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Human Capital, Institutions, Settler Mortality, and Economic Growth in Africa, Asia and the Americas

We study the human capital development in 19th century Africa, Asia, and the Americas using the “age heaping” method. We combine this new data set with the evidence about settler mortality and long-term economic growth, in order to test systematically the views of the colonial legacy literature. The results indicate that the evidence is supporting the Glaeser et al. (2004) views on human capital growth effects, rather than the Acemoglu et al. (2001, 2002) view that settler mortality impacted on the quality of institutions.

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1. Introduction

Nobody would disagree that good institutions are a key ingredient to economic growth. In the empirical growth literature on the long-term impact of institutions, the indicators for the quality of institutions have mostly been based on the “constraints on the executive” concept. According to this idea, a country’s investment climate is evaluated by considering the effectiveness of law enforcement, the sanctity of contracts, and the state of other influences on the security of property rights (Barro 1997: 27). Only if the constraints on the government were strong enough, modern markets could develop and economic growth continued rapidly.¹

In the discussion about the role of various factors explaining today’s different levels of income across countries, the “institutions view” was supported by several empirical studies (Acemoglu et al. 2001, 2002, AJR from here, Easterly and Levine 2003, Rodrik et al. 2004).

AJR had used two instrumental variables, namely settler mortality during the 19th century and population density around 1500 in countries that became European colonies at some point, for instrumenting today’s institutional quality in these countries with seemingly exogenous variables from far back in history. The idea was that European settlement decisions were influenced by the disease environments and population density in the target countries. Where the climate was more benign, as in the (later) USA, Canada or South Africa, Europeans were more willing to immigrate and thus brought their “good” European institutions with them. In contrast, areas where the first settlers faced high mortality rates, as in West Africa for example, Europeans tended to implement more exploitative institutions, with catastrophic effects on growth until today. The settlers avoided also heavily populated countries (such as India, Egypt or Mexico), but migrated to countries of low density.

However, Glaeser et al. (2004) formulated doubts about the AJR approach to explain today’s growth differentials in previously colonized countries. One of the Glaeser et al.

¹ It might be, however, that the recent economic crisis leads to a more careful evaluation of this effect even in the growth economics literature. In the world of today, most economists and the public demand more regulation of financial markets by the government, and this is conceptually somewhat different from the implications of the view that constraints on the executive are the key.

critiques was whether those two variables are actually good instruments for institutions, or whether the growth process went through another causal channel, namely via human capital. If potential instrumental variables are related to another line of causation, they fail to be good instruments. The settlers might have brought their institutions with them, but first of all they brought themselves and their embodied human capital, as Glaeser et al. stress. They argued that it might have been differences in the accumulation of human capital and growth in income that decided about being rich and poor today and follow therein Lipset's hypothesis (Lipset 1960): growth and educated people cause institutional improvement, rather than the other way round. This view is supported by their empirical analyses, where they find human capital (measured by years of schooling), but not executive constraints as a predictor of economic development today.

Unfortunately, Glaeser et al. could not directly test their human capital view with early educational data, as evidence on this core variable of economic growth for the 19th and early 20th century was quite limited at the time. Glaeser et al. had only 14 observations for which overlapping data for human capital around 1900 and settler mortality was available in colonial countries. In the meanwhile, new data on long-run human capital formation has been estimated, based partly on proxy indicators. Especially the "age heaping" strategy has developed into a widely used tool to measure human capital in the past, and numeracy in particular (following Mokyr 1983, see the recent studies by A'Hearn, Baten, and Crayen 2009; Baten, Crayen, and Manzel 2008; Baten, Crayen, and Voth 2008; Baten and Mumme 2008; de Moor and van Zanden 2008; Clark 2007; Crayen and Baten 2009a; Crayen and Baten 2009b; Manzel and Baten 2009a; Manzel and Baten 2009b; Humphries and Leunig 2009; Baten, Reis and Stolz (2009); see also the applications in Cinnirella 2008; Mironov 2006; O'Grada 2006). In the present study, we extend this data set for Africa and Asia, assessing in particular the age heaping of late teenagers and persons in their early 20s, which had been excluded in the previous analyses. We combine this new data set with the wealth of

human capital data collected in the studies above, and test systematically the views on the colonial legacy literature. Even for data-scarce developing countries, this study develops a data set of 54 previously colonized countries (whereas European countries were somewhat better documented, see Reis 2005). Preliminary results indicate that the evidence is supporting the Glaeser et al. (2004) views on human capital growth effects, rather than the view that settler mortality impacted on the quality of institutions.

However, our analysis goes somewhat beyond the Glaeser et al. view that it was mainly the European import of human capital which caused growth in some countries (Figure 0. Please note the “and other factors” remarks in the Figure). Another related factor might be educational differences between the indigenous populations of the countries under study. Some of those countries without European immigration might also have had higher human capital early-on, whereas others had not. Thirdly, also the combined effects of European immigration and indigenous human capital development might play a role: spill-over effects could play a role even where a relatively small immigrant group was present, relative to the large majority of indigenous population. In other words, the focus should be on the human capital of the total population of a country, which we will assess below. Hence we will replace below settler mortality and population around 1500 with the instrument “Basic Numeracy” (and other instruments).

2. Measuring human capital

The measure of the production factor “human capital” has never been simple, as advanced forms of skills are difficult to compare. This is especially true for time periods and regions where conventional measurements as literacy or schooling rates are scarce or not available. Hence all economic historians have resorted to the use of proxy indicators, such as the share of people signing a marriage register. Grundlach (2001) notes that the empirical measurement of the human capital factor and the productivity of education in economic growth are not

satisfying so far. In this study, we use the “age heaping” strategy, which we will explain in somewhat greater detail here, as the application of the method in economic history is still relatively new. This approach employs the set of methods that developed around the phenomenon of “age heaping”, i.e. the tendency of poorly educated people to round their age erroneously – they answer more often “30”, if they are in fact 29 or 31, compared with people with a better endowment of human capital (Mokyr 1983).

This heaping pattern of favouring an age ending on 0 or 5 is captured by the so-called Whipple index. To calculate this index, the number of persons reporting a rounded age ending with 0 or 5 is divided by the total number of people, and this is subsequently multiplied by 500. Thus, the index measures the proportion of people who state an age ending in a five or zero, assuming that each terminal digit should appear with the same frequency in the ‘true’ age distribution.²

$$(1) Wh = \left(\frac{\sum (Age25 + Age30 + \dots + Age60)}{1/5 \times \sum (Age23 + Age24 + Age25 + \dots + Age62)} \right) \times 100$$

For an easier interpretation, A’Hearn, Baten, and Crayen (2009) suggested another index, which is called the ABCC index.³ It is a simple linear transformation of the Whipple index and yields an estimate of the share of individuals who correctly report their age:

$$(2) ABCC = \left(1 - \frac{(Wh - 100)}{400} \right) \times 100 \text{ if } Wh \geq 100; \text{ else } ABCC = 100. ^4$$

Crayen and Baten (2008) found that the relationship between illiteracy and age heaping for Less Developed Countries (LDCs) after 1950 is very close. They calculated age heaping and illiteracy for not less than 270,000 individuals that were organized by 416 regions, ranging

² A value of 500 means an age distribution with ages ending only on multiples of five, whereas 100 indicates no heaping patterns on multiples of five, that is exactly 20 percent of the population reported an age ending in a multiple of five.

³ The name results from the initials of the authors’ last names plus Greg Clark’s, who suggested this in a comment on their paper.

⁴ Whipple indexes below 100 (ABCC indexes above 100, respectively) in the 20th century rich countries are normally caused by random variation, hence those indexes are normally set to 100.

from Latin America to Oceania. The correlation coefficient with illiteracy was as high as 0.7. The correlation with the PISA (Programme for International Student Assessment) results for numerical skills was even as high as 0.85, hence the age heaping measure Whipple Index is more strongly correlated with numerical skills. A'Hearn, Baten, and Crayen (2009) used the large U.S. census sample to perform a very detailed analysis of this relationship. They subdivided by race, gender, high and low educational status and other criteria. In each case, they obtained a statistically significant relationship. Remarkable is also the fact that the coefficients are relatively stable between samples, i.e. a unit change in age heaping is associated with similar changes in literacy across the various tests. Those results are not only valid for the U.S.: In any country studied so far which had substantial age-heaping, the correlation was both statistically and economically significant.⁵

In order to assess the robustness of those U.S. census results and the similar conclusions which could be drawn from late twentieth century LDCs, A'Hearn, Baten, and Crayen (2009) also assessed age heaping and literacy in 16 different European countries between the Middle Ages and the early nineteenth century. Again, they found a positive correlation between age heaping and literacy, although the relationship was somewhat weaker than for the nineteenth or twentieth century data. It is likely that the unavoidable measurement error when using early modern data induced the lower statistical significance.

The possibly widest geographical sample studied so far has been created by Crayen and Baten (2008), who were able to include 70 countries for which both age heaping and schooling data (as well as other explanatory variables) were available. They found in a series of cross-sections between the 1880s and 1940s that primary schooling and age heaping were closely correlated, with R-squares between 0.55 and 0.76 (including other control variables, see below). Again, the coefficients were relatively stable over time. This large sample also allowed the examination of various other potential determinants of age heaping. To assess

⁵ On the regions of Argentina see for example Manzel and Baten (2008).

whether the degree of bureaucracy, birth registration, and government interaction with citizens is likely to influence the knowledge of one's exact age, independently of personal education, Crayen and Baten used the number of censuses performed for each individual country up to the period under study as explanatory variable for their age heaping measure. Except for countries with a very long history of census taking, all variations of this variable turned out insignificant, which would suggest that such an independent bureaucracy effect was rather weak. In other words, it is the case that societies with a high number of censuses and early introduction of birth registers had a high age-awareness. But those societies were also early to introduce schooling, and this was the variable that had clearly more explanatory power than the independent bureaucracy effect. Crayen and Baten (2009a) also tested whether the general standard of living had an influence on age heaping tendencies (using height as well as GDP per capita as welfare indicators) and found a varying influence: in some decades, there was a statistically significant correlation, in others there was none. Cultural determinants of age heaping are also observable, but their strongest influence is visible in East Asia, not in most of the countries under study in this project.

In conclusion, the correlation between age heaping and other human capital indicators is quite well established, and the 'bureaucratic' factor is not invalidating this relationship. A caveat relates to other forms of heaping (apart from the heaping on multiples of five), such as heaping on multiples of two, which is quite widespread among children and teenagers and to a lesser extent among young adults in their twenties. This shows that most individuals knew their age as teenagers, but only in well-educated societies they are able to remember or calculate again their exact age later in life. We will exclude those below age 23 and above 82 since a number of possible distortions affect those specific age groups, leading to age reporting behaviour different to the one featured by the adult group in between. Many young males and females married in their early twenties or late teens, when they also had to register as voters, military conscripts etc. At such occasions, they were sometimes subject to

minimum age requirements, a condition which gave rise to increased age awareness. Moreover, individuals physically grow during this age group, which makes it easier to determine their age with a relatively high accuracy. All these factors tend to deflate age heaping levels for children and young adults, compared with the age reporting of the same individuals at higher ages. The age heaping pattern of very old individuals is subject to upward as well as downward bias, and hence should the very old also be excluded. There remains some uncertainty about whether age heaping in the sources contains information about the numeracy of the responding individual, or rather about the diligence of the reporting personnel who wrote down the statements. A potential bias always exists if more than one person is involved in the creation of a historical source. For example, if literacy is measured by analysing the share of signatures in marriage contracts, there might have been priests who were more or less interested in obtaining real signatures, as opposed to just crosses or other symbols. We find it reinforcing that previous studies always estimated generally much more age heaping (and less numeracy) for the lower social strata, and among the half of the sample population which had lower anthropometric values. Moreover, the regional differences of age-heaping are similar to regional differences in illiteracy. It can be concluded that the method of age heaping is a useful and innovative tool to assess the human capital of migrants, and different groups of migrants, we could not be done before.

3. Data

The data set used for the numeracy analyses in the following consists mainly of census data published by the United Nations, IPUMS and Rothenbacher (2002)⁶. Additional census data

⁶ Some census data provided by the UN Demographic Yearbooks were smoothed and/or rounded, for example the census data of 1961 for India, and cannot be used for the age-heaping method. The same is true for census data that show other heaping patterns than favouring ages ending on 0 or 5 or censuses, where individuals were asked for their year of birth rather their age. In the latter case, a strong birth year heaping is observable, what cannot be captured by the conventional Whipple or ABCC indexes. That kind of heaping patterns would distort the ratio of the numerator and denominator in the index-formulas and therefore overestimate the numeracy levels.

come from many different sources (see Appendix). Crayen and Baten (2009a) have already documented a large number of those sources, and Manzel and Baten (2009a, b) reported the sources for Latin American countries.⁷

In the first step, ABCC-indexes for age groups ranging from 23 to 32, 33 to 43, ..., 72-83 are calculated. In a second step they are assigned to the corresponding birth decades.

The data set covers 123 countries across all continents, of which 54 were colonies of European powers at some point, and were hence included in this colonial legacy study. The birth decades range from the 1760s to the 1960s, whereas for most countries data are available only for the birth decades 1870s to 1940s.

4. What might have influenced the numeracy development?

In the following section, we will take a glance at the numeracy trends in a large number of countries, but before doing so, we need to discuss what might have influenced age numeracy in the context of the AJR and Glaeser et al. views.

Firstly, possible determinants include culture and religion. Some cultures may have had a stronger propensity to develop numeracy, for example, because astrology and calendars fascinated their people. Crayen and Baten (2009a) have argued that this applies in particular to the Chinese culture, which influenced other East Asian cultural structures again. Although China was never legally a Western colony and is hence not included below, we will see this phenomenon in the case of Hong Kong, for example. Next, religious factors could be important. Max Weber's well-known hypothesis that protestants – and Calvinists in particular - had special attitudes found recently strong support in the works of Becker and Woessmann (2009) who stressed the human capital interpretation of Protestantism. Colonies of protestant countries are well-known to have higher literacy levels until today (Barro and McCleary,

We also excluded data from countries with a population size smaller than 500,000 and census data that considered only European populations in colonies rather than the whole population.

⁷ Among others, additional estimates included in this study for the first time are the census of Ecuador in 1870.

2005), and colonies of the partly Calvinist Dutch (such as Sri Lanka, Indonesia or Surinam) might have had higher human capital values than the average of the respective world region. Census and population register traditions can also be considered as cultural factors, although Crayen and Baten (2009a) found in systematic tests that this was not visible in the data (except in countries with very long census traditions).

More closely in the context of the AJR/Glaeser et al. debate, population density might matter. AJR interpreted a high population density in 1500 as a signal of wealth, hence European colonizers might have decided to set up exploitative institutions. In the Glaeser et al. context of immigrating human capital one could take a different view: As indigenous populations were large, the European immigrants were by far outnumbered by indigenous people, and if the human capital of the latter was lower, the average was also quite modest. Moreover, in such a situation a high inequality might be the result, as Engerman and Sokoloff (1997) stressed for Latin America. Finally, high population density early-on might also imply adverse nutrition and health effects (Koepke and Baten 2005, 2008; Steckel 2008; Komlos and Baten 2004). If the quality of nutrition deteriorates due to high population density, a larger fraction of the population might suffer from the infant protein malnutrition syndrome (IPMS), which tends to retard human capital formation (see the extended review in Baten, Crayen, Voth 2008).

Thirdly, also the combined effects of European immigration and indigenous human capital development might play a role: spill-over effects could promote higher education even where only a relatively small immigrant group was present, and a large majority of indigenous population.

Another interesting aspect in the AJR versus Glaeser et al. debate is the issue of timing. Institutions have by definition a long-run nature. AJR would have preferred to obtain 18th century data on settler mortality, as the institutional decisions – exploitative or growth-promoting – were already made in this early period. In contrast, if causality runs via importing

people with high human capital, there might also be short-run effects. This might have played a role in some countries, such as Argentina and Uruguay, which were subject to migrant waves late in the 19th century, when Europe had introduced mass-schooling, and the recent migrant waves were more educated than the older migrant waves.

Finally, more advanced levels of education, such as the European and Neoeuropean mass schooling of the late 19th century were also initiated by democracy, national competition and regional participation in schooling decisions (Lindert 2004).

5. Trends in sample countries

Figures 1-7 display the numeracy trends of former colonies, where numeracy levels could be calculated. All numeracy values are organized by birth cohorts, as the very basic levels of numeracy measured here are normally obtained during the first decade of life. Figure 1 reports those cases in the Americas for which we could obtain long-run trends, i.e., for which birth decades before the 1860s could be documented. Numeracy levels were high in Canada and to a lesser extent in the U.S. during the 18th century, whereas it was low in Venezuela and Mexico, and around 1800 even lower in Ecuador. Among many countries of low numeracy values, the progress was limited until the late 19th century. The wide range of numeracy values that can be observed for the 1870s (between about 40 and 100 percent) was actually already visible in the 1810s. One of the countries with an early improvement was Argentina, whereas most of the other less-educated countries improved after the 1870s. What does this tell us for our main research question, i.e. whether imported institutions or immigrating people with their human capital was more important? As mentioned in section 4, institutions are defined by a long-run stability, and AJR argue with an import during the late 18th century already, whereas people with immigrating human capital might have a more short-run effect. This seems visible in the Argentinian case, in which mass immigration took place during the late 19th century, bringing many Europeans who were born during the middle and later parts

of the century. It also applies similarly to Uruguay and Brazil, although European immigration to Brazil was more modest – relative to the large population -- and took place slightly later in time.

Can we distinguish cases with high population densities early-on from countries with low population density in Figure 1? Clearly, Mexico and Peru were countries with high population densities early-on. While our data for Peru start late, we find in fact that in Mexico human capital development stagnated between the late 18th and late 19th century. Is this evidence for lacking institutional or human capital imports? Unfortunately, it can be actually both, so we cannot use this evidence to confirm or reject our contrasting hypotheses. Both during the late 18th and the late 19th century European immigration to Mexico was quite limited, which meant that shocks to both institutional and human capital development were not given.

In Figure 2 and 3, we show the Latin American cases for which data starts only during the 1870s (and partly 1860s). Note that we changed the scale of the figure compared to the previous one in order to make the differences between countries visible. Countries with strong immigration had quite high levels initially, such as Chile and Guayana, but also countries with strong contact with human capital rich neighbors, such as Panama or Paraguay. Lagging in development were countries such as Bolivia, Haiti, and the Dominican Republic.

In North Africa, we have a long series for Egypt, which became a European (British) colony during the late 19th century (Figure 4). Nevertheless, Egyptian numeracy did stagnate on a very low level from the late 18th to the very late 19th century. In fact, Egypt had the lowest numeracy among the countries which we could observe here. As Egypt is one of the examples of very high population densities early-on, the case is somewhat similar to the Mexican case: stagnant and low human capital until quite late. Jointly with Morocco, it had a strong upward trend after the 1880s. The French immigration colonies of Algeria and Tunisia showed a relatively high basic numeracy early-on, perhaps the French educational system had

played a role here. One can also imagine that there were spill-over effects from French immigrants, but we clearly do not know about the numeracy of those countries early-on.

For Subsaharan Africa, we unfortunately do not have yet good estimates of 18th or early 19th century numeracy (Figure 5 and 6). In West Africa, the range seems to have been between 50 and 70 percent in the 1880s, i.e. not a lower minimum than the Americas (with its lower range of 40 in Figure 5, but note the higher Latin maxima). Low values were given in Nigeria with its very problematic institutional quality until the 21st century, and Gambia. The colonies of Ivory Coast, Togo and Ghana were doing somewhat better early-on in West Africa.

In the rest of Subsaharan Africa, Mauritius stands out with its very high early numeracy, perhaps impacting on the quite high income per capita until today (by African standards, see Figure 6). It is followed by South Africa and Tanzania. Relatively low was initial basic numeracy in Cameroon, Uganda and Kenya.

Finally, in Figure 7 we present some data on Asia. The series on the territory of today's India and Myanmar stretches back in time to the 1830s. India had a quite low numeracy already in the 1830s, whereas Myanmar (also under British colonial rule later-on, named British Burma) was doing better. This might be caused by the Buddhist temple schools in Myanmar. Sri Lanka and Malaysia also had a remarkably high numeracy around mid-century, but even higher were the values in Australia, New Zealand, and Hong-Kong, who had solved their basic numeracy problem by the 1860s. On the other hand, what is today Bangladesh and Pakistan were regions with very low numeracy, similarly low as Egypt around 1900. Indonesia was situated between India and the Sri Lanka/Malaysia level.

6. Comparing settler mortality and early human capital formation

Settler mortality and early human capital formation should be negatively correlated, following from the discussion above. A tool to discriminate between the two variables as potential

instruments of later institutional quality and education can be gained by focusing on those countries in which settler mortality and early human capital formation deviated (Figure 8). In general, both indicators correspond, with low settler mortality in the high-education cases US, Canada, New Zealand, Hong Kong and South Africa (za). Interestingly, also Malaysia, Guyana and Mauritius fit to this pattern (my, gy, mu). On the other side, Nigeria, Mali, and Gambia had low numeracy and high settler mortality, the classical West African cases. But there were five interesting deviations, with only modest settler mortality, but very low early human capital values in 1900: Pakistan, Bangladesh, Egypt, India, and Morocco. Settler mortality in those countries is estimated as being lower than in most Latin American countries, including Argentina and Uruguay. To a lesser extent, Indonesia also belongs to this group, although settler mortality was somewhat higher. All of those are still poor countries today, and their institutional and human capital level during the second half of the 20th century was modest. This would suggest that the early human capital formation had a stronger influence than the settler-mortality-related institutional decision.

We tested the various instruments in an instrumental regression framework, as it was similarly used by AJR and Glaeser et al. (Table 1). Glaeser et al. used it to show that the ultimate causality chain might run from settler mortality and early population density via modern human capital to income. But we argue that the human capital of indigenous people and the spill-over effects to them should also be acknowledged in the model. Hence we will test whether those instruments can be replaced by early human capital formation, or more precisely basic numeracy, and whether the results are still consistent with the Glaeser et al. interpretation. This is actually the case (Table 2). Using early human capital formation has even a more systematic impact via modern education on income than the alternative instruments, as the R-squared is higher in some cases, even when numbers of cases are small.

7. Conclusion

We have studied the human capital development in 19th century Africa, Asia, and the Americas. Our main methodological tool was the “age heaping” method, which estimates the share of persons who were able to report their age exactly in years. We combined this new data set with the evidence about settler mortality and long-term economic growth, in order to test systematically the views of the colonial legacy literature. Our results indicated that the evidence is supporting the Glaeser et al. (2004) views on human capital growth effects, rather than the Acemoglu et al. (2001, 2002) view that settler mortality impacted on the quality of institutions. We went even a step further arguing that the human capital of the indigenous population and potential spill-over effects were also important.

We also suggest a slightly different view at the instrumental variable ‘population density around 1500’. The original interpretation was that those economies were rich, as population density is sometimes used as indicator of wealth. As they were rich, they became victims of European exploitative institutions. However, if the migration of Europeans and their import of human capital is the decisive factor, the overall human capital in densely populated countries such as Mexico, Egypt or India might have remained low, because the number of European immigrants was by far outnumbered by the indigenous population. We found in fact that countries such as Egypt and Mexico stagnated in basic numeracy between the 18th and late 19th century. Apart from institutional and migration factors, this might also have been caused by nutritional and health problems in such densely populated countries, and by the high inequality between some elite groups and the majority of the population.

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Table 1: Settler mortality and population density around 1500 as instruments: IV regression of today's GDP per capita on human capital and institutional quality, instrumented with settler mortality and population density around 1500

	(1)	(2)
Years of schooling (1960-2000)	0.7894*** (0.2753)	0.4836** (0.1875)
Executive constraints (1960-2000)	-0.3432 (0.2577)	-0.2965 (0.241)
Share of population living in temperate zone	-1.6969 (1.2053)	-0.0863 (0.7714)
Observations	47	55
R-squared	0.31	0.5

Source: Glaeser et al. (2004). Second-stage regressions. Dependent variable is log GDP per capita in 2000. Both are instrumented with the share of population living in moderate zone, and French legal origin. Moreover, (1) is instrumented with settler mortality (2) with population density in 1500. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2: Numeracy as instrument: IV regression of today's GDP per capita on human capital and institutional quality, instrumented with early human capital

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Birth decade	1900	1890	1880	1870	1860	1850	1840	1830	1820
Years of schooling	0.24*** (0.09)	0.26*** (0.07)	0.28*** (0.08)	0.21 (0.14)	0.19** (0.07)	0.27*** (0.05)	0.27*** (0.06)	0.23** (0.11)	0.13 (0.10)
Executive constraints	0.357 (0.29)	0.29 (0.20)	0.26 (0.24)	0.52 (0.58)	0.33 (0.24)	0.13 (0.12)	0.17 (0.16)	0.30 (0.26)	0.85 (0.59)
Constant	5.51*** (1.27)	5.82*** (0.89)	5.90*** (1.13)	4.70* (2.89)	5.84*** (1.11)	6.65*** (0.53)	6.42*** (0.68)	5.89*** (1.09)	2.99 (3.25)
Observations	44	43	35	27	14	8	11	10	7
R-squared	0.40	0.49	0.35	0.75	0.90	0.86	0.75	0.79	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All columns are instrumented with the ABCC numeracy index of the respective birth decade, the share of population living in moderate zone, and French legal origin.

Figure 0. Main views on institutional and human capital determinants of income

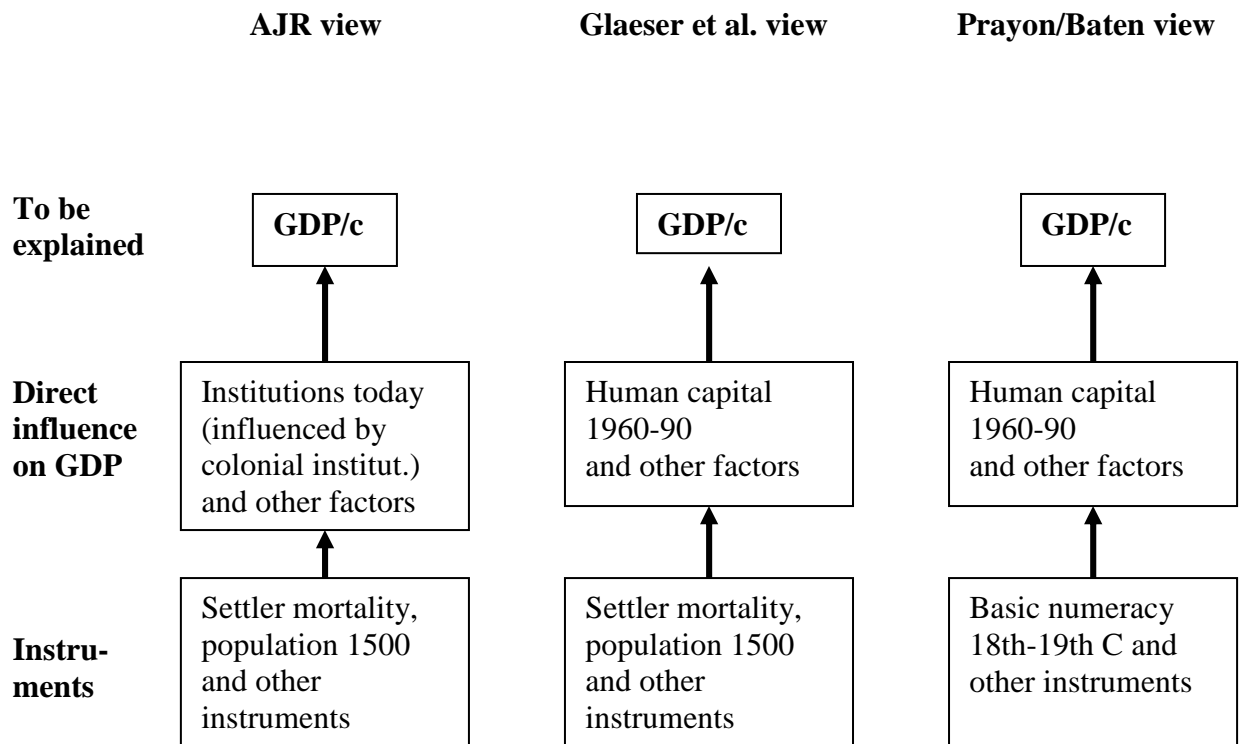


Figure 1. Long-run numeracy trends (ABCC-index) for former colonies in the Americas

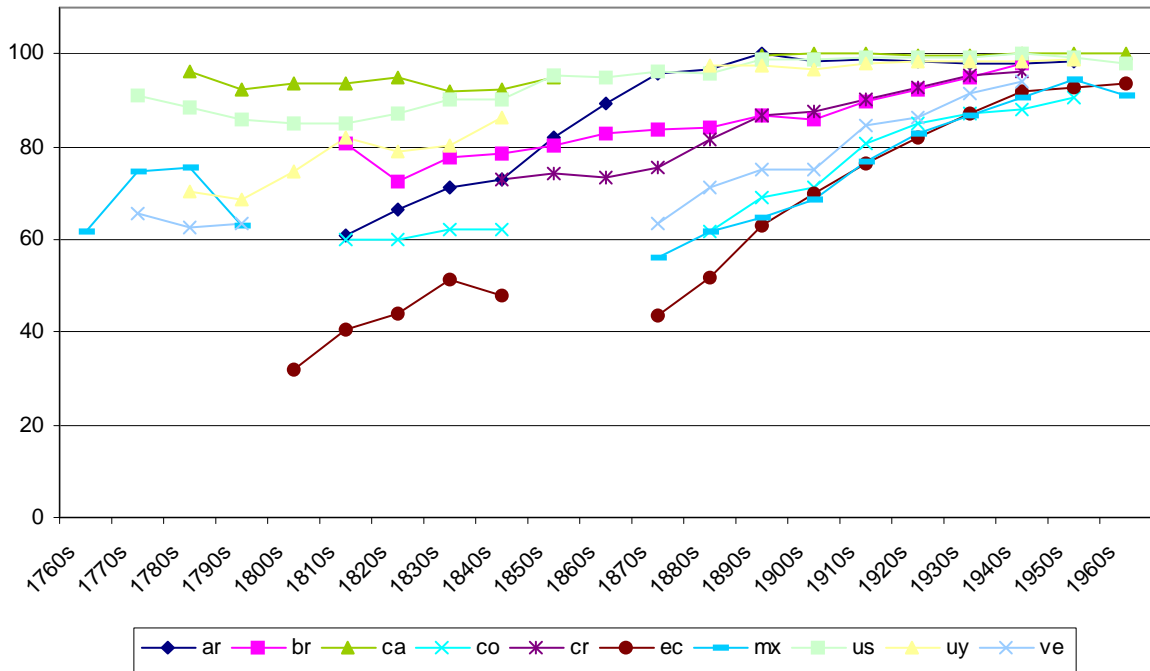


Figure 2. Numeracy trends (ABCC-index) for former colonies in the Americas II

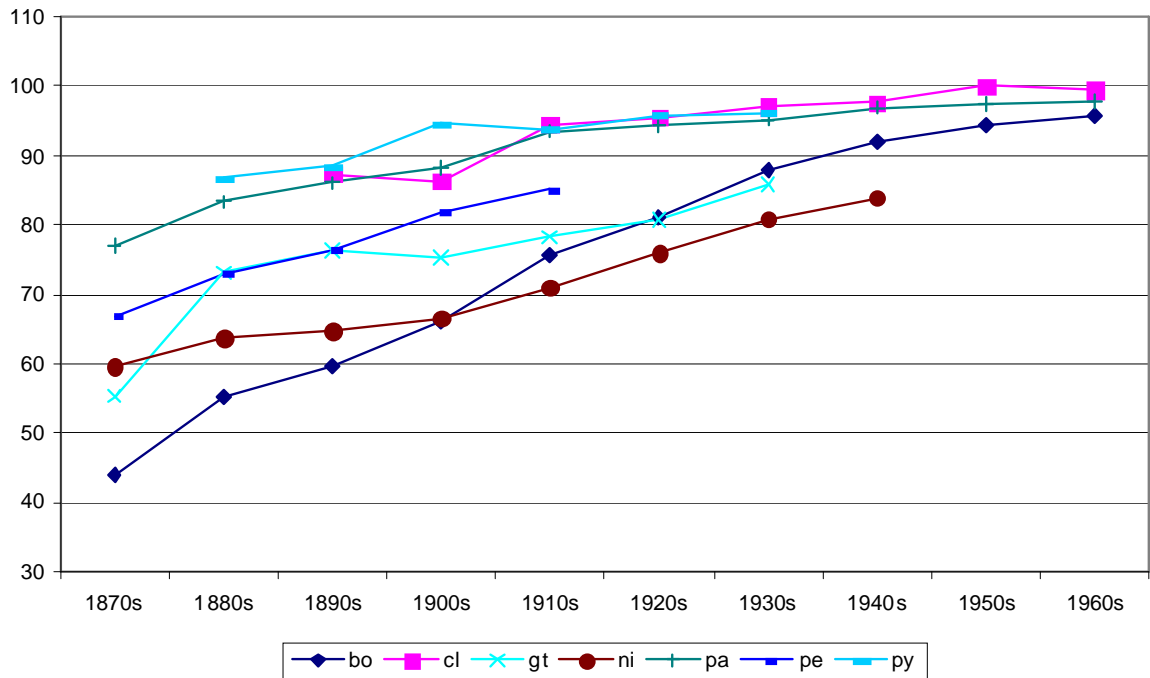


Figure 3. Numeracy trends (ABCC-index) for former colonies in the Americas III

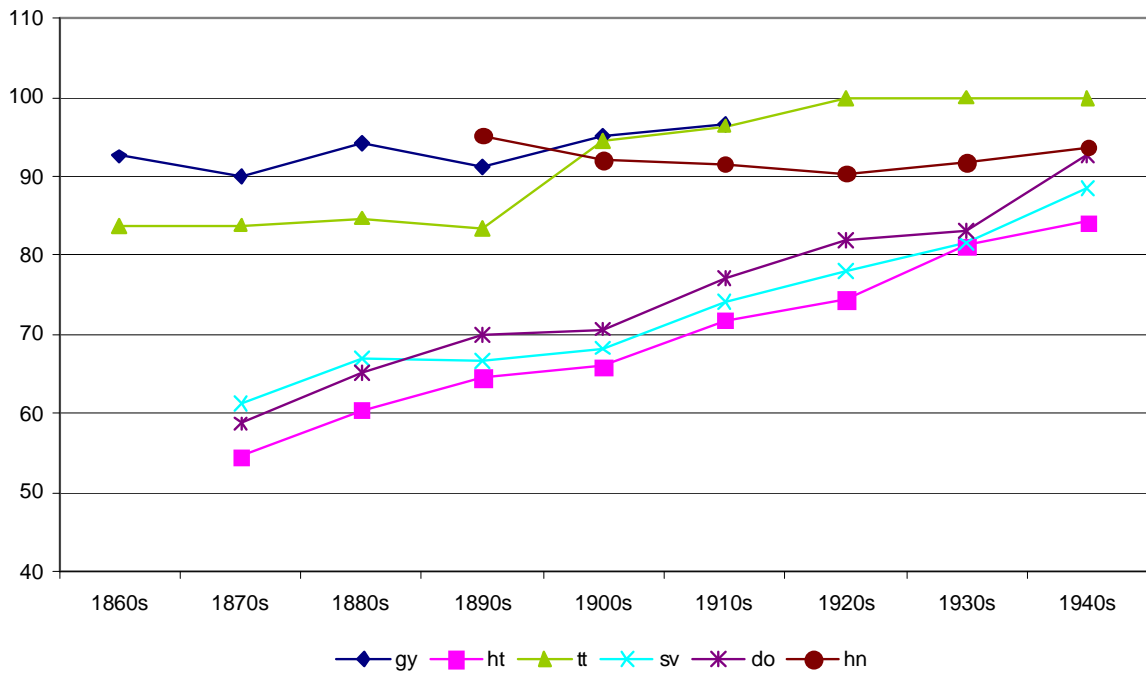


Figure 4. Numeracy trends (ABCC-index) for former colonies in North Africa

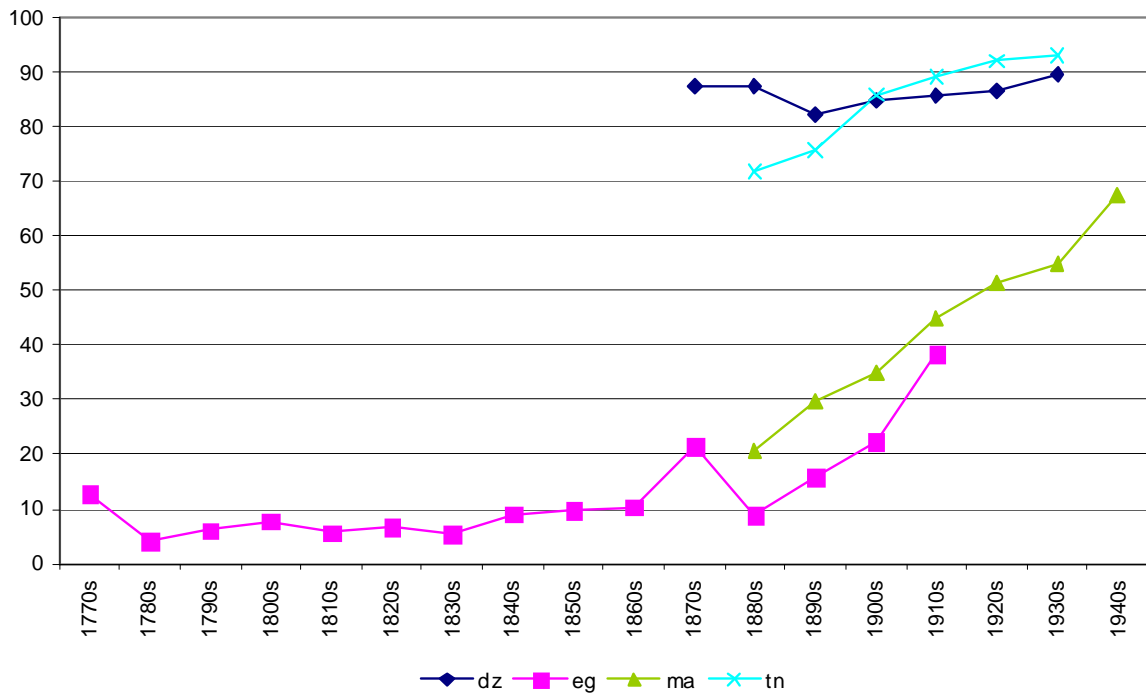


Figure 5. Numeracy trends (ABCC-index) for former colonies in West Africa

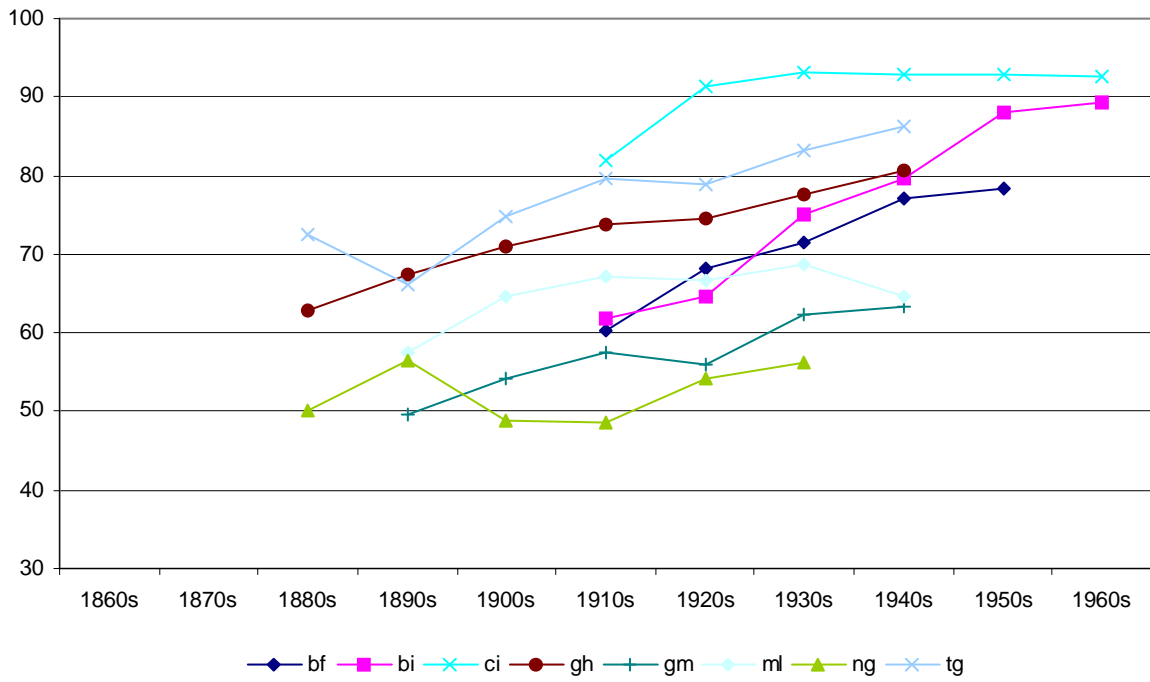


Figure 6. Numeracy trends (ABCC-index) for former colonies in East, Central and South Africa

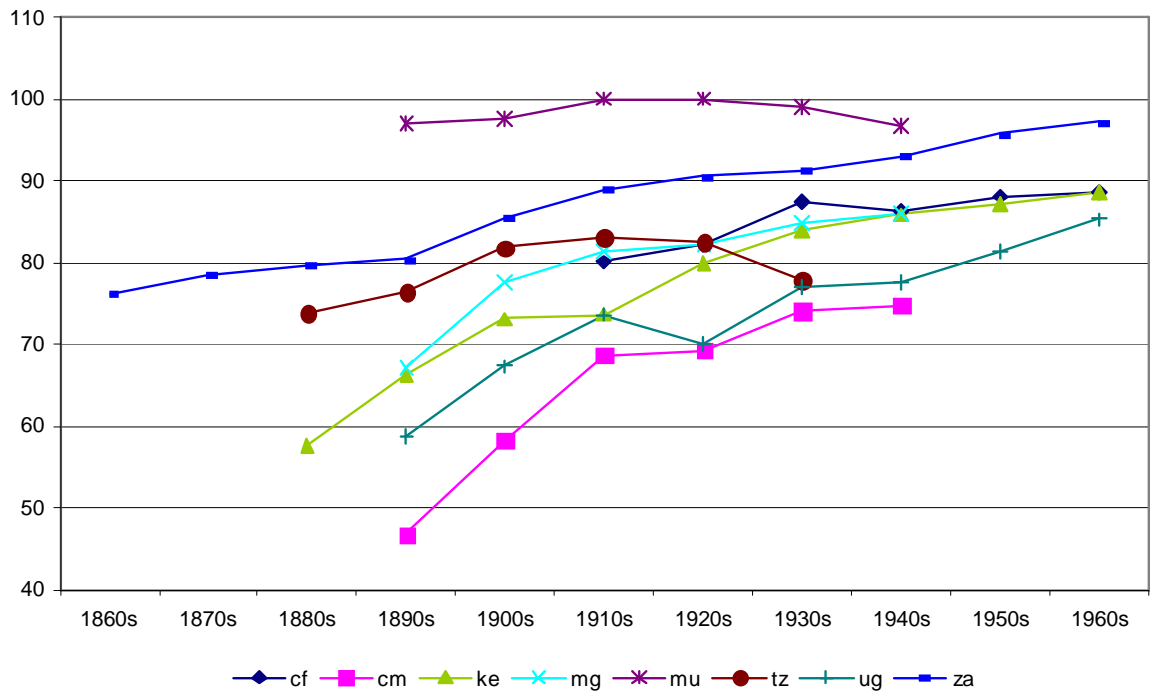


Figure 7. Numeracy trends (ABCC-index) for former colonies in Asia and Pacific

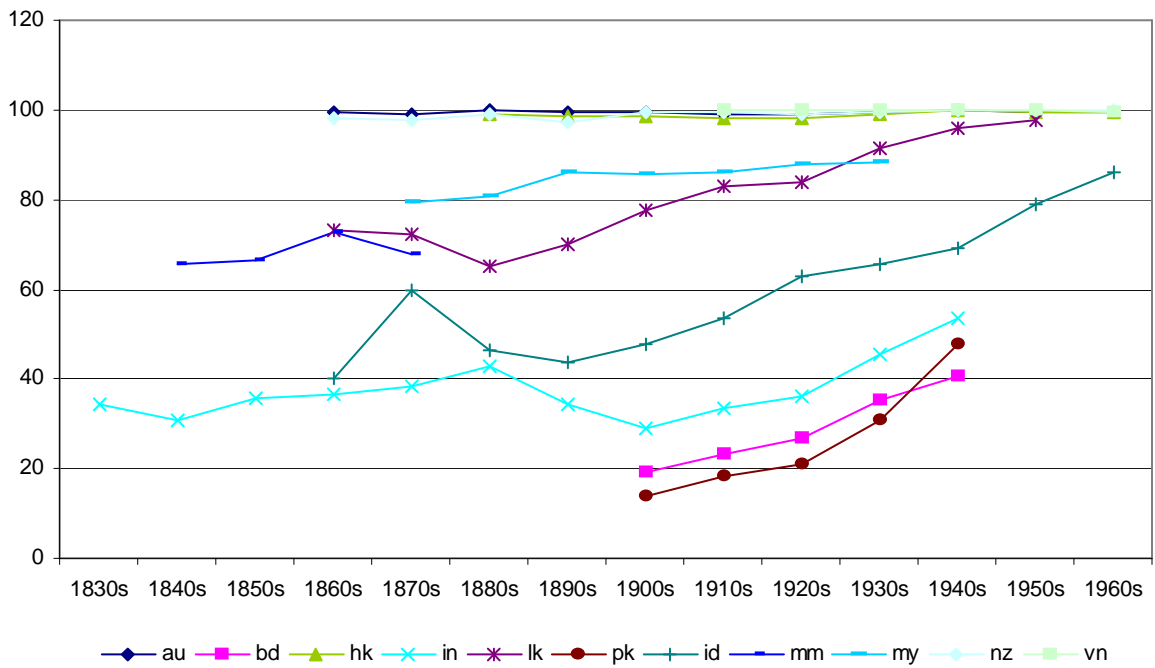
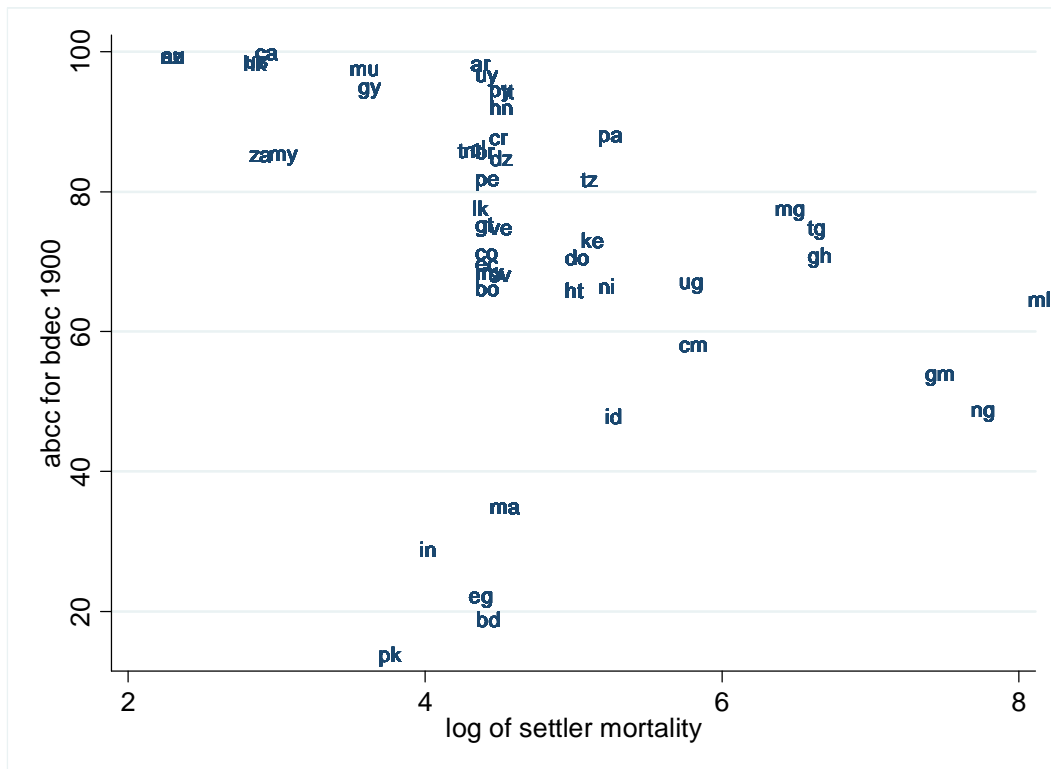


Figure 8. Numeracy (ABCC-index) vs. log settler mortality in 1900



Appendix I: Variable Definitions

ABCC

See section 2 for details.

Data sources: See the documentation in Crayen and Baten (2009a), Manzel and Baten (2009a, b). Additional sources: Ecuador 1870 (thanks to Dacia-Tania Juif and Heike Schmutz for providing the archival data).

Executive constraints

A measure of extent of institutional constraints on the decision main powers of chief executives. The variable ranges from 1 (unlimited authority) to 7 (executive parity or subordination). This variable is calculated as the average from 1960 to 2000, whereas the values -66,-77,-88 for periods of interruption or transition were converted to missing values.

Source: Jagers and Marshall (2000). Center for International Development and Conflict Management, University of Maryland.

Data available online at: <http://www.systemicpeace.org/polity/polity4.htm>

This paper uses the data from the Polity IV Dataset version p4v2007.

French legal origin

Dummy variable that identifies the French legal origin of the company law or commercial code of each country.

Source: La Porta et al. (1999).

GDP per capita

Gross domestic product per capita.

Source: Heston et al. (2002).

Data available online at: http://pwt.econ.upenn.edu/php_site/pwt_index.php

This paper uses the data from the PWT 6.1 version (base year 1996).

Log settler mortality

Log of the mortality rate faced by European settlers at the time of colonization.

Source: Acemoglu, Johnson, and Robinson (2001).

Population density in 1500

Total population divided by total arable land in 1500 A.D.

Source: McEvedy and Jones (1978) as cited by Acemoglu, Johnson, and Robinson (2002).

Share of population living in temperate zone

Percentage of a country's population in Koeppen-Geiger temperate zone in 1995.

Source: Center for International Development, Geography Data sets, General Measures of Geography, Köppen-Geiger Climate zones.

Data available online at: <http://www.cid.harvard.edu/ciddata/ciddata.html>

Years of Schooling

Years of schooling of the total population aged over 25. This variable is constructed as the average from 1960 through 2000.

Source: Barro and Lee (2000). Center for International Development.

Data available online at: <http://www.cid.harvard.edu/ciddata/ciddata.html>