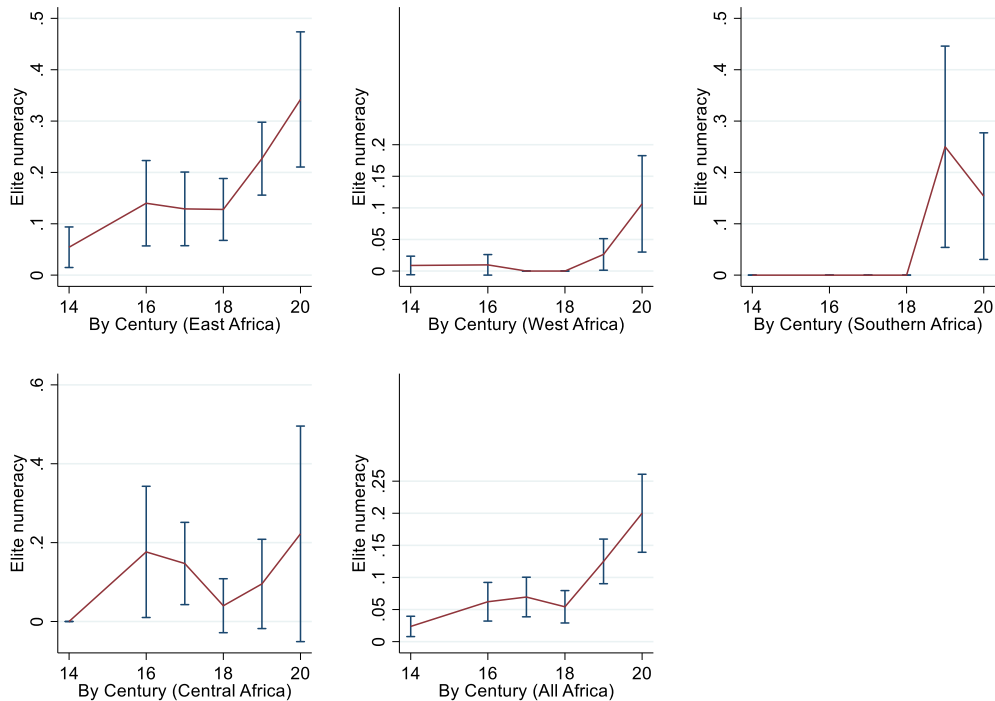
Figure 3: Regicide vs homicide: Evidence for the plausibility of the regicide indicator

(Germany, Italy, Spain, UK, 1300-1900 CE)

Note: The figure shows a decline in violence and the relationship between elite violence (regicide, defined as the share of rulers who were killed) and interpersonal violence (homicide per 100,000 population). *Sources:* Homicide data from Eisner (2014). Regicide: Keyword and Baten (2020). Figure modified, using Keyword and Baten (2020).

Figure 4: Elite numeracy in African regions

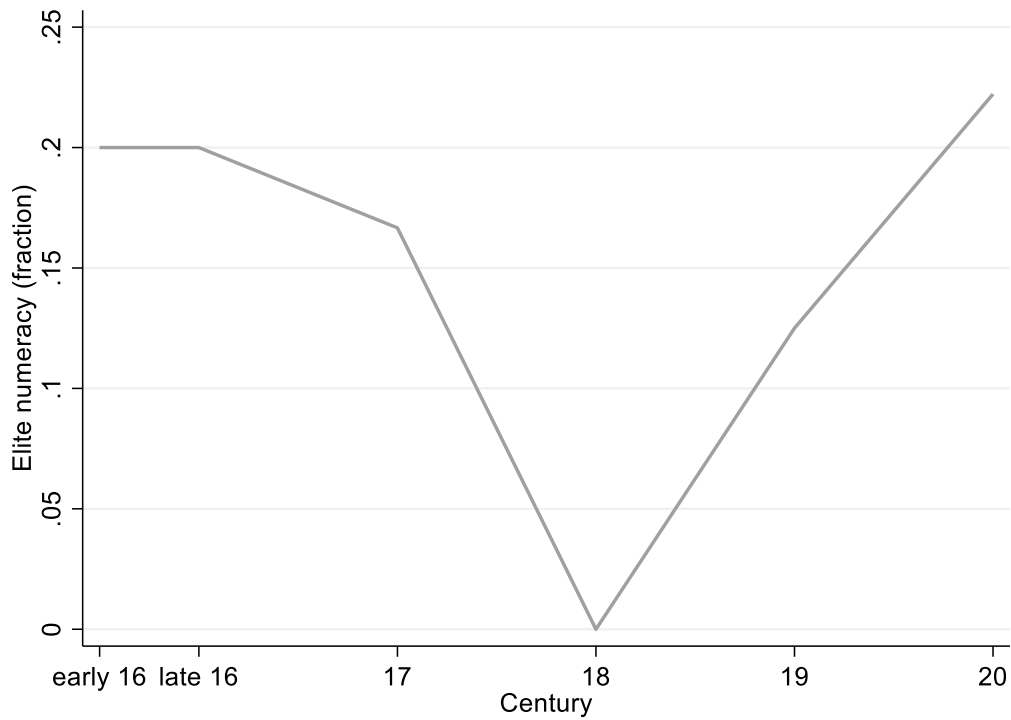
Panel A: all principalities

Panel B: Survivors that already existed in the 14<sup>th</sup>/15<sup>th</sup> century

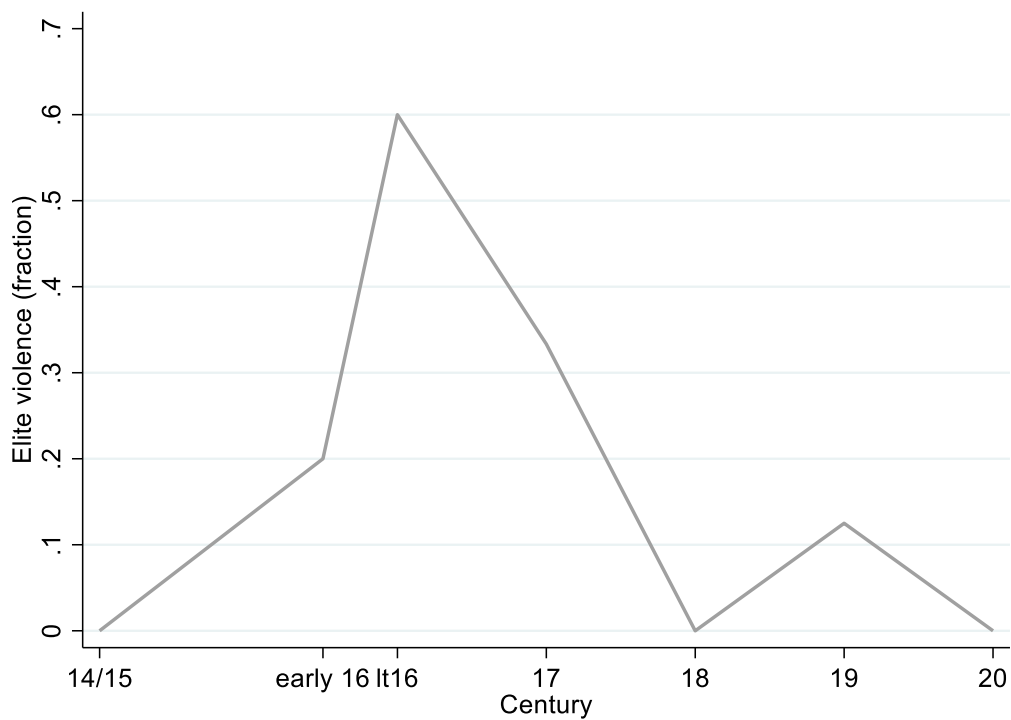
Notes: Confidence intervals refer to the 90% level of significance. We included only country-and-century units with at least one birth-year-known case before 1800 (see Table 2) in order to ensure sufficiently high measurement quality. All century numbers refer to the beginning of a ruler's reign (except "14" for 14<sup>th</sup>/15<sup>th</sup>).

Figure 5: Elite numeracy and elite violence in the Ba-Kongo kingdom

Panel A: Elite numeracy by century



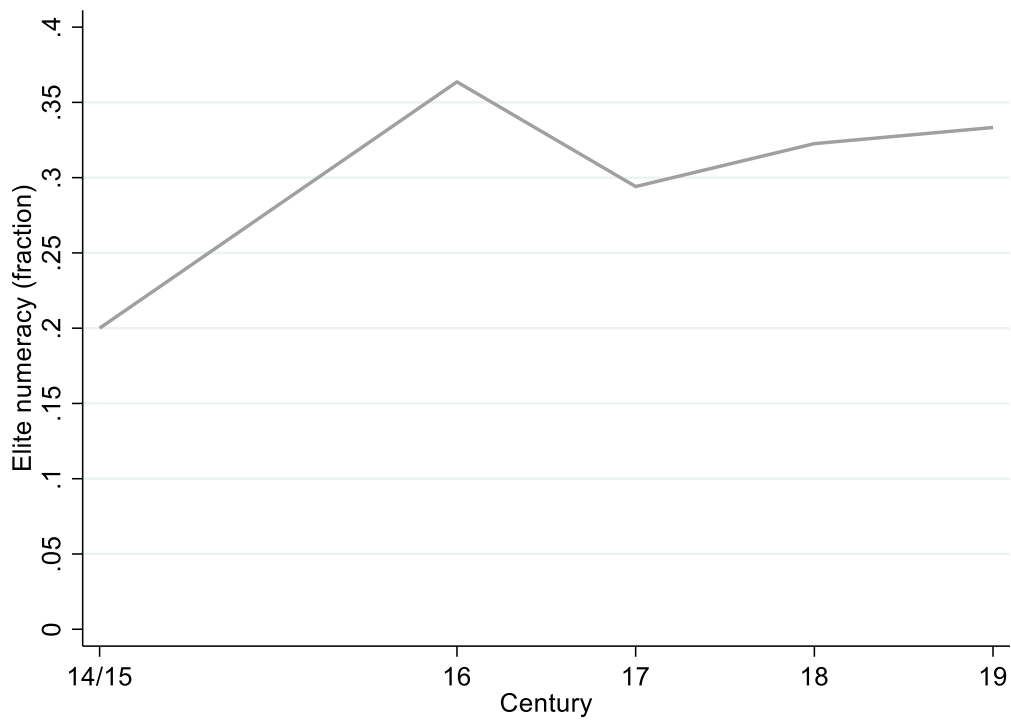
Panel B: Elite violence by century



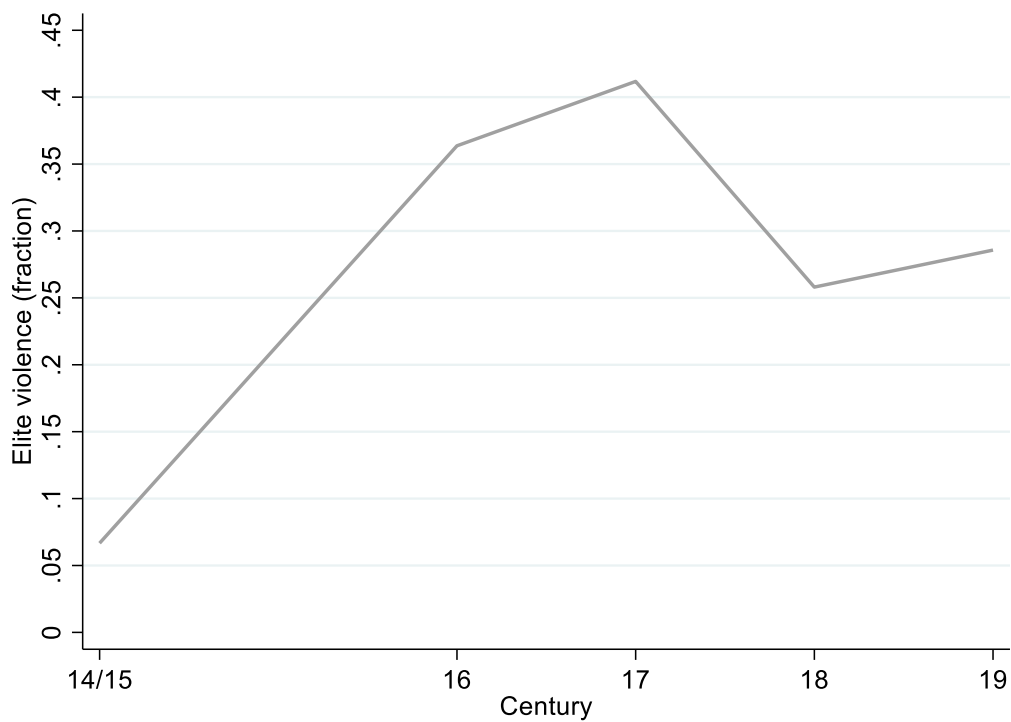
Note: “early 16<sup>th</sup>” century is 1500-49, “lt16” refers to 1550-99. In this figure, we do not claim statistical significance, hence the figure does not include confidence intervals.

Figure 6: Elite numeracy and elite violence in the Abyssinian Empire

Panel A: Elite numeracy by century



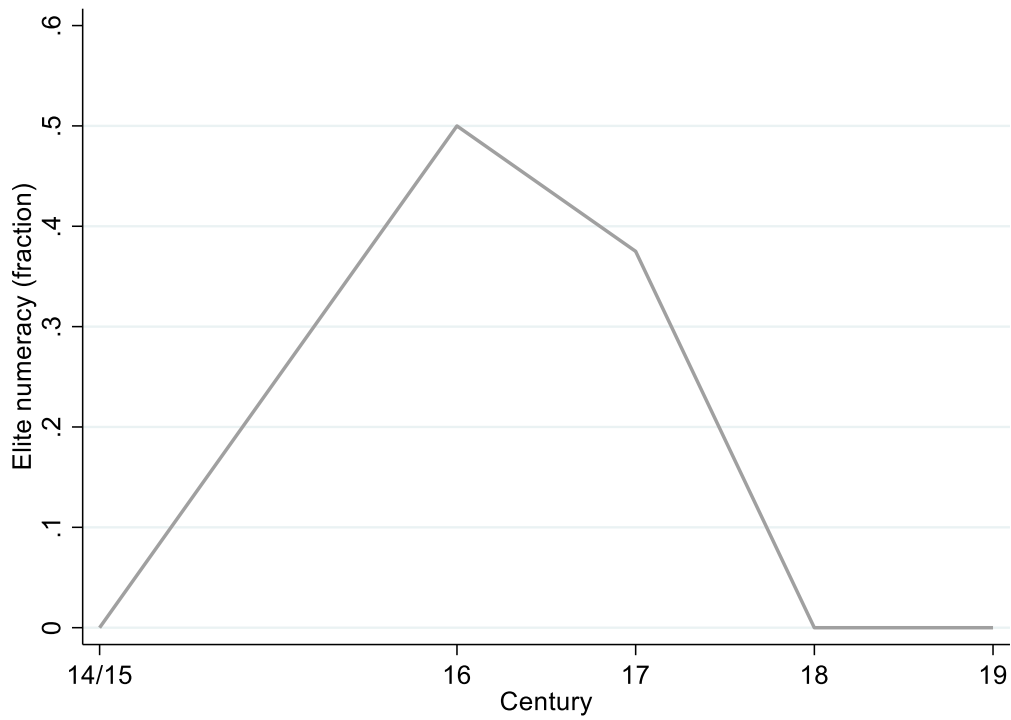
Panel B: Elite violence by century



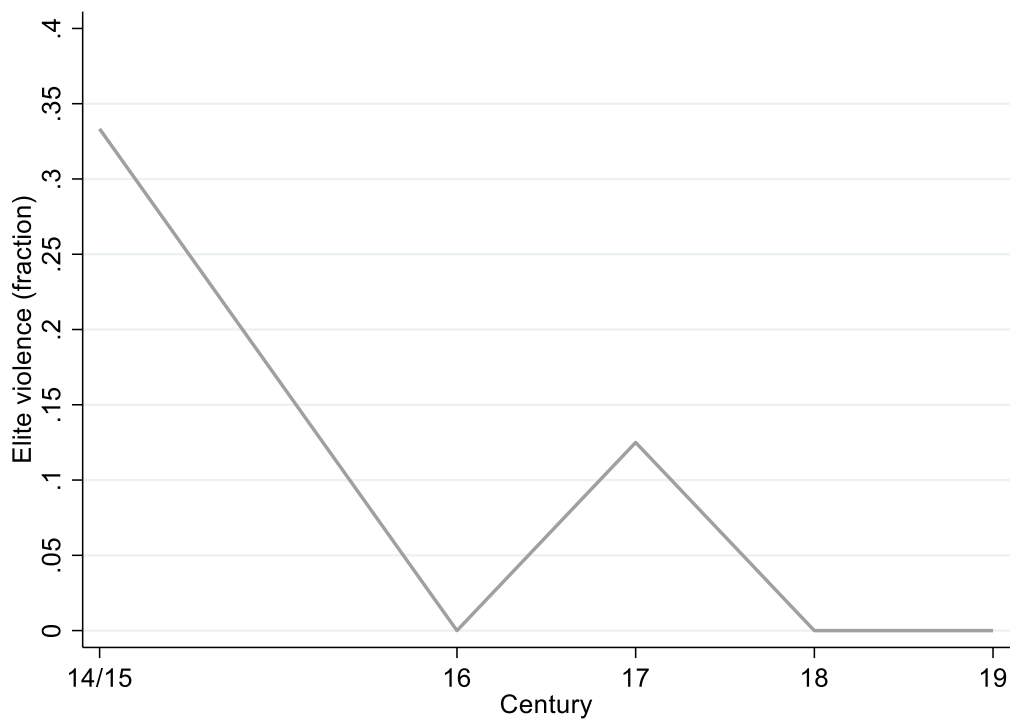
Note: In this figure, we do not claim statistical significance, hence the figure does not include confidence intervals.

Figure 7: Elite numeracy and elite violence in the Mutapa kingdom

Panel A: Elite numeracy by century



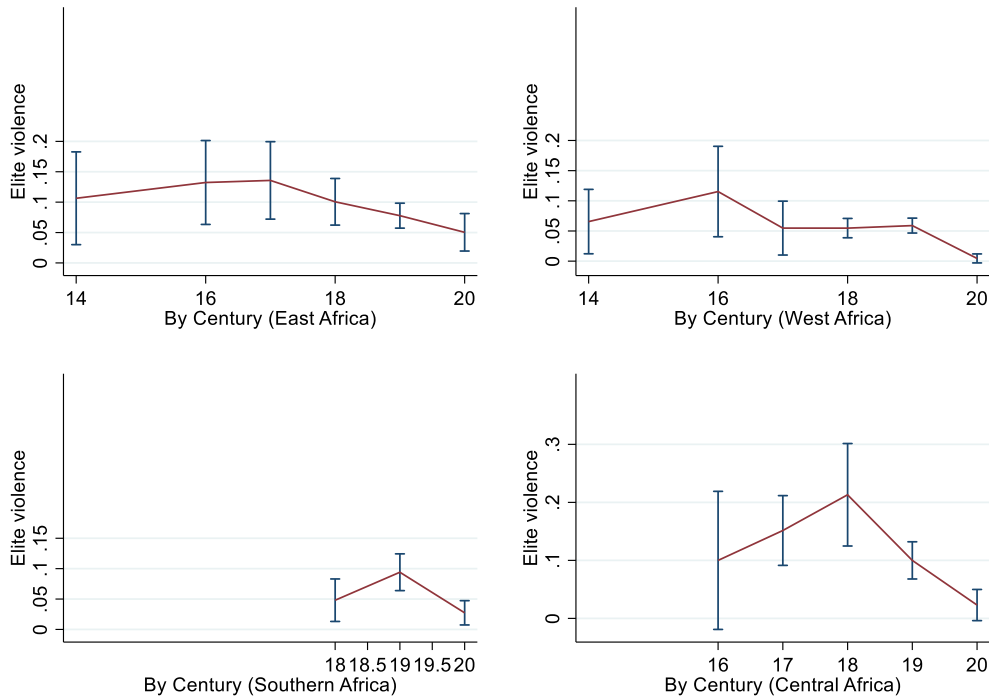
Panel B: Elite violence by century



Note: In this figure, we do not claim statistical significance, hence the figure does not include confidence intervals.

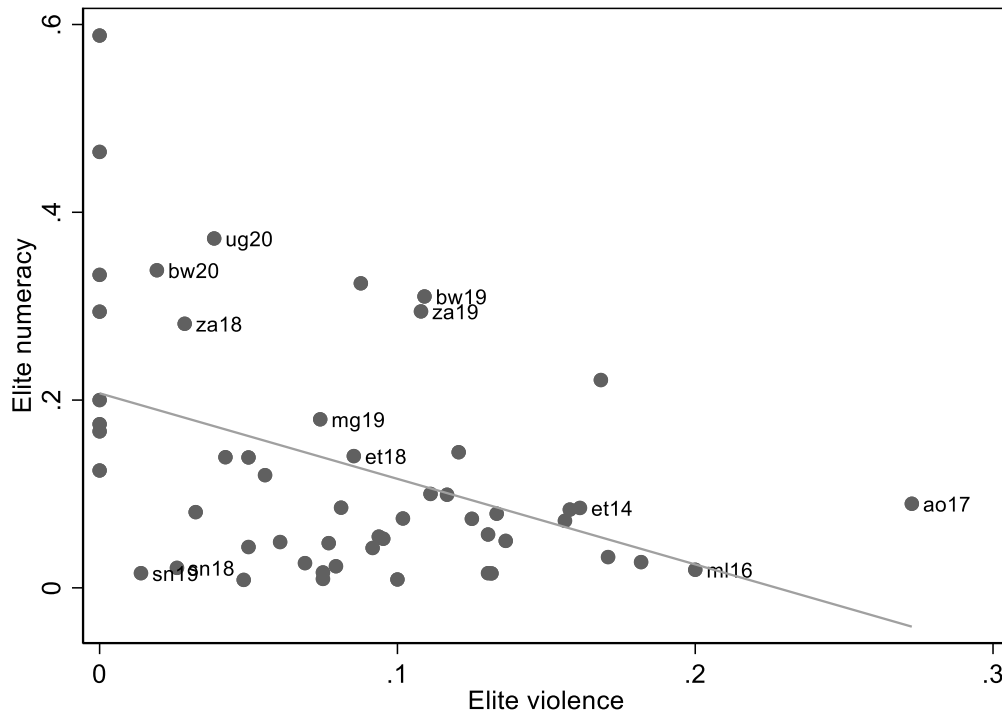


Figure 8: Elite violence in African regions



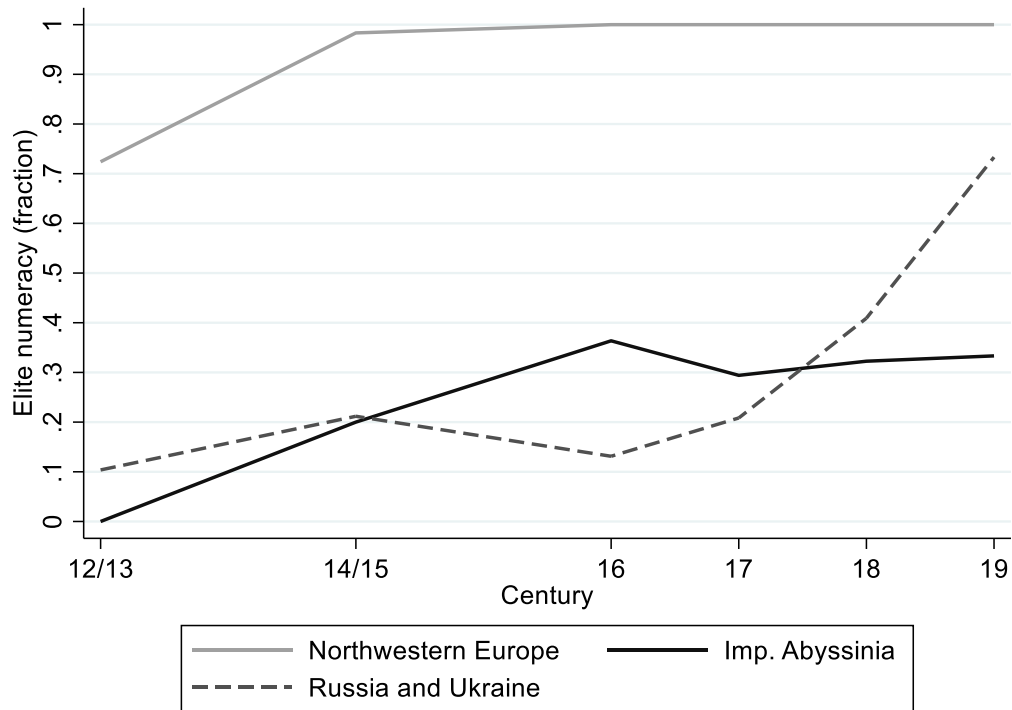
Notes: The indicator is the share of rulers who were killed either in battles or due to interpersonal killing mostly by neighbours or competing nobility. Confidence intervals refer to the 90% level of significance. All century numbers refer to the beginning of a ruler's reign (except "14" for 14<sup>th</sup>/15<sup>th</sup>). We included only country-and-century units with at least one birth-year-known case in order to ensure sufficiently high measurement quality.

Figure 9: Elite violence and elite numeracy



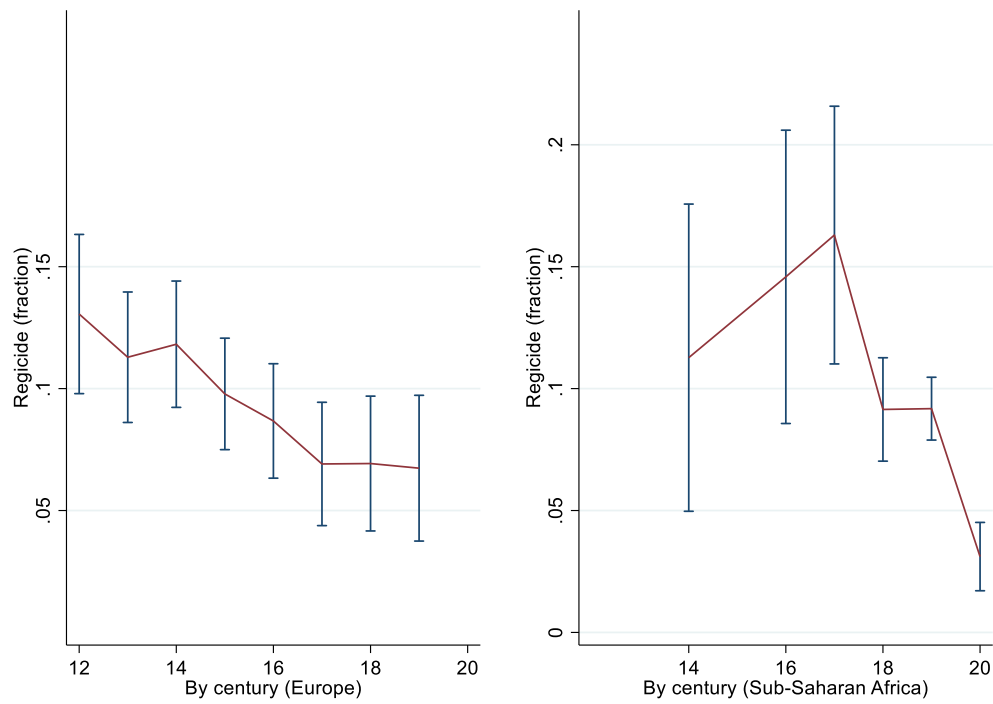
Note: In this Figure, we show the elite violence (based on regicide) and elite numeracy. We included only country-and-century units (before 1500 two-century-units) with at least one birth-year-known case in order to ensure sufficiently high measurement quality. The abbreviations follow the ISO-2 standard combined with the corresponding century, for example, ug20=Uganda in the 20<sup>th</sup> century, bw=Botswana, za=South Africa, mg=Madagascar, et=Ethiopia, sn=Senegal, ml=Mali, ao=Angola, for the full list see Table 2. On the aggregation by modern country, see Appendix L.

Figure 10: Elite numeracy in Imperial Abyssinia compared to selected Eastern and North-western European regions



Note: See notes for Figure 4. Source: Russia/Belarus/Ukraine: an average of Russia, Belarus and Ukraine elite numeracy. Data comes from Rogutskaya (2019) and Keywood and Baten (2020). North-western Europe: UK, Netherlands and Belgium. In this figure, we do not claim statistical significance, hence the figure does not include confidence intervals.

Figure 11: Elite violence in Europe and Africa



Note: Source: see notes for Figure 10. We included only country-and-century units (before 1500 two-century-units) with at least one birth-year-known case for Africa in order to ensure sufficiently high measurement quality.

Table 1. An example page of the data on rulers. Here: The kingdom of Ba-Kongo, 1568-1622

Begin of rule	End of rule	Name	Birth year	Death Year	Killed
1568	1587	Nimi ne Mpangu Lukeni lua Mweba, portug.: Alvaro I.	1542	1587	
1587	1614	Nimi ne Mpangu Lukeni lua Mweba, portug.: Alvaro II.		1614	
1614	1614	Antonio de Silva, Duke of Mweba (Regent, ruled 3 days)		1620	
1614	1615	Nimi ne Mpangu Lukeni, portug.: Bernardo II.		1615	Yes
1615	1622	Mbika Nimi, Duke of Mweba, portug.: Alvaro III.		1622	

Source: Truhart (2002), p. 931.

Table 2: Share of principalities with at least one birth year known before 1800, by country

		Principalities with...			Share of principalities with
		No birthyear known	At least one known	Total	birth year(s) known
Angola	ao	15	3	18	17
Burkina Faso	bf	11	0	11	0
Burundi	bi	1	0	1	0
Benin	bj	12	3	15	20
Botswana	bw	6	2	8	25
Dem. Rep. Congo	cd	13	0	13	0
Central Afric. Rep.	cf	1	0	1	0
Rep. Of Congo (Brazz.)	cg	2	0	2	0
Cote d'Ivoire	ci	11	0	11	0
Cameroon	cm	21	0	21	0
Ethiopia	et	21	10	31	32
Ghana	gh	30	3	33	9
Gambia	gm	2	0	2	0
Guinea	gn	17	1	18	6
Equat.-Guinea	gq	1	0	1	0
Guinea-Bissau	gw	1	0	1	0
Kenya	ke	2	1	3	33
Komoros	km	10	1	11	9
Liberia	lr	0	1	1	100
Madagascar	mg	22	4	26	15
Mali	ml	22	2	24	8
Malawi	mw	12	0	12	0
Mozambique	mz	9	0	9	0
Namibia	na	3	0	3	0
Niger	ne	27	1	28	4
Nigeria	ng	48	0	48	0
Rwanda	rw	10	0	10	0
Sudan	sd	13	3	16	19
Sierra Leone	sl	9	2	11	18
Senegal	sn	12	2	14	14
Somalia	so	5	0	5	0
Eswatini	sz	0	1	1	100
Chad	td	8	0	8	0
Togo	tg	6	0	6	0
Tanzania	tz	28	0	28	0
Uganda	ug	22	1	23	4
South Africa	za	17	6	23	26
Zambia	zm	10	1	11	9
Zimbabwe	zw	10	1	11	9

Notes: We compare the number of principalities with no ruler birth year known before 1800 with those with at least one positive ruler birthyear known case before 1800. Bold cases are those with at least one positive ruler birthyear known case before 1800. On the aggregation by modern country, see Appendix L.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Elite Numeracy	53	0.127	0.127	0.008	0.588
Elite Violence (Regicide)	53	0.084	0.061	0.000	0.273
Fame Bias	53	0.377	0.489	0.000	1.000
Contact	53	0.585	0.497	0.000	1.000
Slave intensity	49	0.170	0.625	0.000	4.240
Centralisation	49	0.392	0.194	0.000	0.769
Slave*Central.	46	-0.007	0.107	-0.177	0.242

Note: The cases included here are based on Table 4, regression specification 1. The source of the slave variable (per area) is Nunn and Wantchekon (2011), and we also used Micek (2019) who combined Eltis's and Nunn's work to estimate a time-variant version of this factor. Less information is available for the Red Sea and the Trans-Saharan slave trade, but this was also very concentrated on very few countries like Ethiopia, Sudan and Chad. Centralisation is based on Alsan (2015) and her sources. For European contact, please see Appendix J. Fame, birth known (elite numeracy) and regicide: see text. On the aggregation by modern country, see Appendix L.



Table 4: Potential correlates of elite numeracy (8 Regressions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Elite violence (regicide)	-8.39*** (0.006)	-8.02*** (0.009)	-8.34*** (0.007)	-8.03** (0.011)	-7.49** (0.017)	-7.98** (0.012)	-7.44** (0.035)	-6.25* (0.073)
Fame						-0.02 (0.941)	-0.20 (0.580)	0.50 (0.383)
Slavery								0.02 (0.922)
Centralization								-4.03 (0.112)
Slave*Centr.								-0.73 (0.794)
European contact					0.35 (0.348)		0.40 (0.408)	0.26 (0.611)
Region FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Constant	1.97*** (0.000)	1.98*** (0.000)	1.79*** (0.000)	1.79*** (0.000)	1.37** (0.031)	1.79*** (0.000)	1.37** (0.047)	2.13** (0.020)
Observations	53	53	52	52	52	52	46	46
Adjusted R-squared	0.145	0.134	0.205	0.193	0.192	0.175	0.153	0.254

Notes: P-values in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. All regressions are estimated with robust standard errors, and clustering by country-and-century combinations, which also avoids temporal autocorrelation effects. We also calculated wild boot tests which confirmed the significant negative effect of elite violence for all models. Model 1 only includes elite violence, measured as the share of rulers killed. We assess first a bivariate regression of elite violence and elite numeracy (column 1) and then we add time fixed effects (column 2), region fixed effects (column 3) as well as time and region fixed effects (column 4). We add more control variables such as “fame bias” in column 6 and European contact in column 5, and the slavery-precolonial centralization interaction in column 8. Column 7 restricts that regression in column 5 to the cases that are available in column 8. We included only country-and-century units (before 1500 two-century-units) with at least one birth-year-known case in order to ensure sufficiently high measurement quality. The source of the slave variable is Nunn and Wantchekon (2011), and we also used Micek (2019) who combined Eltis’s and Nunn’s work to estimate a time-variant version of this factor. Less information is available for the Red Sea and the Trans-Saharan slave trade, but this was also very concentrated on very few countries like Ethiopia, Sudan and Chad. Centralisation is based on Alsan (2015) and her sources. For European contact, please see Appendix J. Fame: see text. The coefficients were multiplied by 10 for expository purposes. The variance inflation factors (VIF) are smaller than 10 (hence no severe multicollinearity), although some are in the 2.5-5 range, indicating modest multicollinearity). On the aggregation by modern country, see Appendix L.

Table 5: Spatial autocorrelation does not affect the regicide–elite numeracy correlation

	(1)	(2)	(3)	(4)	(5)	(6)
Distance/bandwidth	250	500	1000	2000	3000	4000
Elite violence	-0.41**	-0.41**	-0.41**	-0.41**	-0.41*	-0.41**
	(0.027)	(0.035)	(0.013)	(0.036)	(0.057)	(0.046)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49	49	49	49	49	49
Adjusted R-squared	0.447	0.447	0.447	0.447	0.447	0.447

Notes: P-values of panel-adjusted Conley standard errors in parentheses using the Hsiao (2010) HAC panel model, which also avoids temporal autocorrelation and heteroskedasticity effects.. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . We consider Conley standard errors for distance cutoff of 250, 500, 1000, 2000, 3000 and 4000 kilometers, which reflect the distances such as 220 km from Lomé (Togo) to Porto Novo (Benin), or almost all the way from Pretoria (South Africa) to Mogadishu (Somalia) in the far Northeast. All regressions are estimated with robust standard errors. All models includes elite violence, measured as the share of rulers killed, time fixed effects, European contact and precolonial centralization. We included only country-and-century units (before 1500 two-century-units) with at least one birth-year-known case in order to ensure sufficiently high measurement quality. Centralisation is based on Alsan (2015) and her sources. For European contact, please see Appendix J. On the aggregation by modern country, see Appendix L.

Table 6: Decomposing into military and interpersonal violence

Interpers. Elite viol.	-12.19**	-12.13**	-14.09***	-14.22**	-13.24**	-14.23**	-13.21**	-11.68
	(0.015)	(0.017)	(0.009)	(0.010)	(0.021)	(0.014)	(0.037)	(0.121)
Military elite viol.	-12.80***	-10.35***	-16.84***	-14.54***	-14.77***	-14.41**	-16.92**	-21.72***
	(0.004)	(0.009)	(0.002)	(0.004)	(0.002)	(0.028)	(0.037)	(0.000)
Fame						-0.03	0.14	0.45
						(0.972)	(0.900)	(0.360)
Slavery								-0.11
								(0.924)
Centralization								-7.43**
								(0.032)
Slave*Centr.								-5.78
								(0.131)
Europ. contact					0.40		0.23	-0.40
					(0.576)		(0.830)	(0.595)
Region FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Constant	2.53***	2.58***	2.56***	2.68***	2.14	2.68***	2.29	3.85***
	(0.000)	(0.000)	(0.001)	(0.003)	(0.100)	(0.004)	(0.141)	(0.009)
Observations	29	29	28	28	28	28	24	24
Adjusted R-squared	0.201	0.194	0.178	0.158	0.132	0.116	-0.026	0.272

Note: Notes: P-values in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . All regressions are estimated with robust standard errors, and clustering by country-and-century combinations, which also avoids temporal autocorrelation effects. Model 1 only includes elite violence, interacted with (a) peace periods (“interpersonal”) and (b) war periods (“military”) measured as the share of rulers killed. We assess first a bivariate regression of elite violence and elite numeracy (column 1) and then we add time fixed effects (column 2), region fixed effects (column 3) as well as time and region fixed effects (column 4). We add more control variables such as “fame bias” in column 6 and European contact in column 5, and the slavery-precolonial centralization interaction in Column 8. Column 7 restricts that regression to column 5 to the cases that are available in Column 8. We included only country-and-century units (before 1500 two-century-units) with at least one birth-year-known case in order to ensure sufficiently high measurement quality. The source of the slave variable is Nunn and Wantchekon (2011), and we also used Micek (2019) who combined Eltis’s and Nunn’s work to estimate a time-variant version of this factor. Less information is available for the Red Sea and the Trans-Saharan slave trade, but this was also very concentrated on very few countries like Ethiopia, Sudan and Chad. Centralisation is based on Alsan (2015) and her sources. For European contact, please see Appendix J. Fame: see text. The coefficients were multiplied by 10 for expository purposes. On the aggregation by modern country, see Appendix L.

## Appendix A: List of principalities

Appendix Table A.1 Which principalities were included for a certain country and time unit?

Notes: “14” refers to beginning of rule in the 14<sup>th</sup> and 15<sup>th</sup> centuries, 16 to beginning of rule in the 16<sup>th</sup>, 17 to 17<sup>th</sup> etc.

“nc” (and the third column in general) stands for the number of cases of rulers in the raw data set.

The spelling differs by source quite dramatically, we excuse for any inconsistency with other spelling preferences. If possible, we adopted here the spelling used in Truhart (2002) who undertook the largest effort in data collection. We excuse for any political incorrectness of changes of spelling suggested by ethnic groups since then – please remember that this is a historical study, hence the historical terms have the advantage to allow identifying a principality if it should be compared with other historical sources, for example.

We compared with many other sources, such as for other African regions, we used “*the biographic encyclopaedia of Africa*”. We also drew on historical dictionaries such as, for example, the “*Historical Dictionary of Lesotho*” (Haliburton, 1977) and the “*Historical Dictionary of Namibia*” (Grotper, 1994), as well as the “*Dictionary of African Historical Biography*” (Lipschutz and Rasmussen, 1978), worldstatesmen.org, and the “*Encyclopaedia of Southern Africa*” (Rosenthal, 1973).

cent2	principality	nc
Angola		
14	Ba-Kongo	5
14	N'Dongo	2
16	Ba-Kongo	10
16	Kalembe	1
16	Kasanye	2
16	Mbamba	1
16	N'Dongo	3
16	Ngalangi	1
17	Ba-Kongo	24

17 Ba-Yaka	3
17 Bailundu	1
17 Biye	2
17 Cingolo	2
17 Ciyaka	5
17 Cuanhama	1
17 Kalembe	3
17 Kasanye	5
17 Mbamba	6
17 Mbata	1
17 N'Dongo	5
17 N'Dulu	1
17 Ndembu	4
17 Ngalangi	2
17 Nsundi	2
18 Ba-Kongo	12
18 Ba-Yaka	1
18 Bailundu	6
18 Biye	6
18 Cingolo	7
18 Ciyaka	11
18 Cuanhama	1
18 Kalembe	5
18 Kalukembe	3
18 Mbata	1
18 N'Dulu	6
18 Ngalangi	3
18 Nsundi	1
18 Sambu	6
19 Ba-Kongo	8
19 Ba-Yaka	3
19 Bailundu	15
19 Biye	12
19 Cingolo	7
19 Ciyaka	9
19 Cuanhama	10
19 Gumba	1
19 Huambo	12
19 Kalembe	5
19 Kalukembe	6
19 Kasanye	7
19 N'Dulu	7
19 Ngalangi	8
19 Sambu	8
20 Ba-Kongo	9
20 Ba-Yaka	9
20 Bailundu	7

20 Biye	5
20 Cingolo	1
20 Ciyaka	8
20 Cuanhama	3
20 Gumba	6
20 Kalembe	1
20 Kalukembe	1
20 Kasanye	1
20 N'Dulu	8
20 Ngalangi	9
20 Sambu	1
Burkina Faso	
14 Gurma	5
14 Wagadugu	2
14 Yatenga	8
16 Bursuma & Bussuma	1
16 Giti	1
16 Gurma	2
16 Liptako & Dori	2
16 Wagadugu	12
16 Yatenga	9
17 Gurma	3
17 Komono	1
17 Liptako & Dori	1
17 Wa	1
17 Wagadugu	3
17 Yatenga	4
18 Bobo	3
18 Bursuma & Bussuma	2
18 Gurma	4
18 Gwiriko	4
18 Komono	5
18 Tyefo	7
18 Wa	1
18 Wagadugu	5
18 Yatenga	4
19 Bilanga	3
19 Bilayanga	1
19 Bobo	7
19 Bongadini	2
19 Bursuma & Bussuma	3
19 Con	2
19 Gurma	6
19 Gwiriko	9
19 Komono	4
19 Kuala	2
19 Lalle	1

19	Liptako & Dori	9
19	Macacoali	4
19	Pamma	2
19	Piala	4
19	Salmatenga	1
19	Tyefo	5
19	Wa	1
19	Wagadugu	9
19	Yatenga	16
20	Bilanga	5
20	Bobo	1
20	Con	4
20	Gurma	2
20	Gwiriko	1
20	Komono	1
20	Kuala	3
20	Liptako & Dori	5
20	Macacoali	10
20	Pamma	5
20	Piala	3
20	Tyefo	5
20	Wa	3
20	Wagadugu	3
20	Yatenga	4
Burundi		
16	Burundi	4
17	Burundi	4
18	Burundi	5
19	Burundi	4
20	Burundi	65
Benin		
14	(Adja-)Tado	1
14	Mitsamihuli	1
16	Allada	1
16	Hamahame	1
17	Abomey	5
17	Adjatshe Ibo	1
17	Allada	3
17	Dassa	1
17	Hamahame	1
17	Ketu	3
17	Nikki	1
17	Savalu	5
17	Widah	4
18	Abomey	8
18	Adjatshe Ibo	9
18	Aledju	2

18	Allada	5
18	Dassa	3
18	Kandi	4
18	Ketu	7
18	Kwande	1
18	Nikki	7
18	Paraku	13
18	Savalu	4
18	Widah	7
19	Abomey	4
19	Adjatshe Ibo	9
19	Aledju	1
19	Allada	2
19	Dassa	6
19	Fitta	1
19	Hamahame	3
19	Itsha	1
19	Kandi	7
19	Ketu	6
19	Kwande	7
19	Mitsamihuli	3
19	Nikki	3
19	Paraku	4
19	Savalu	4
19	Widah	4
20	Abomey	2
20	Adjatshe Ibo	5
20	Aledju	2
20	Allada	3
20	Dassa	2
20	Itsha	2
20	Kandi	3
20	Ketu	3
20	Kwande	6
20	Nikki	9
20	Paraku	4
20	Savalu	3
Botswana		
14	Ba Kgatla	2
14	Ba Malete	3
14	Ba Rolong	1
16	Ba Kgatla	3
16	Ba Kwena (baga Kgabo)	2
16	Ba Malete	2
16	Ba Rolong	3
17	Ba Kgatla	5



17	Ba Kwena (baga Kgabo)	4
17	Ba Malete	1
17	Ba Ngwaketse	3
17	Ba Rolong	3
17	Ba TIokwa	2
17	Ba ma-Ngwato	5
18	Ba Kgatla	6
18	Ba Kwena (baga Kgabo)	6
18	Ba Malete	3
18	Ba Ngwaketse	6
18	Ba Rolong	7
18	Ba TIokwa	5
18	Ba Tawana	1
18	Ba ma-Ngwato	6
19	Ba Kgatla	10
19	Ba Kwena (baga Kgabo)	11
19	Ba Malete	4
19	Ba Ngwaketse	7
19	Ba Rolong	2
19	Ba TIokwa	5
19	Ba Tawana	9
19	Ba ma-Ngwato	10
20	Ba Kgatla	12
20	Ba Kwena (baga Kgabo)	8
20	Ba Malete	5
20	Ba Ngwaketse	9
20	Ba Rolong	9
20	Ba TIokwa	4
20	Ba Tawana	10
20	Ba ma-Ngwato	11
Democratic Republic of the Congo		
14	Ba-Kuba	1
16	Ba-Kuba	2
16	Ba-Luba	3
16	Ba-Lunda	4
16	Kinkondja	1
17	Ba-Luba	3
17	Ba-Lunda	4
17	BaTumbwe	1
17	Mangbetu	1
17	Mwatha Kombana	1
17	Sabanga	1
18	Ba-Kuba	1
18	Ba-Luba	4
18	Ba-Lunda	3

18 BaTumbwe	3
18 Cokwe	6
18 Kinkondja	7
18 Kiombo Mkubwa	3
18 Luapula	5
18 Mangbetu	5
18 Shinge	1
18 Tyo	1
19 Ba-Kuba	5
19 Ba-Luba	9
19 Ba-Lunda	14
19 BaTumbwe	3
19 Kabinda	1
19 Kangu	1
19 Katanga	1
19 Kinkondja	1
19 Kiombo Mkubwa	1
19 Luapula	3
19 Lulua	4
19 Mangbele	3
19 Mangbetu	16
19 Mulenge	4
19 Mwatha Kombana	1
19 Sabanga	1
19 Shi	3
19 Tyo	5
19 Utelele	2
20 Akwa Mushinga	6
20 Akwa N'Dala	2
20 Akwa Samba	4
20 Ba-Kuba	11
20 Ba-Luba	7
20 Ba-Lunda	6
20 BaTumbwe	8
20 Kangu	1
20 Katanga	3
20 Kinkondja	1
20 Kiombo Mkubwa	1
20 Lozo	2
20 Lulua	3
20 Mangbetu	1
20 Mulenge	1
20 Mwatha Kombana	1
20 Niungu	4
20 Shimuna	2
20 Tyo	8

Central African Republic

18 Ezo	2
19 Eliwa	1
19 Ezo	4
19 Malinginda	2
19 Mbomu-Zemio	2
19 Mopoi	2
19 Sasa	1
19 Wando	2
20 Ezo	1
20 Sasa	2
20 Wando	1
Republic of the Congo	
18 Bondo-Gabir	2
18 N'Zakara	2
19 Bondo-Gabir	5
19 Chinko-Rafa'i	4
19 N'Zakara	4
20 Bondo-Gabir	2
20 Chinko-Rafa'i	2
20 N'Zakara	6
Ivory Coast	
14 Abron	2
14 Gonya	1
14 Tenkodogo	1
16 Abron	7
16 Gonya	2
16 Tenkodogo	3
17 Buna	5
17 Gonya	3
17 Krinjabo	1
17 Tenkodogo	6
18 Abenguru	1
18 Abrada	5
18 Abron	4
18 Ashua	1
18 Baule	5
18 Buna	7
18 Euasso	1
18 Gonya	2
18 Kong	3
18 Krinjabo	5
18 Tenkodogo	6
19 Abenguru	10
19 Abrada	3
19 Abron	6
19 Ashua	3
19 Baule	2

19	Buna	6
19	Euasso	7
19	Kong	4
19	Krinjabo	3
19	Tenkodogo	3
20	Abenguru	6
20	Abrada	5
20	Abron	7
20	Ashua	2
20	Baule	1
20	Euasso	2
20	Gonya	1
20	Krinjabo	8
20	Tenkodogo	3
Cameroon		
14	Bamum	4
14	Mandara	2
14	Nso	1
14	Ntem	1
16	Bamum	4
16	Mandara	3
16	Mpongwe	1
16	Nso	1
16	Ntem	1
17	Bamum	2
17	Duala	7
17	Mandara	4
17	Ntem	1
18	(M'Bot-) N'Du	1
18	Aghwi	2
18	Assiga	1
18	Bafut	1
18	Bakweri	1
18	Bamileke	2
18	Bamum	1
18	Bandjun (g)	1
18	Bikom	2
18	Bimbia	5
18	Duala	4
18	Enenga	1
18	Kijem	1
18	Longone-Birni	4
18	Mandara	4
18	Marwa	6
18	Mayumba	1
18	Mpongwe	4
18	Ntem	1

18 Orungu	3
19 (Koncha-) Banyo	2
19 (M'Bot-) N'Du	1
19 Adamawa	4
19 Adyumba	1
19 Aghwi	3
19 Assiga	3
19 Ba Awandji	2
19 Babungo	1
19 Bachama	1
19 Bafreng	1
19 Bafut	1
19 Bakweri	2
19 Balda	1
19 Bali-Kumbad	3
19 Bali-Nyonga	3
19 Bamileke	1
19 Bamum	7
19 Bamunka	1
19 Batta	1
19 Bikom	3
19 Bimbria	2
19 Binder	6
19 Bum	5
19 Duala	6
19 Enenga	1
19 Eshira	1
19 Galwa	2
19 Garwa	1
19 Kijem	2
19 Longone-Birni	2
19 Madagali	1
19 Malimba	1
19 Mandara	3
19 Mankon	2
19 Marwa	6
19 Mayumba	1
19 Mbula	3
19 Mpongwe	7
19 Munggong	3
19 N'Doumou	1
19 Nkomi	3
19 Nso	1
19 Ntem	6
19 Orungu	4
19 Seke	1
20 (Koncha-) Banyo	1

20 (M'Bot-) N'Du	2
20 Adamawa	7
20 Adoumra-Bihene	1
20 Babanki	2
20 Bachama	4
20 Bafut	2
20 Bali-Nyonga	3
20 Bamileke	3
20 Bamum	2
20 Bandjun (g)	3
20 Batta	3
20 Bibemi	1
20 Bimbia	1
20 Bum	1
20 Duala	11
20 Ewondo	2
20 Garwa	2
20 Goulfey	1
20 Longone-Birni	2
20 Madagali	1
20 Mandara	7
20 Mankon	1
20 Mbula	2
20 Mindif	1
20 Munggong	2
20 Nso	4
20 Ntem	5
21 Duala	1
21 Ewondo	1
21 Garwa	1
Ethiopia	
14 Adal	9
14 Addio	1
14 Damot	1
14 Empire	15
14 Hadiya	7
14 Ifat	7
14 Kafa	3
14 Samien	3
14 Sawa	1
16 Adal	3
16 Addio	2
16 Aussa	2
16 Begemder	1
16 Boran	3
16 Bosa	1
16 Empire	11

16 Galla Confederation	9
16 Harrar II	12
16 Kafa	3
16 Madri Bahri	4
16 Samien	5
16 Sawa	2
16 Seka	2
16 Tigre	5
16 Walamo	3
17 Addio	5
17 Amhara	1
17 Aussa	3
17 Begemder	2
17 Bosa	4
17 Damot	3
17 Dawaro	1
17 Empire	17
17 Gimma	1
17 Gojjam	1
17 Harrar III	3
17 Kafa	4
17 Konta	3
17 Madri Bahri	2
17 Samien	3
17 Sawa	1
17 Seka	3
17 Tigre	3
18 Addio	2
18 Amhara	4
18 Aussa	4
18 Begemder	8
18 Bosa	5
18 Damot	1
18 Dawaro	1
18 Empire	31
18 Gojjam	5
18 Harrar III	9
18 Kafa	4
18 Konta	3
18 Maca	2
18 Madri Bahri	9
18 Samien	7
18 Sawa	4
18 Seka	4
18 Tigre	7
18 Walamo	1
18 Wolayta	1

18	Wollo	2
19	Addio	2
19	Amarro	1
19	Amhara	8
19	Aussa	6
19	Begemder	1
19	Bosa	2
19	Damot	6
19	Dawaro	4
19	Empire	21
19	Gera	6
19	Gimma	5
19	Gojjam	12
19	Goma	3
19	Guma	6
19	Gurage	2
19	Harrar III	11
19	Kafa	7
19	Konta	2
19	Leqa	5
19	Limu & Ennarya	5
19	Madri Bahri	19
19	Samien	6
19	Sawa	6
19	Seka	5
19	Tigre	15
19	Walamo	2
19	Wolayta	5
19	Wollo	7
20	Aussa	3
20	Begemder	11
20	Biru	1
20	Damot	1
20	Empire	12
20	Gimma	1
20	Gojjam	10
20	Harrar I	2
20	Harrar III	8
20	Kafa	5
20	Leqa	5
20	Madri Bahri	2
20	Tigre	8
20	Wollo	5
Ghana		
14	Adanse	1
14	Akwamu	1
14	Akyem Abuakwa	2



14 Bono	5
14 Pusiga	1
16 Adanse	5
16 Agona	3
16 Akwamu	7
16 Asebu	1
16 Bono	6
16 Elmina	1
16 Ga-Adangbe	4
16 Gonya	3
17 Adanse	6
17 Adom	2
17 Agona	5
17 Ahanta	1
17 Akron	1
17 Akwamu	6
17 Akwapim	4
17 Akyem Abuakwa	2
17 Ankobra	1
17 Ashanti	4
17 Bono	10
17 Dua Yaw-Nkwanta	5
17 Dwaben	4
17 Ga-Adangbe	4
17 Gonya	3
17 Kokofu	9
17 Kpessi	4
17 Sabe	1
17 Sehwi	1
18 Adom	2
18 Agona	6
18 Ahanta	1
18 Akron	1
18 Akwamu	7
18 Akwapim	2
18 Akyem Abuakwa	8
18 Akyem Kotoku	2
18 Ankobra	1
18 Annamabo	1
18 Arbra	1
18 Ashanti	8
18 Bono	2
18 Bonoso	1
18 Dua Yaw-Nkwanta	5
18 Ga-Adangbe	5
18 Gonya	3
18 Komminda	1

18 Kpessi	7
18 Krepi	3
18 Labade	6
18 Manya Krobo	3
18 Nkoranza	3
18 Sabe	4
18 Sehwi	1
18 Tafo	3
18 Wahrale	1
19 Abeasi	1
19 Adanse	7
19 Adjumako	1
19 Adom	2
19 Agona	5
19 Ahanta	7
19 Akwamu	4
19 Akwapim	10
19 Akyem Abuakwa	10
19 Akyem Bosome	5
19 Akyem Kotoku	4
19 Amo Adai	1
19 Ankobra	3
19 Annamabo	1
19 Arbra	5
19 Ashanti	9
19 Assikuma	1
19 Assin Apimenem	2
19 Assin Attendansu	4
19 Bantama	1
19 Bekwai	6
19 Bono	6
19 Bonoso	2
19 Didiyasi	1
19 Dua Yaw-Nkwanta	6
19 Dwaben	5
19 Edweso	2
19 Ekumfi	4
19 Elmina	1
19 Fante Confederation	3
19 Fantyn	2
19 Fiaso	3
19 Ga-Adangbe	7
19 Gonya	4
19 Kokofu	5
19 Komminda	1
19 Kpessi	4
19 Krepi	7

19	Kwaku Aputai	1
19	Manya Krobo	4
19	Nkoranza	3
19	Oguaa	4
19	Sabe	3
19	Sehwi	2
19	Wahrale	6
19	Wassa	1
20	Adanse	2
20	Agona	6
20	Ahanta	3
20	Akwamu	3
20	Akwapim	14
20	Akyem Abuakwa	10
20	Akyem Kotoku	3
20	Amanfi	1
20	Annamabo	1
20	Arbra	1
20	Ashanti	4
20	Assin Apimenem	2
20	Bono	9
20	Dormaa Ahenkro	1
20	Dua Yaw-Nkwanta	5
20	Dwaben	1
20	Ekumfi	4
20	Elmina	1
20	Fantyn	1
20	Fiaso	2
20	Ga-Adangbe	5
20	Gonya	11
20	Idoma	3
20	Krepi	4
20	Mampong	1
20	Manya Krobo	3
20	Nkoranza	2
20	Sabe	1
20	Sehwi	1
20	Wam	1
21	Krepi	1
Gambia		
16	Wuli	1
17	Kombo	1
17	Wuli	1
18	Wuli	2
19	Badibu	4
19	Kombo	2
19	Marabut State (Brit. Gambia)	2

	19 Nyumi	3
	19 Wuli	3
Guinea		
	14 Samburu	1
	16 Fukumba	2
	16 Samburu	5
	17 Dembelia-Sinkunia	2
	17 Fukumba	3
	17 Khasso	6
	17 Labe	1
	17 Landuma	1
	17 Samburu	4
	17 Solimana	3
	17 Timbi-Tunni	1
	18 Bakia	1
	18 Bramaya	1
	18 Dembelia-Sinkunia	4
	18 Folosaba-khori	2
	18 Fukumba	8
	18 Futa-Dyallon	13
	18 Kankan	1
	18 Khasso	4
	18 Koba	4
	18 Labe	9
	18 Landuma	1
	18 Morea	1
	18 Nalu	1
	18 Sankaran	1
	18 Solimana	5
	18 Timbi-Tunni	6
	18 Tya	2
	19 Bakia	1
	19 Bramaya	2
	19 Dembelia-Sinkunia	6
	19 Dubreka & Tombo	9
	19 Folosaba-khori	6
	19 Fukumba	7
	19 Futa-Dyallon	39
	19 Gobir	1
	19 Gumba	2
	19 Kanea	4
	19 Khasso	10
	19 Koba	5
	19 Labe	14
	19 Landuma	7
	19 Morea	5
	19 Nalu	4

19 Samburu	7
19 Sankaran	4
19 Sanu	4
19 Solimana	7
19 Timbi-Tunni	2
19 Tya	7
20 Fukumba	2
20 Futa-Dyallon	3
20 Gobir	14
20 Khasso	2
20 Timbi-Tunni	3
Equatorial Guinea	
18 Benga	2
19 Benga	10
19 Bubi	3
20 Bubi	3
Guinea-Bissau	
14 N'Gabu	5
19 N'Gabu	5
Kenya	
14 Bata	6
16 Bata	3
16 Mombasa	6
16 Siyu	1
17 Bata	5
17 Mombasa	5
18 Bata	10
18 Mombasa	7
19 Bata	10
19 Faza	1
19 Kitutu	3
19 Masai	4
19 Mombasa	10
19 Nandi (Brit.Kenya)	3
19 Siyu	3
19 Wanga	3
19 Witu	4
20 Masai	1
20 Nandi (Brit.Kenya)	1
Comoros	
14 Domba	1
14 Wasili	1
16 Ansuani	4
16 Badgini	1
16 Bambao	2
16 Itsandra	1
16 M'Bwankuu	1

16	Mayuta	3
17	Ansuani	5
17	Badgini	1
17	Bambao	1
17	Hambuu	1
17	M'Budi	1
17	Mayuta	3
17	Mwali	1
17	Wasili	1
18	Ansuani	6
18	Bambao	2
18	Itsandra	1
18	Mayuta	4
18	Mwali	1
19	Ansuani	18
19	Badgini	6
19	Bambao	13
19	Hambuu	3
19	Itsandra	10
19	M'Budi	4
19	Mayuta	7
19	Mwali	15
20	Mwali	1
Liberia		
18	Republic of Liberia	3
19	Republic of Liberia	28
20	Republic of Liberia	17
19	abaPhuti	1
Madagascar		
14	Imerina	4
16	Ambohitrabiby	2
16	Ikongo	1
16	Imamo	1
16	Imerina	5
16	Maroserana Kingdoms	2
16	Matitana	5
16	Menabe	1
17	(I)Boina	1
17	Antafaisy	1
17	Arindrano	1
17	Bara	1
17	Imamo	2
17	Imerina	5
17	Isandra	1
17	Lalangina	1
17	Linta	1
17	Manandriana	1

17	Maroserana Kingdoms	1
17	Matitana	2
17	Onilahy	1
17	Pirate Rule in ile Sainte marie	1
17	Sakatovo	1
18	(I)Boina	9
18	(Later) Menaranda	1
18	Ambohimanga	4
18	Ambohitrabiby	1
18	Ambohitratrimo	2
18	Antafaisy	1
18	Antankarana	3
18	Arindrano	3
18	Bara	2
18	Betsimisaraka	7
18	Fisakana	3
18	Imamo	2
18	Isandra	4
18	Lalangina	2
18	Manandriana	3
18	Menabe	1
18	Merina Empire	1
18	Pirate Rule in ile Sainte marie	1
18	Tananarive	5
19	(I)Boina	5
19	Ampasimina	1
19	Antankarana	3
19	Arindrano	2
19	Bara	1
19	Bara-Iantsantsa	1
19	Bara-Imamono	1
19	Fisakana	1
19	Ikongo	2
19	Isandra	3
19	Lalangina	1
19	Menabe	4
19	Merina Empire	12
19	Ranohitra	2
Mali		
14	Bambuk	2
14	Djenne	14
14	Gumbu	1
14	Mali	16
14	Masina (French Sudan)	6
14	Zagawa	22
16	Bambuk	2

16	Djenne	15
16	Djerma	9
16	Mali	1
16	Masina (French Sudan)	8
16	Timbuktu	7
16	Zagawa	10
17	Barisa	3
17	Djenne	13
17	Djenne-were	30
17	Djerma	9
17	Kaarta	2
17	Mali	2
17	Masina (French Sudan)	9
17	Menaka	1
17	Segu	4
17	Timbuktu	84
18	Barisa	7
18	Cisse	1
18	Djenne	1
18	Djenne-were	4
18	Djerma	2
18	Kaarta	6
18	Kokoro	2
18	Logo	1
18	Masina (French Sudan)	3
18	Menaka	2
18	Mirria	2
18	Segu	8
18	Timbuktu	73
19	Barisa	4
19	Djerma	7
19	Kaarta	7
19	Kenedugu	9
19	Kokoro	4
19	Konkodugu	1
19	Konyakari	1
19	Masina (French Sudan)	8
19	Menaka	6
19	Mirria	10
19	Segu	10
19	Takei	7
19	Timbuktu	8
19	Washa	5
20	Djerma	5
20	Konkodugu	1



20	Konyakari	1
20	Menaka	1
20	Takei	1
20	Timbuktu	1
20	Washa	1
Malawi		
16	Lambya	1
16	Maravi	1
16	Msukwa	1
16	Ngonde	1
17	Lambya	4
17	Maravi	1
17	Msukwa	2
17	Ngonde	3
17	Undi	1
18	Kanyenda	1
18	Lambya	4
18	Msukwa	4
18	Mwa Fulirwa	1
18	Mwase Kasungu	2
18	Ngonde	4
18	Ngoni	1
18	Nkhamanga	5
18	Nthalire	1
18	Undi	1
18	Yao Confederation in Malawi in N- Mozambique	1
19	Kanyenda	2
19	Lambya	5
19	Maravi	1
19	Msukwa	4
19	Mwa Fulirwa	2
19	Mwase Kasungu	5
19	Ngonde	4
19	Ngoni	12
19	Nkhamanga	3
19	Nkhota	4
19	Undi	2
19	Yao Confederation in Malawi in N- Mozambique	7
20	Kanyenda	4
20	Lambya	2
20	Msukwa	1
20	Mwase Kasungu	3
20	Ngonde	2
20	Ngoni	1
20	Nkhamanga	1

## Mozambique

14	Angoche	1
14	Mozambique & Quelimane	2
16	Angoche	1
16	Barwe	1
16	Ma-Danda	1
16	Teve	3
17	Angoche	1
18	*Kitangonya	1
18	*Sancul	1
18	Angoche	1
18	Makua	1
18	Sanga	1
19	*Kitangonya	6
19	*Sancul	10
19	Angoche	7
19	Barwe	6
19	Imbamella	2
19	Makanga	9
19	Makua	1
19	Massangano	6
19	Massangire	4
19	Teve	4
19	amaGaza	5
20	*Kitangonya	1
20	Imbamella	1

## Namibia

16	Herero	2
16	Ovambo Tribes	3
17	Herero	3
17	Ovambo Tribes	5
18	(Uu) Kwambi	1
18	Herero	6
18	Ovambo Tribes	5
19	(O) Ndonga	4
19	(O) ngandjera	1
19	(Uu) Kwambi	1
19	Hei-Khauan	3
19	Herero	4
19	Ovambo Tribes	4
20	(O) Ndonga	4
20	(O) ngandjera	3
20	(Uu) Kwambi	1
20	Herero	7
20	Kwaluudhi	1
20	Ovambo Tribes	6

## Niger

14	Arewa	2
14	Ayuru	1
14	Karakara (Niger)	1
14	Tessawa	4
16	Arewa	3
16	Ayuru	1
16	Dargol	1
16	Dendi	3
16	Karakara (Niger)	1
16	Katarma (Niger)	1
16	Takassaba	2
16	Tessawa	2
17	Adar (Niger)	1
17	Arewa	2
17	Dargol	1
17	Dendi	14
17	Gan	3
17	Hammonat (Niger)	4
17	Katarma (Niger)	8
17	Kel-Illemed	3
17	Komuri	2
17	Konni	1
17	Lissawan	3
17	Muniyo	1
17	Takassaba	4
17	Tessawa	2
18	Adar (Niger)	6
18	Ahmet Confederation (Niger)	1
18	Arewa	6
18	Damagaram	8
18	Damergu (Niger)	2
18	Dargol	2
18	Dendi	5
18	Djugu	1
18	Gan	11
18	Goruol	4
18	Hammonat (Niger)	3
18	Karakara (Niger)	8
18	Katarma (Niger)	4
18	Kel Gress	1
18	Kel Wi Confederation	3
18	Kel-Illemed	3
18	Komuri	7
18	Konni	4
18	Kutus	3
18	Lissawan	2

18 Muniyo	5
18 Say	4
18 Takassaba	1
18 Tampkala (Niger)	1
18 Tegazza	1
18 Tera	7
18 Tessawa	2
19 Adar (Niger)	13
19 Ahmet Confederation (Niger)	4
19 Arewa	6
19 Damagaram	12
19 Damergu (Niger)	4
19 Dargol	3
19 Dendi	9
19 Djugu	7
19 Gamu	2
19 Gan	10
19 Goruol	6
19 Hammonat (Niger)	3
19 Katarma (Niger)	3
19 Kel Gress	6
19 Kel Wi Confederation	6
19 Kel-Illemed	11
19 Komuri	6
19 Konni	6
19 Kutus	9
19 Lissawan	7
19 Maradi	19
19 Mossibi	3
19 Muniyo	10
19 Say	3
19 Takassaba	8
19 Tampkala (Niger)	4
19 Tegazza	18
19 Tera	7
19 Tessawa	3
19 Tsibiri (Niger)	4
20 Adar (Niger)	4
20 Arewa	4
20 Damagaram	4
20 Damergu (Niger)	4
20 Djugu	2
20 Gamu	3
20 Gan	4
20 Goruol	4
20 Hammonat (Niger)	3

20	Karakara (Niger)	1
20	Kel Wi Confederation	2
20	Kel-Illemed	2
20	Komuri	1
20	Konni	1
20	Kutus	1
20	Lissawan	1
20	Maradi	5
20	Muniyo	1
20	Say	2
20	Takassaba	1
20	Tampkala (Niger)	1
20	Tegazza	2
20	Tera	1
20	Tessawa	1
20	Tsibiri (Niger)	4
Nigeria		
14	Bedde	1
14	Benin	8
14	Biram	2
14	Dagomba	3
14	Doma	1
14	Fika	6
14	Ile Ife	1
14	Kano	14
14	Katsina	11
14	Mamprusi	1
14	Mossi States	4
14	Nupe*	3
14	Oyo	1
14	Warri Iselema	1
14	Yawuri	6
14	Zamfara	7
14	Zaria	2
16	Benin	3
16	Biram	5
16	Biyu	2
16	Bonny	1
16	Dagomba	1
16	Doma	1
16	Fika	2
16	Idoani	2
16	Ijebu	1
16	Jukun*	1
16	Kano	8
16	Katsina	9
16	Kebbi	4

16 Nembe	1
16 Nupe*	1
16 Onitsha	2
16 Oyo	1
16 Warri Iselema	1
16 Yawuri	9
16 Zamfara	8
16 Zauzau	15
17 Akwa Akpa	1
17 Benin	7
17 Biram	1
17 Biyu	4
17 Bonny	3
17 Dagomba	1
17 Doma	1
17 Fika	6
17 Idoani	5
17 Igala	1
17 Jukun*	6
17 Kano	10
17 Katsina	6
17 Kebbi	10
17 Lagos	2
17 Mamprusi	3
17 Nembe	3
17 Nupe*	4
17 Saka	3
17 Warri Iselema	2
17 Yawuri	10
17 Zamfara	7
17 Zaria	9
17 Zauzau	4
18 Akwa Akpa	1
18 Awome	2
18 Bedde	1
18 Benin	5
18 Biram	4
18 Biyu	9
18 Bonny	4
18 Bussa	5
18 Bwarat	1
18 Dagomba	5
18 Daura & Daura-Zango	1
18 Doma	9
18 Fika	7
18 Fulbe	1
18 Gambaga	1

18 Gumel	4
18 Ibadan	2
18 Idoani	5
18 Igala	4
18 Ile Ife	1
18 Jukun*	2
18 Kano	7
18 Katsina	5
18 Kebbi	5
18 Keffi*	1
18 Lafia	1
18 Lafiagi	1
18 Lagos	4
18 Mamprusi	2
18 Mundang	5
18 Nembe	5
18 Ningi	1
18 Nupe*	15
18 Obioko	1
18 Obutong	7
18 Oshogbo	2
18 Oyo	7
18 Pai	1
18 Warri Iselema	2
18 Yawuri	2
18 Zamfara	12
18 Zaria	16
19 Abeokuta	9
19 Abuja & Dependent Chiefdoms	3
19 Agaie	4
19 Akwa Akpa	9
19 Argungu	6
19 Aribinda	1
19 Awome	2
19 Bauchi	5
19 Baure	11
19 Bedde	5
19 Benin	5
19 Bida	12
19 Binder	6
19 Biram	1
19 Biyu	3
19 Bonny	10
19 Bussa	5
19 Bwarat	3
19 Dagomba	7
19 Daura & Daura-Zango	7

19 Dawa-Zango	9
19 Doma	3
19 Fika	14
19 Fitri	1
19 Fulbe	7
19 Gambaga	2
19 Gombe	8
19 Gumel	9
19 Gwandu	12
19 Hadejia & Dependent States	12
19 Ibadan	5
19 Idoani	5
19 Igala	4
19 Igbo Okwu	1
19 Ijaye	1
19 Ijebu-Ode	5
19 Ijesha	17
19 Ile Ife	4
19 Ilorin	8
19 Jama'a	10
19 Jama'ari	5
19 Jukun*	5
19 Katagum & Shira	7
19 Katsina	9
19 Kazaure	4
19 Kebbi	3
19 Keffi*	7
19 Kontagora	3
19 Lafia	10
19 Lafiagi	10
19 Lagos	8
19 Lapai	7
19 Mamprusi	4
19 Missau	6
19 Mundang	6
19 Muri	8
19 Nassarawa	5
19 Nembe	8
19 Ningi	3
19 Nupe*	3
19 Obioko	8
19 Oke-Ona	2
19 Onitsha	3
19 Opobo	3
19 Oyo	10
19 Pategi	5
19 Potiskum	6



19 Sabu'n Birni	9
19 Shonga	3
19 Sokoto	11
19 Warri Iselema	7
19 Wase	14
19 Yawuri	8
19 Yoruba Confederations	2
19 Zamfara	11
19 Zaria	14
20 Abeokuta	3
20 Abuja & Dependent Chiefdoms	5
20 Agaie	5
20 Akwa Akpa	2
20 Argungu	6
20 Auchi	3
20 Awome	1
20 Bauchi	5
20 Baure	2
20 Bedde	3
20 Benin	1
20 Bida	6
20 Biyu	4
20 Bonny	4
20 Bussa	5
20 Bwarat	2
20 Dagomba	7
20 Daura & Daura-Zango	4
20 Dawa-Zango	3
20 Dikwa	12
20 Fika	3
20 Fitri	1
20 Fulbe	6
20 Gombe	2
20 Gumel	2
20 Gwandu	7
20 Hadejia & Dependent States	5
20 Ibadan	3
20 Idoani	2
20 Igala	7
20 Igbirra	2
20 Igbo Okwu	2
20 Ijebu	5
20 Ijebu-Ode	7
20 Ijebu-Remo	1
20 Ijesha	9
20 Ile Ife	1

20	Ilorin	5
20	Jama'a	6
20	Jama'ari	3
20	Jos	2
20	Jukun*	5
20	Kaiama	5
20	Katagum & Shira	3
20	Katsina	3
20	Kazaure	5
20	Keffi*	7
20	Kontagora	7
20	Koton Karifi	1
20	Lafia	4
20	Lafiagi	5
20	Lagos	7
20	Lapai	4
20	Mamprusi	10
20	Missau	3
20	Mundang	5
20	Muri	4
20	Nassarawa	5
20	Nembe	5
20	Ningi	3
20	Obioko	1
20	Oke-Ona	1
20	Okpe	3
20	Okpoma	1
20	Onitsha	3
20	Opobo	1
20	Oshogbo	2
20	Owo	5
20	Oyo	9
20	Pai	2
20	Pategi	3
20	Potiskum	1
20	Sabu'n Birni	1
20	Sokoto	8
20	Tiv	4
20	Warri Iselema	5
20	Wase	4
20	Yawuri	6
20	Zamfara	4
20	Zaria	6
21	Abuja & Dependent Chiefdoms	1
21	Argungu	1
21	Auchi	1
21	Bussa	1

	21 Ijebu-Remo	1
	21 Muri	1
	21 Shonga	1
Rwanda		
	14 Gisaka	1
	14 Mubari	1
	14 Nduga	1
	14 Rwanda	7
	16 Bushi	1
	16 Rwanda	3
	17 Ngweshe	1
	17 Rwanda	3
	18 Gisaka	2
	18 Rwanda	4
	19 Bushiru	1
	19 Gisaka	2
	19 Kibari	1
	19 Rwanda	4
	19 Rwankeri	1
	20 Buhoma	1
	20 Bukonya	1
	20 Bushiru	2
	20 Bwanamwali	3
	20 Kibari	1
	20 Rwanda	1
Sudan		
	14 Dar Fur	16
	14 Dotawo	4
	14 Makuria	3
	14 Nubia	9
	14 Qarri	1
	16 Dar Fur	3
	16 Qarri	1
	16 Sandi	1
	16 Shilluk	3
	16 Sinnar	8
	16 Taqali	4
	17 Dar Fur	3
	17 Fazugli	2
	17 Kurdufan	2
	17 Qarri	2
	17 Sandi	8
	17 Shilluk	8
	17 Sinnar	9
	17 Taqali	3
	17 Vungaka	1
	18 Dar Fur	8

18	Dar Qimr	2
18	Egyptian Sudan (Mahdi Empire)	2
18	Fazugli	4
18	Kurdufan	3
18	Mirafabi	1
18	Qarri	5
18	Qasm al-Bahr	2
18	Sandi	6
18	Shilluk	8
18	Sinnar	16
18	Taqali	1
18	Vungaka	3
19	Dar Fur	12
19	Dar Qimr	1
19	Dar al-Masalit	3
19	Egyptian Sudan (Mahdi Empire)	57
19	Fazugli	2
19	Gabal Marra	7
19	Mahdi Sudan (Anglo- Egypt.Sudan)	3
19	Mbio	1
19	Mirafabi	2
19	Qarri	1
19	Qasm al-Bahr	2
19	Sandi	1
19	Shilluk	10
19	Sinnar	5
19	Tambura	2
19	Taqali	9
19	Vungaka	4
20	Dar Qimr	1
20	Dar al-Masalit	3
20	Mbio	1
20	Shilluk	8
20	Tambura	1
20	Taqali	2
20	Vungaka	2
Sierra Leone		
14	Falama	2
16	Bullom	2
16	Bureh	3
16	Karu	2
16	Koya-Temne	3
17	Bullom	2
17	Karu	5
17	Koya-Temne	6
18	Bafodaya	1

18	Banana Island	4
18	Bullom	1
18	Bureh	1
18	Dembelia-Musaia	2
18	Koya-Temne	5
18	Wonkafong	1
18	Yoni	1
19	Aku	3
19	Bafodaya	1
19	Banana Island	1
19	Benna	3
19	Bullom	1
19	Bumban	1
19	Bumpe	6
19	Bureh	1
19	Dembelia-Musaia	5
19	Koya-Temne	14
19	Kpaa Mende Seneghum	3
19	Kpaka	3
19	Lawua	1
19	Maliguia & Rowula	3
19	Mano	2
19	Nieni	2
19	Nongowa	1
19	Panguma	2
19	Samaya	2
19	Shenge	5
19	Tikonko	1
19	Tonko Limba	4
19	Wonkafong	4
19	Yoni	2
20	Bumpe	1
20	Bureh	1
20	Kpaa Mende Seneghum	2
20	Kpaka	4
20	Nongowa	2
20	Safroko	3
20	Tonko Limba	3
Senegal		
14	Dyolof	9
14	Futa Toro	1
14	Salum (Senegal)	1
14	Sine	4
14	Walo	14
16	Baol	3
16	Dyolof	5
16	Futa Toro	6

16 Kayor	3
16 Salum (Senegal)	9
16 Sine	2
16 Walo	11
17 Baol	8
17 Bundu	2
17 Dyolof	4
17 Futa Toro	5
17 Gayaga (French Senegal)	1
17 Kayor	12
17 Salum (Senegal)	9
17 Sine	2
17 Walo	2
18 Almamis	3
18 Baol	8
18 Bundu	9
18 Dyolof	6
18 Futa Toro	24
18 Gayaga (French Senegal)	1
18 Kammera	7
18 Kayor	11
18 Lebu (French Senegal)	1
18 Salum (Senegal)	12
18 Sine	4
18 Walo	8
19 Almamis	80
19 Baol	19
19 Bundu	12
19 Dyolof	17
19 Fuladu	1
19 Kammera	1
19 Kayor	10
19 Lebu (French Senegal)	7
19 Salum (Senegal)	13
19 Sambala (French Senegal)	6
19 Sine	16
19 Walo	10
20 Bundu	3
20 Fuladu	1
20 Salum (Senegal)	5
20 Sine	1
Somalia	
14 Galadi	1
14 Lugh	3
14 Magirtayn	2

14	Maqdisu	11
16	Lugh	1
16	Magirtayn	4
16	Maqdisu	1
16	Tagura	1
17	Magirtayn	3
17	Maqdisu	1
18	Galadi	1
18	Tagura	2
19	Gaba'ad	1
19	Galadi	4
19	Hobyu	1
19	Magirtayn	12
19	Maqdisu	1
19	Rahayta	2
19	Tagura	3
20	Gaba'ad	1
20	Galadi	1
20	Hobyu	2
20	Tagura	3
Swaziland		
17	Swazi Paramount Chiefs (Swaziland)	1
18	Swazi Paramount Chiefs (Swaziland)	4
19	Swazi Paramount Chiefs (Swaziland)	10
20	Swazi Paramount Chiefs (Swaziland)	1
Chad		
14	Bornu	19
14	Bulala	10
14	Kanem	12
14	Kel Ahir Confederation	9
14	Wadai	4
16	Bagirmi	4
16	Bornu	7
16	Bulala	11
16	Kel Ahir Confederation	6
16	Tubu	1
16	Wadai	3
17	Bagirmi	6
17	Bornu	4
17	Bulala	3
17	Keana	5
17	Kel Ahir Confederation	3
17	Tubu	2
17	Wadai	4

18	Bagirmi	6
18	Bornu	7
18	Kanem	1
18	Keana	3
18	Kel Ahir Confederation	15
18	Tubu	3
18	Wadai	3
19	(Dar) Kutu	3
19	Bagirmi	7
19	Bornu	14
19	Keana	6
19	Kel Ahir Confederation	12
19	Tubu	6
19	Wadai	9
20	(Dar) Kutu	1
20	Bagirmi	3
20	Bornu	7
20	Kanem	2
20	Kel Ahir Confederation	5
20	N'Djamena	3
20	Tama	1
20	Tubu	2
20	Wadai	7
20	Zagawa	1
Togo		
16	Anlo	2
17	Anlo	7
17	Genyigba	2
18	Aneho	2
18	Chokossi	1
18	Genyigba	3
18	Kpando	3
19	Agbanankin	1
19	Agwe	10
19	Aneho	11
19	Anlo	3
19	Bassar	2
19	Chokossi	13
19	Genyigba	8
19	Kabu	3
19	Kotokoli	2
19	Kpando	3
19	Kumde	1
19	Porto Seguro	1
19	Togo	3
20	Agbanankin	1



20	Agwe	4
20	Aneho	8
20	Anlo	3
20	Bassar	1
20	Chokossi	3
20	Genyigba	4
20	Kabu	3
20	Kotokoli	2
20	Kpando	3
20	Kpessi	1
21	Anlo	1
Tanzania		
14	Bayangwe	1
14	Kiamtwara	1
14	Kilwa	23
14	Kinyoro	1
14	Kiziba	1
14	Zanzibar	1
14	Zinza	1
16	Bayangwe	1
16	Karagwe	1
16	Kiamtwara	1
16	Kilwa	8
16	Kiziba	1
16	Zanzibar	1
16	Zinza	1
17	Bugabo	2
17	Hadimu Island	1
17	Kiamtwara	3
17	Mafia	5
17	Marangu	3
17	Zanzibar	2
17	Zinza	1
18	(Kwa)Ndali	1
18	(Northern) Bena	1
18	(U)Nyamwezi	1
18	Hadimu Island	4
18	Ihangiro	2
18	Keni	2
18	Kerewe	1
18	Kiboshi	5
18	Kilema	4
18	Kilwa	5
18	Kirua	3
18	Konko	2
18	Mamba	4
18	Marangu	6

18	Mwika	2
18	Ng'uluhe	1
18	Ngulu	2
18	Shamba'a	1
18	Ussuwi	1
18	Zanzibar	2
19	(Bu)Kumbi	1
19	(Bu)Siha	1
19	(Kwa)Ndali	5
19	(Northern) Bena	5
19	(U)Kimbu	4
19	(U)Luguru	3
19	(U)Nyamwezi	7
19	Bugabo	3
19	Bugando	2
19	Buhindi	9
19	Chagga Paramount Chiefs	4
19	Hadimu Island	3
19	Ihangiro	2
19	Itilima	1
19	Karagwe	7
19	Keni	2
19	Kerewe	4
19	Kiamtwara	2
19	Kianja	2
19	Kiboshi	7
19	Kilema	4
19	Kilwa	6
19	Kirua	3
19	Kiziba	1
19	Konko	4
19	Machame	5
19	Mafia	1
19	Mamba	11
19	Marangu	14
19	Maruku	4
19	Masoka	2
19	Mbokomo	4
19	Mkuu	5
19	Moshi	5
19	Msae	3
19	Mugunduko	1
19	Mwagalla	2
19	Mwanza	1
19	Mwika	5
19	Nera	2
19	Ng'uluhe	6

19 Ngoni Mafiti	11
19 Ngulu	9
19 Niussu	1
19 Njambwa	4
19 Pogoro	6
19 Samake	3
19 Shamba'a	7
19 Shinyanga	1
19 Siha	3
19 Sultanate (Zanzibar)	8
19 Tumbalu	4
19 Usseki	2
19 Ussuwi	4
19 West Ussuwi	2
19 Zanzibar	7
19 Zinza	4
20 (Bu) Siha	2
20 (Kwa) Ndali	1
20 (Northern) Bena	5
20 (U) Nyamwezi	3
20 Bugabo	1
20 Bugando	1
20 Buhindi	2
20 Buhungukira	3
20 Busmao	4
20 Chagga Paramount Chiefs	2
20 Ihangiro	1
20 Itilima	1
20 Karagwe	3
20 Kerewe	2
20 Kiamtwara	2
20 Kianja	1
20 Kiboshi	5
20 Kilema	6
20 Kirua	2
20 Kiziba	4
20 Konko	1
20 Machame	5
20 Mamba	3
20 Mara States	7
20 Marangu	3
20 Maruku	1
20 Masoka	1
20 Mbokomo	3
20 Meatu	1
20 Mkuu	1

20	Moshi	2
20	Msae	2
20	Mugunduko	1
20	Mwagalla	2
20	Mwika	4
20	Nera	1
20	Ngulu	1
20	Niussu	5
20	Njambwa	1
20	Nunghu	2
20	Pogoro	3
20	Samake	1
20	Shamba'a	4
20	Shinyanga	2
20	Siha	6
20	Sultanate (Zanzibar)	4
20	United Uhehe	2
20	Usseki	3
20	Ussuwi	1
20	West Ussuwi	1
20	Zinza	7
Uganda		
14	Buganda	9
14	Bunyoro	4
14	Kitara	6
14	Nkore Kingdom	2
14	Tekidi	2
16	Buganda	4
16	Bukooli	1
16	Bunyoro	3
16	Nkore Kingdom	4
17	Buganda	4
17	Bunyoro	4
17	Busiki	2
17	Igara	1
17	Nkore Kingdom	4
17	Nshenyi	1
18	Bugabula	3
18	Buganda	8
18	Bugweri	6
18	Bujumbura	2
18	Bukono	5
18	Bukooli	10
18	Bukwanga Kiki	1
18	Bunha	1
18	Bunyoro	4
18	Busiki	3

18	Buzaaya	2
18	Buzimba	5
18	Igara	1
18	Jopalu	1
18	Kajara	1
18	Luuka	3
18	Nkore Kingdom	4
18	Nshenyi	2
18	Obwera	1
18	Payira	3
18	Rukiga	1
19	Bugabula	5
19	Buganda	10
19	Bugweri	13
19	Buima	2
19	Bukono	6
19	Bukooli	5
19	Bukwanga Kiki	3
19	Bunha	3
19	Bunyoro	9
19	Busiki	11
19	Buzaaya	2
19	Buzimba	11
19	Jopalu	1
19	Kigulu	1
19	Kitagwenda	1
19	Kooki	1
19	Luuka	6
19	Nkore Kingdom	8
19	Nshenyi	1
19	Payira	7
19	Toro	15
20	Bugabula	1
20	Buganda	10
20	Buima	1
20	Bukedi	2
20	Bukwanga Kiki	1
20	Bunyoro	4
20	Busiki	1
20	Busoga Confederation	5
20	Buzaaya	1
20	Kigulu	2
20	Nkore Kingdom	4
20	Payira	3
20	Toro	8
South Africa		
16	Xhosa	1

16	abaThembu	2
16	amaPondo (in Pondoland/Transkei)	1
17	Chainouqua (Khoisan)	4
17	Gorachouqua (Khoisan)	2
17	Gorinhaiqua	2
17	Kochoqua	3
17	Xhosa	7
17	Zulu	1
17	abaThembu	4
18	Awa-Khoi	1
18	Hhurutshe	1
18	Jan Boois & Aman	1
18	Khunwana (in Transvaal)	1
18	Kou-Gwa	1
18	Mthethwa	4
18	Ndwandwe	1
18	Pondomisi	3
18	Quabe	1
18	Thabu N'chu in OFS	3
18	Various Khoisan tribal org	3
18	Xhosa	25
18	Zulu	3
18	abaThembu	5
18	amaHlubi	1
18	amaPondo (in Pondoland/Transkei)	1
18	baPedi	4
18	baThlaping	4
18	haMhaphuli	1
19	Aich-Ai	4
19	Aman	6
19	Awa-Khoi	6
19	Ba-Tlokwa	3
19	East Pondo	2
19	Gami-Nun	1
19	Gei-Khauan	3
19	Gibeon	4
19	Hhurutshe	15
19	Jan Boois & Aman	1
19	Khunwana (in Transvaal)	6
19	Kou-Gwa	4
19	Lobedu	2
19	Mthethwa	3
19	Ndwandwe	2
19	Nyawo	3

19	Pondomisi	6
19	Quabe	2
19	Rehoboth	2
19	Sotho	5
19	Taung	2
19	Thabu N'chu in OFS	6
19	Various Khoisan tribal org	16
19	Venda	7
19	Xhosa	31
19	abaThembu	6
19	amaBhaca	5
19	amaHlubi	3
19	amaNdzundza	6
19	amaPondo (in Pondoland/Transkei)	5
19	baPedi	11
19	baThlaping	17
19	haMhaphuli	2
20	Caprivi	4
20	East Pondo	6
20	Gami-Nun	1
20	Gibeon	3
20	Hhurutshe	17
20	Kavangoland	2
20	Khunwana (in Transvaal)	3
20	Kou-Gwa	1
20	Sotho	6
20	Thabu N'chu in OFS	1
20	Venda	5
20	Xhosa	28
20	abaThembu	8
20	amaBhaca	4
20	amaNdzundza	3
20	amaPondo (in Pondoland/Transkei)	3
20	baPedi	6
20	baThlaping	13
20	haMhaphuli	1
Zambia		
14	Dama	4
16	Dama	4
17	Bemba (Lunda)	3
17	Bu-Lozi	6
17	Dama	3
17	Lubumbu	2
18	Bemba (Lunda)	3
18	Bena-Mukulu	1

18	Bu-Lozi	5
18	Chishinga	3
18	Dama	4
18	Kopa	4
18	Lubumbu	6
18	Lungu	1
18	Ma-Kololo	1
18	Mambwe	4
18	Nsama	1
19	Bemba (Lunda)	10
19	Bena-Mukulu	6
19	Bu-Lozi	6
19	Chiberakunde	2
19	Chishinga	5
19	Dama	4
19	Kopa	6
19	Lubumbu	5
19	Lungu	9
19	Ma-Kololo	11
19	Mambwe	6
19	Ndbele	6
19	Nsama	6
20	Bemba (Lunda)	5
20	Chishinga	1
20	Dama	6
20	Lungu	1
20	Ma-Kololo	8
20	Mambwe	1
20	Ndbele	1
21	Ma-Kololo	1
Zimbabwe		
14	(Butwa-)Torwa	2
14	Changamire	2
14	Mutapa-Rozwi	6
16	Changamire	1
16	Manyika	2
16	Mutapa-Rozwi	4
17	Manyika	2
17	Maungwe	3
17	Mutapa-Rozwi	8
18	Bocha	2
18	Changamire	1
18	Duma	6
18	Govera	1
18	Hera	1
18	Manyika	7
18	Maungwe	4



18	Mutapa-Rozwi	10
18	Nhowe	2
18	Shawasha	2
19	Bocha	1
19	Changamire	4
19	Duma	1
19	Govera	4
19	Hera	1
19	Manyika	7
19	Mari	5
19	Maungwe	7
19	Mutapa-Rozwi	12
19	Nhowe	4
19	Shawasha	7
19	Zezuru	4
20	Manyika	6
20	Nhowe	1
20	Shawasha	1

## **Appendix B: Did a bias arise from source survival in East Africa, esp. Tanzania?**

We would have expected an early elite violence development in the coastal regions of what is today Tanzania, as their principalities were founded by Islamic traders that played an active role in long-distance trade quite early.<sup>18</sup> We do in fact observe that in the interior either fewer polities existed in the earlier period, or nothing is known about them, compared to the coast (Appendix A). Moreover, during the 19<sup>th</sup> and 20<sup>th</sup> centuries, the coastal areas had higher elite numeracy values (Table B.1). However, we observe actually zero elite numeracy both in the coastal and the interior region of Tanzania until the beginning of the 19<sup>th</sup> century. This might be caused by the fact that elite numeracy declined in many Islamic polities during the early modern period, as Baten (2019) observed for principalities in the Middle East. As a consequence, a coastal-interior source survival bias seems unlikely. It might be that some interior principalities existed, but were unreported. However, as these most likely would only have duplicating the few existing principalities of the interior and their zero value, the estimate for the interior until around 1800 would have still remained zero. It is not likely that a principality of the interior that had a substantial elite numeracy would have been completely forgotten, although we would not exclude this possibility.

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<sup>18</sup> Also the slavery history of this region and its Southern neighbors might support this assumption: The slaves were mostly deported from the interior, such as the Lake Malawi region, for example, which might have also contributed to higher elite numeracy in the coastal regions initially. However, during the late 18<sup>th</sup> century, the epicentre of trading activities shifted to Zanzibar, while increasingly more slaves were deported from Mozambique, Madagascar and southern Tanzania, catering to the rapidly growing French demand on Mauritius, Reunion and other colonies (Nunn and Wantchekon 2011). Hence, the negative effects of slave trade were observable in Mozambique in the 18<sup>th</sup> century. The elite numeracy of these East African sources of slaves declined in the 18<sup>th</sup> century. The temporary benefits and the long-run decline of slave-trading kingdoms were driven by the destruction of trust, the import of weapons and the resource curse, which often destroyed any early development (Nunn and Wantchekon 2011).

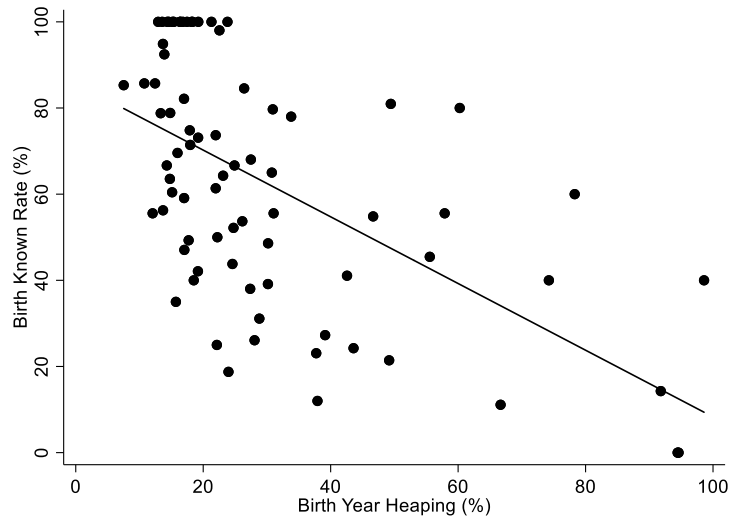
The conclusion that the coastal principalities did not have an elite numeracy advantage before 1800 also corresponds with our observation that in East Africa, the hotspots of early elite numeracy development were mostly in the interior: The early success story of Abyssinia was located in the interior, as well as the centre of the Mutupa Empire (in today's Zimbabwe, Mozambique, and Zambia, which are part of East Africa using the UN definition), the Ma-Kololo kingdom in today's Zambia (originating in today's Botswana), and the Imerina kingdom in central Madagascar. Madagascar is an interesting case, as its textile industries were most competitive in all of East Africa early-on (Clarence-Smith 2014), and during the early 19<sup>th</sup> century, the Imerina kingdom tried to initiate an Industrial Revolution with limited, but not negligible success (Campbell 2005).

Table B.1 Elite numeracy in coastal and interior principalities on the territory of today's Tanzania

Century	Coast	Interior
14/15	0	0
16	0	0
17	0	0
18	0	0
19	0.22	0.04
20	0.21	0.08

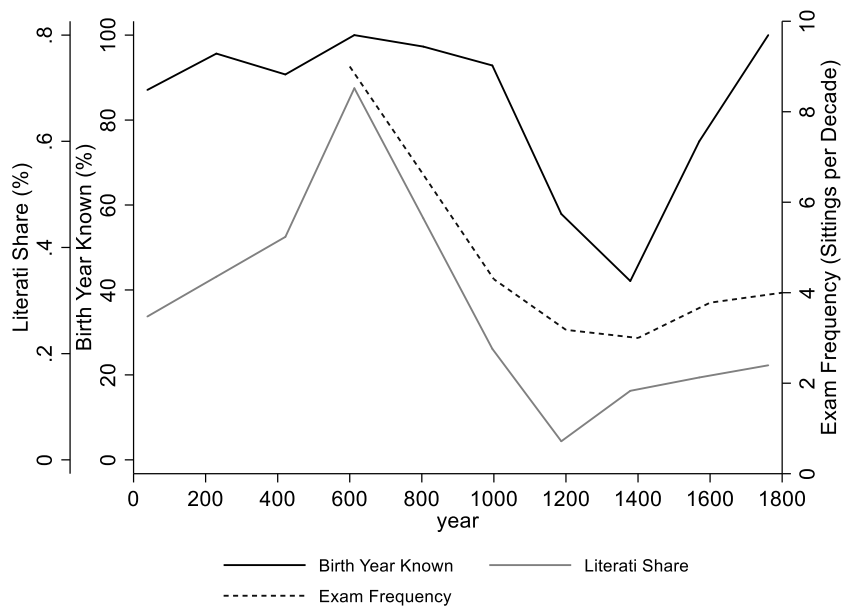
**Appendix C: Checking the ruler-birth-year-known-indicator for Europe and China**

Figure C.1: Birth Year Heaping vs Birth Known Rate (7 European Regions, 800–1800 CE)



Note: Birth year heaping calculated from Cummins' (2017) sample of 115 650 European noblemen (correlation coefficient  $\rho = -0.58$ ; or  $\rho = -0.54$  where the birth known rate is less than 100%). Source: Cummins (2017), reprocessed in Keywood and Baten (2019)

Figure C.2: Elite Numeracy and the “Literati” (China, 0 – 1800 CE)



Note: The “literati system” is the Chinese examination system for elite officials (proxies: exam frequency and literati share of the population, Source: Deng, 1993). The ruler birth year proxy measures elite human capital because the rate of known birth years for rulers is highly correlated with the proxy indicators of elite human capital. Sources: see text.

For China, a measure for elite numeracy has been suggested for the various centuries. Traditionally, Chinese elites were formed by the famous exams that selected between more and less able candidates (Deng 1993). These exams were enormously difficult to pass, and candidates often spent several years preparing for it. If a candidate succeeded to pass the exam, he became a member of an educational nobility of the country called “literati”, with very high social status and substantial income. During some centuries of Chinese history, the literati system was of lower importance, notably in the centuries after nomadic invasions. Keyword and Baten (2020) observed that in these centuries also the ability of the governing elites to report ruler birth years was declining (Appendix Figure C.2).

## Reference

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#### **Appendix D: Cappelli and Baten's assessment of slave samples: are numeracy estimates based on slaves affected by selectivity?**

Cappelli and Baten (2017) report that Eltis (1982) convincingly argued that the difference between the sample of freed slaves and the population from which they were drawn was, in terms of health and social status, very small: first, he compared African labour markets with those characterizing the most prominent slave destinations. During the 19<sup>th</sup> century, (slave) labour was increasingly demanded by the growing economic activities within Africa, such as plantations and physically demanding transport-related tasks (e.g., canoeing and portering). These occupations required relatively healthy and strong workers; thus, it seems unlikely that a positive selection—on average—characterized slaves deported to the Americas. Second, Eltis argued that if the health and strength of the slaves were crucial, a significant premium on the price paid for taller slaves would be expected—yet such a premium cannot be observed in the data. Third, if positive slave selectivity truly existed, the distribution of the heights in the samples of adult slaves would necessarily be skewed towards taller stature ranges. By contrast, Eltis observed a virtually unbiased, normal distribution in all samples. The available evidence suggests that slaves deported to the Americas constitute a relatively unbiased selection of the African populations in the source countries. It is worth noting that the similarity of height trends for slaves and free Africans in Ghana and Burkina Faso supports this argument (Austin, Baten, and Van Leeuwen 2012).

Similarly, Cappelli and Baten (2021) assessed the geography-related selectivity of our slave samples, we compare the regional distribution of numeracy in Western Sudan (today's Senegal) across two distinct datasets to test whether our estimates of numeracy suffer from specific bias: we find that numeracy calculated from local census lists is highly consistent with

figures obtained from slave records (Figure 1, estimates drawing on census lists are from Cappelli and Baten 2017).

Cappelli and Baten (2021) also compare numeracy levels obtained from our dataset on slaves deported to the Americas with the numeracy of the natives in the Cape Colony around the same time (obtained from Baten and Fourie 2015) to check for non-self-reporting bias: indeed, one issue could be that slaves did not self-report their age and that this was thus estimated by their owners or others. Since the court-register records used to reconstruct numeracy in the Cape Colony explicitly state that people were declaring their age themselves in court, this is an effective way to test whether our sources suffer from substantial non-self-reporting bias. Furthermore, Baten and Fourie (2015) carefully checked the selectivity of their sample, and their published evidence confirms that their data are representative of the underlying population.<sup>19</sup> The average numeracy in the Midlo-Hall and Hawthorne slave dataset is 29.5 in the period from 1750 to 1800; the numeracy of natives in South Africa ranged from approximately 25 (Khoesan) to approximately 30 (slaves) and up to approximately 35 (South African blacks, mostly Xhosa; see Figure 4 in Baten and Fourie 2015, p. 648).<sup>20</sup> In summary, although it is impossible to rule out all bias completely, this back-of-the-envelope comparison using a virtually unbiased source from the Cape Colony shows similar numeracy levels of Atlantic economy slaves and Africans in the Cape Colony. This suggests that our numeracy estimates from deported slaves are probably not severely affected by self-reporting bias. The

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<sup>19</sup> They also studied and controlled for selectivity due to different crimes committed and judged.

<sup>20</sup> Although it may seem odd that slaves were given the opportunity to declare their own age, it is worth noting that racism increased over time, so that it was less strong in the 18<sup>th</sup> century than it was later (Gould 1996). That slaves were asked to declare their age may also be dependent on the fact that the numeracy gap between the African and European populations during the 18<sup>th</sup> and early 19<sup>th</sup> century was not as large as it was during the late 19<sup>th</sup> and early 20<sup>th</sup> century, when racism reached its nadir (Baten and Fourie 2015).

two examples we discussed were not selected from a large number of possible comparisons between slave and census evidence, but they represent all comparison possibilities that are currently known.

Finally, Cappelli and Baten (2021) checked whether the slave samples reflect the geographical distribution of different cultures and people across regions of their countries of origin. For example, slave populations might have been captured closer to slave ports. When ethnic information is available, we see that many different regions within each country were represented. For example, the slaves deported from Senegal, Gambia and West Mali are recorded in the following way: 67 percent came from the coast, 15 percent were Mandingos from the southeast, 10 percent were Wolof from the north and northeast, and other groups made up a smaller share of the total slaves recorded. This roughly reflects the regional population structure and density within Senegambia during the 19<sup>th</sup> century (see, e.g., Rousseau 1929, p. 401, Figure 1). This regional slave selectivity issue can only be checked for Western Africa given the data constraints.

#### References

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#### **Appendix E: Other time and age recording systems**



We studied how to treat societies with other forms of age and time recording systems than written records. Some societies recorded birth 'time' in relationship to events, by giving names such as 'born in the time of war', famine etc. Or age-set systems, which effectively record 'age' by the time of a person's initiation, often in the form of an age set name. A large variety of age and time recording existed in Africa. In general, we would certainly not argue that some of the age and time recording systems were somehow inferior to others. But we do observe that, for example, BA-Kongo and Abyssinia at the beginning of our period developed a more efficient recording system for years than other countries. These two countries were not benefitting from their initially high elite human capital during the 19th and 20th centuries, because their economies and societies were destructed by conflict and civil war in the 17th to early 19th centuries. In contrast, Botswana, South Africa, and other regions developed a very high elite numeracy, which tends to be correlated with a very high overall numeracy in the 18th and 19th centuries. We can show this by observing a correlation with Cappelli and Baten's overall population numeracy estimates based on the age-heaping technique, which in turn tends to be correlated with math tests, see Baten (2020). These two countries are still among the richest economies of Africa, jointly with Mauritius, which also had very high numeracy (but no evidence on elite numeracy). In sum, we think that our indicator, which is in a way an outcome approach evaluating different age and time recording systems (that we cannot measure one by one), can help to understand the long-run development.

The original sources are sometimes clear, such as in the Congo and Ethiopian cases in which members of the court wrote down the ruler lists. In today's Mozambique, there were priest castes who recorded the rulers' lineages. In the Sahel region, the Islamic clergy reported ruler lists very often. In regions with oral tradition, the quantification of sources does not exist, nor any other quantifications for most areas of African history as is well known. This is why such proxy indicators that we are using here are of particular relevance, even if the individual measurements are not beyond doubt in each case, as we emphasize in the text.

In the regression analysis, we include only the highest quality data available.<sup>21</sup> For example, we include only country-century units in which the birth-year-known rate is above zero, as zero might not only indicate lower elite numeracy but could also be a result of poor or lost documents or perhaps the influence of a different cultural system recording time and age. In other words, if special cultural systems of age and time recording did result in non-recording of ruler birth years, we excluded these cases from our regressions.

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<sup>21</sup> We follow the excellent suggestion of the referees on this point.

## **Appendix F: Did the inclusion of only these countries that had some ruler birth years mentioned cause a substantial selectivity?**

In the regression analysis, we include only the highest quality data available.<sup>22</sup> For example, we include only country-century units in which the birth-year-known rate is above zero, as zero might not only indicate lower elite numeracy but could also be a result of poor or lost documents or perhaps the influence of a different cultural system recording time and age. We might expect that including only the best-documented cases could introduce a certain selectivity towards the more developed regions and periods. We can analyse, however, whether we included only the most urbanised countries (which is often taken as a proxy for the richest and most developed economies, see Cappelli and Baten 2021). If we compare with the urbanization share in 1800, we find that the urbanization of the countries that we include in our regressions after applying the highest quality selection criteria range from Sierra Leone with 0.1% urban share to Senegal with 7.1% urbanization share according to the figures in the ClioInfra database as processed by Cappelli and Baten (2021), normalized by the population estimates of Frankema and Jerven (2014). Moreover, although there is a group of low urban share that is not included, overall there is no correlation between being included and the urban share. The correlation coefficient is a negligible 0.03 ( $p=0.864$ ). In conclusion, we did not detect substantial selectivity, as most of the urban development distribution can be included.

Appendix Table F.1: African countries that were included or not, sorted by the urbanization in 1800 (Ratio between urban population as reported in Clio-infra.eu and Cappelli and Baten 2021, relative to the population figures as provided by Frankema and Jerven (2014))

co	included	urban1800	Co	included	urban1800
gm	0	0.000	Ao	1	0.029
sl	1	0.001	Cg	0	0.030
mw	0	0.002	Gw	0	0.031
ci	0	0.002	za	1	0.032
rw	0	0.002	cv	0	0.036
mz	0	0.003	ga	0	0.038

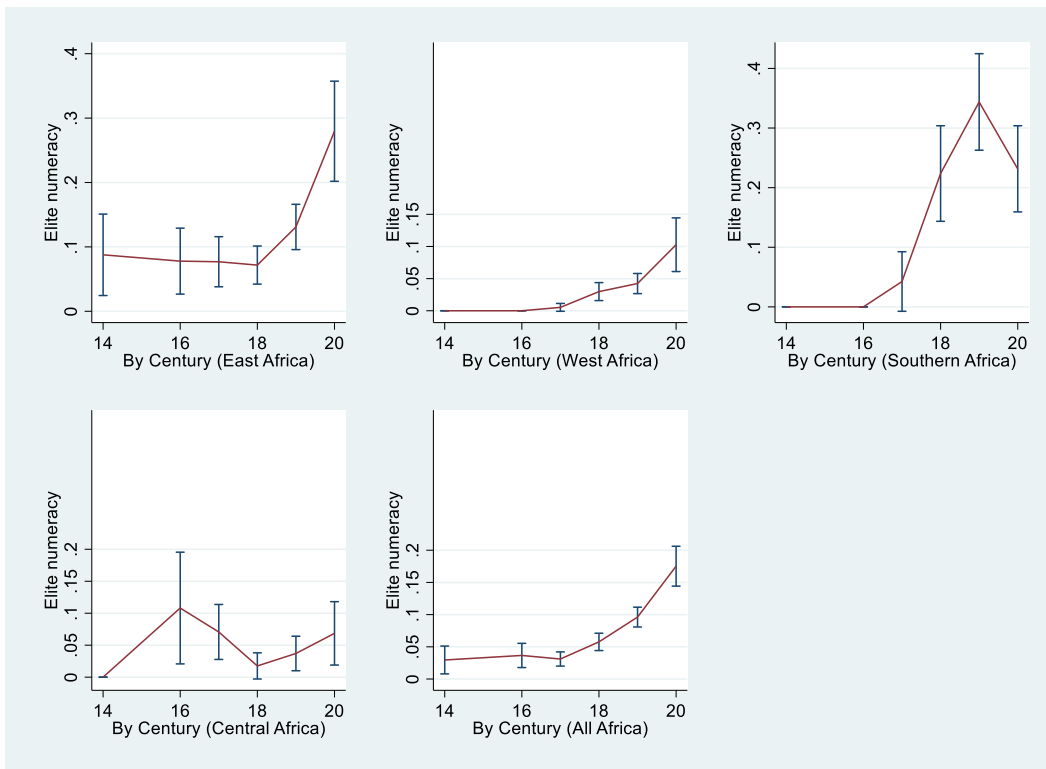
<sup>22</sup> We follow the excellent suggestion of the referees on this point.

bi	0	0.004	ml	1	0.041
tz	0	0.004	zw	1	0.051
so	0	0.005	ng	0	0.055
ug	1	0.007	sn	1	0.071
bj	1	0.007	na	0	0.140
sz	1	0.007	cd	0	n.d.
zm	1	0.008	dj	0	n.d.
bf	0	0.010	et	1	n.d.
td	0	0.011	gh	1	n.d.
cf	0	0.013	gq	0	n.d.
mg	1	0.013	km	1	n.d.
ke	1	0.017	ls	0	n.d.
tg	0	0.018	mr	0	n.d.
cm	0	0.021	mu	0	n.d.
bw	1	0.025	ne	1	n.d.
gn	1	0.025	sd	1	n.d.
lr	1	0.026			

The ISO-2-country codes are explained in Table 2.

### Appendix G: Selectivity analysis, 17<sup>th</sup> century

Figure G.1: trends of elite numeracy, using only principalities that existed already in the 17<sup>th</sup> and continued to exist thereafter



## **Appendix H. The underlying determinants of the violence eruption in Southern Africa during the 19<sup>th</sup> century (the Mfecane)**

The violence eruption in early 19<sup>th</sup> century Southern Africa and its causes have been explored by several scholars from various points of view. As Eldredge states, “there is no simple monocausal explanation for these disruptions: neither great leaders, nor environment and ecology, nor overpopulation nor trade (including the slave trade and raiding) alone set off the wars and migrations that plagued the area through these decades” (1992, p.2). Cobbing (1988) argues that slave trade initiated by Europeans was the main cause and trigger for this violence, while removing the responsibility from the Zulu community (a popular belief supported by the white supremacist regime as well as Apartheid later). However, the evidence used by Cobbing (1988) refers to the boom of slave exports in the 1820s and 1830s, after the outbreak of the violence.

Eldredge claims that the violence predated the slave trade boom and offers a re-assessed synthesis of former interpretations of the so-called “Mfecane” case. She shows that the socio-political and demographic changes as well as the consequent violence were the fruits of the interplay between environmental factors and local patterns of economic organisation. Specifically, increasing inequalities (mainly caused by wealth accumulation deriving from ivory trade at Delagoa Bay) and extreme weather shocks made competition for land and labour harsh. As a result, poor people became more vulnerable to famine, due to food scarcity. Plus, considerable migration of Dutch Boers avoiding British rulers in the 1830s-40s harmed further political stability, which eventually led to disruptive violence that lasted over two decades.

### References

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## Appendix I: How did the percentage of birth years known differ in regicide versus in non-regicide situations?

In Table I.1, we aggregate for three principalities as examples the share of birth years known in the regicide versus the non-regicide situation. For the kingdom of Ba-Kongo, we see that the share of known birth years was 14.3 percent among the 44 cases of no regicide, whereas among the 13 cases of regicide, the share is much lower (0 percent), suggesting a correspondingly lower elite numeracy during this period. In the Abyssinian Empire, the result is different. Both the regicide and the non-regicide cases have a relatively high share of birth years known, 21 percent in the non-regicide case and 35 percent in the regicide case. Hence, here, we see not the expected result supporting our hypothesis 3. In contrast, in the principality of the Ba-Kagatla (the principality in Botswana with the largest number of rulers), we see that the non-regicide cases were far more numerate: The share of known birth year cases was 15 percent, whereas the two regicide cases resulted in a zero percent share of birth years known. In conclusion, case 1, Ba-Kongo, and case 3, Ba-Kagatla, support hypothesis 3, whereas the second case of the Abyssinian Empire does not support this hypothesis. Hence, we need to consider a regression analysis to study more systematically which of the two cases is more representative.

Table I.1: Examples of principalities: Birth year known by regicide situation

Principality	Violence	No birthy. known	Birthy. known	Total	Share birth year known
Ba-Kongo	No regicide	54	9	63	14.3
Ba-Kongo	Regicide	13	0	13	0.0
Abys. Empire	No regicide	73	26	99	26.3
Abys. Empire	Regicide	17	9	26	34.6
Ba-Kagatla (BW)	No regicide	34	6	40	15.0
Ba-Kagatla (BW)	Regicide	2	0	2	0.0

Note: BW is Botswana



## **Appendix J: European contact**

In the text, we discussed to which degree European contact might have played a role in developing the corresponding techniques of recording birth years of rulers and in generating interest for numbers and dates in general. Several strong arguments about why the contact with Europeans might not have influenced this measure – independently of the “true” elite numeracy -- are presented in the main text of the paper. Nevertheless, we would like to assess this statement in a more systematic way. Therefore, we defined a measure of European contact which is mainly based on historical descriptions like the one by Oliver and Atmore (2001) about European contacts.

The earliest contact probably took place via Saharan pathways during antiquity and medieval periods, but the connections were reduced after the adoption of Islam in North Africa. Still, the Christian Sudanese principalities – until they ceased to exist -- and Ethiopian Empires had some limited contact. Via the Mediterranean and Nile transportation way, the Christian kingdoms of Sudan had always been in touch with Europeans to a certain extent. The early Portuguese exploration, beginning in the 15<sup>th</sup> century, created connections with the territories south of today’s West Sahara (Cape Bojador), reaching in the 15<sup>th</sup> century Arguin (Mauretania), Senegal, Cape Verde, Sierra Leone, Ghana and the Gulf of Guinea, and finally opening the way to India via the Cape of Good Hope and the East coast of Africa. The kingdom of Ba-Kongo had quite early contacts, already in the 1480s. We discussed this issue in the main text.

Apart from that, the Portuguese expansion of the 15<sup>th</sup> and 16<sup>th</sup> century generated and intensified a number of additional contacts. The coast of today’s Republic and Democratic Republic of Congo saw early Portuguese visits and trading activities, partly based on copper and slave trade interests. Later on, also the Kasanje principality of the interior (of modern Angola) got into contact via the slave trade, as the Portuguese slave traders started to bring slaves especially to São Tomé (and later Brazil). In what is today Angola, the principalities of

Lundu and Kalonga, similarly with other population groups such as the Ovimbundu and later the Kuba kingdom, had early contacts.

The southern African region had more intensive contacts starting mainly in the 17<sup>th</sup> century. At that time, the Dutch Cape Colony expanded its contact with local people in order to produce food and provide it to the passing ships on their way to India. Nevertheless, the South African settlers did not usually cross the Drakensberge Mountains until the early 19<sup>th</sup> century. The Mutapa empire in today's Zimbabwe, Mozambique and Zambia was engaged in trade with the Portuguese in the 16<sup>th</sup> century (and with Arab traders before that), especially for luxury goods trade. The Portuguese also had contact with the Shona kingdoms and Kiteve in today's Zimbabwe during the 16<sup>th</sup> century. Moreover, they were in contact with the Kazembe kingdom which was located between Kongo and Zambia in the 18<sup>th</sup> century. Moving up the east African coast, the Kilwa sultanate in current Tanzania had contact with the Portuguese and French from the early 16<sup>th</sup> century onwards, especially for slave and ivory trade. Moreover, the Tsonga kingdom (Mozambique/South Africa) had contact with the Dutch for trading textile, ivory and slaves.

Abyssinia (in modern Ethiopia) came in contact with the Portuguese just after reaching their peak of high elite numeracy level in the early 16<sup>th</sup> century (although limited contact via the travel link of Abyssinia to Jerusalem never fully stopped). In the 16<sup>th</sup> century, however, the contact with Portuguese Jesuits increased. During this period, the stagnation of elite numeracy in Abyssinia started.

We coded all these individual contacts as an indicator variable being 1, if during a century the region had contact for most of the decades or the contact started before mid-century. We defined the regions as modern countries, as no information on contacts of all 700 principalities was available (rather on two dozens), and because arguably the external effects of one principality having contact (with Europeans) on neighbouring principalities were strong.

The whole African interior region had very modest direct contact with Europeans until quite late in the 19th century. Of course, we coded the whole 20<sup>th</sup> century as having contact, even for the interior regions. The coefficient of the contact variable might hence slightly be biased upwards, capturing some of the positive trends of the 20<sup>th</sup> century elite numeracy in interior countries and regions.

## **Appendix K: An IV analysis of a potential effect of slavery on elite numeracy**

We performed an instrumental variable analysis in order to circumvent the endogeneity issue in particular with respect to the direction of causality and measurement error. The slavery variable is one of the variables that might be affected by endogeneity -- partly because it is impossible to measure the extent of slavery precisely, and also because one could also imagine that elite numeracy might have a feedback effect on slavery. It is very challenging to find suitable instruments for African economic history during the early modern period, because this is a time period and region in which quantitative evidence is particularly scarce. One possibility is given by the work of Nunn and Wantchekon (2011), who suggested instrumental variables for African slavery using the distance to locations of slave demand. He argued that the locations of slave demand in the West Indies, the South of the United States and Brazil were mainly determined by the climate and soil suitability for sugar and tobacco plantations in the former two regions, as well as gold and silver mines in Brazil.

The Atlantic slave trade is one of the most exogeneously determined and most relevant slave trades, whereas the other three, the Red sea, and Saharan slave trades were more “traditional” (already important in earlier centuries), and the Indian Ocean slave trade and these other two were also more close to the African sources of slaves, which makes endogenous relationships more likely, compared the Atlantic slave trade that was determined by climate and soil suitabilities on the other side of the globe.

Hence we instrument slave intensity with Nunn and Wantchekon’s variable of the distance to the transatlantic slave demand regions. We observe that unfortunately the instrument is relatively weak (as it was also the case in the original study): none of the F-statistics of the various versions of instrument variable estimations came even close to the threshold level of the F-Statistic of 10.

We also studied other potential specifications, such as including all slave trades, different combinations, adding São Tomé as a slave trade destination for the early period and other

specifications. The Atlantic slave trade distance IV is the strongest instrument of all the potential IVs (and their combinations) studied here, yielding an F-statistic between 2 and 3 (the other potential IVs specifications are available from authors). Hence we found it worth reporting in this Appendix. Moreover, we could imagine that other scholars would want to try using this instrument for this specific question and we want to report the results here in order to prevent other scholars making similar efforts without finding a strong instrument.

Using these weak instruments, we observed that slavery did not have a systematic impact on elite numeracy although we admittedly cannot be perfectly sure given the econometric issue of the instrument (Table K.1).

Table K.1 IV regressions of elite numeracy

	(1)	(2)
<i>Second stage</i>		
Slave trade	0.04 (0.619)	0.03 (0.756)
Elite violence	-0.57 (0.153)	-0.52 (0.128)
Fame bias	0.01 (0.825)	
European contact	-0.03 (0.607)	-0.03 (0.612)
Slave trade*central.	0.04 (0.648)	0.06 (0.570)
Region FE	Yes	Yes
Time FE	Yes	Yes
Constant	0.20* (0.051)	0.19** (0.029)
<i>First stage</i>		
Distance Atlantic slave demand	0.12 (0.125)	0.09 (0.203)

Observations	35	35
Adjusted R-squared	0.065	0.108
F	2.521	1.704

## **Appendix L: On the aggregation by the territory of modern countries**

To obtain sufficient cases per region-time unit in our regressions below, we needed to make the methodological decision to assign all early modern kingdoms and smaller units of rule to a geographic unit that allows comparisons over time. Although this is anachronistic and creates spatial aggregation issues – an important caveat –, we decided to use modern borders and modern country names. We use the location of historical capitals or geographic centres of rule within modern boundaries as a criterion for how to assign them. The ruling elites were mostly living in capitals or central locations, and their elite numeracy can therefore be assigned to this geographic unit. We could also formulate our findings as the “trend of elite numeracy of all capitals that are situated within the boundaries of modern Ghana”, for example. As this would be too long to include in each sentence, the country name is an abbreviation, but we need to remember that it constitutes a geographic unit and not a modern nation. The alternative, assigning elite numeracy values to grid cells across Africa, would not be possible, because for the majority of African countries, the exact borders of the polity territories are not known.

The country border research strategy has several advantages over using changing historical boundaries. A large number of studies in economic history have used modern country boundaries because this allows for tracing long-term determinants. For example, Maddison (2001) aimed to trace post-Soviet countries back into Soviet times. The Clio-Infra database also allows studying countries in their modern boundaries across time. As the boundaries changed, the modern country names may seem somewhat anachronistic, but the insights from understanding the long-term development of these territorial units far outweigh the costs. If there were more rulers (in smaller principalities, for example) within modern country borders, we assigned them to the modern country according to where their capital was located. Several smaller principalities within a modern country are actually an advantage for our analysis, as they allowed us, in some cases, to reach the minimum observation number of

four rulers per century. We assigned them according to the locations of capitals to, for example, Ethiopia and Angola because their bureaucracies were also centred in these places, and the main explanatory variables we assess below (such as regicide) also relate to the same places.