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Institutions and the long-run impact of early development

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ABSTRACT

We study the role of institutional development as a causal mechanism of history affecting current economic performance. Several indicators capturing different dimensions of early development in 1500 AD are used to remove the endogenous component of the variations in institutions. These indicators are adjusted with large-scale movements of people across international borders using the global migration matrix of Putterman and Weil (2010) to account for the fact that the ancestors of a population have facilitated the diffusion of knowledge when they migrate. The exogenous component of institutions due to historical development is found to be a significant determinant of current output. By demonstrating that the relationship between early development and current economic performance works through the channel of institutions and that better institutions can be traced back to historical factors, the results of this paper shed some light on how history has played a role in shaping long-run comparative development.

1. Introduction

This paper studies the role of institutions as a channel through which historical development influences current economic outcomes. The issue of whether history matters for current economic performance has received considerable attention from recent contributions to the literature on long-run comparative development. For example, Nunn (2008) provides evidence showing that Africa's external trade in slaves had a permanent negative impact on economic development in the region. Comin et al. (2010) measure the level of technology for the periods up to 1000 BC, 1 AD and 1500 AD and find that historical rates of technology adoption show a high level of persistence over the last three millennia. They also find that the 1500 AD indicator of technological sophistication is most strongly associated with per capita income today.[1] Putterman and Weil (2010) demonstrate that the length of state history and the timing of agricultural transition are robust predictors for current levels of income.[2] Their findings also indicate that the predictability of these indicators improves substantially once they are adjusted for the location of the current populations' ancestors in 1500 AD, hence suggesting that cross border migration influenced early development's impact on contemporary countries through the dissemination and exchange of knowledge.

While the importance of these historical factors for growth in the very long run and for understanding the variation of income levels across countries today have been well documented in the literature, it is not clear if these effects run through some intermediate channels rather than affect growth or income levels directly. One important channel through which history can affect economic outcomes is institutions (Acemoglu and Robinson, 2012; Nunn, 2009; Putterman and Weil, 2010). Building on the earlier contributions of North and Thomas (1973) and North (1981), who highlight the fact that countries with good institutions are able to use their factors of production more efficiently to achieve higher levels of income, Acemoglu et al. (2001), Engerman and Sokoloff (1997), and La Porta et al. (1997) argue that differences in economic performance today are due to colonial rule that created completely different institutional development trajectories. Hence, their argument concentrates on institutional development as a causal mechanism through which colonial rule influences economic development.

These studies, along with the subsequent contributions of Acemoglu et al. (2002) and Acemoglu and Johnson (2005), among others, focus almost exclusively on the effects of the European expansion and colonialism since the sixteenth century that resulted in the evolution of institutions, and hence the different development paths for former colonies. However, we cannot rule out the possibility that historical factors prior to the major colonization of modern times have also played an influential role in the evolution of institutional development. This paper investigates how current income can be traced to historical forces through the process of institutional development by analyzing the

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[1] Using more recent and comprehensive data on the diffusion of technologies, Comin and Hobijn (2010) show that technology adoption lags have shortened substantially in the past few decades, and the timing of adoption of new technologies over the last two centuries accounts for at least 25% of the cross-country differences in per capita income.

[2] See also the previous contributions of Bockstette et al. (2002), Burkett et al. (1999), Chanda and Putterman (2005), Chanda and Putterman (2007), Putterman (2000) and Putterman (2008).

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specific roles of an early development of successful agrarian systems, the historic presence and formation of polities and state societies, the level of ancient technological sophistication, the ease of adopting the frontiers' technologies due to genetic similarity and geographical proximity, and the extent of economic prosperity up to 1500 AD.

The idea that good institutions are precipitated by the above historical forces is not new. For instance, Diamond (1997) proposes that superior modes of agricultural production following the transition from hunting and gathering to sedentary agriculture, or the Neolithic transition, led to the accumulation of food surpluses. The availability of excess food thus enabled the creation of a class of specialists who could engage in writing legal codes, defining property rights, and developing initial social and political structures, which formed the basis for subsequent institution building.

The emergence of early polities and state societies is another major contributing factor for institutional development. A longer history of statehood, which is often associated with stronger political integration, is deemed conducive to improving institutional capacity because efficient and stable states have more competent bureaucrats who can design effective rules of law (Bockstette et al., 2002). Effective states can also foster linguistic unity that harmonizes social interaction and facilitates the adoption of social norms that reduces the risks of creating weak and fragile states (Chanda and Putterman, 2007).

Furthermore, Mokyr (2003) argues that, historically, institutions and technology have substantial interaction. The effect of technology on institutions can work through several mechanisms. For instance, technological development in the military altered the balance of power between ordinary people and government, thus enabling the creation of centralized states that subsequently provided the rule of law in the modern world. Rapid technological change had also contributed to institutional development when a “factory system” emerged during the Industrial Revolution. Workers were expected to follow certain rules such as being cooperative, punctual, disciplined and willing to accept guidance, all of which lay the foundations of present day institutions.

We argue in this paper that the effects of early development on institutions and how current performance is shaped by historical events are not two unrelated consequences, and hypothesize that the relationship between history and current income reflects the effect of early development working through institutions. To test this hypothesis, we regress current income on previous decade institutions, and instrument the latter using seven different indicators of pre-modern development, henceforth PMD, in 1500 AD, including the timing of agricultural transition, state history, the historical rate of technology adoption, geographical proximity to the regional frontier, genetic similarity to the global frontier, population density, and their first principal component to capture various dimensions of early development. These indicators are adjusted for the effects of global migration using the cross-border population flow data of Putterman and Weil (2010) to account for the fact that when people migrate they bring with them their know-how and ideas. Current institutions are measured as the first principal component of the six Worldwide Governance Indicators of the World Bank, namely voice and accountability, political stability, rule of law, control for corruption, regulatory quality, and government effectiveness.

Our first-stage regressions of current institutions on the above-mentioned individual indicators of PMD deliver economically and statistically significant effects. Technological adoption rates and the overall early development indicator (i.e., the first principal component) are found to be the most significant determinants of institutions. The significance of these migration-adjusted estimates also suggests that the diffusion of knowledge or innovation through cross-border migration has been crucial for institutional development. Our results, based on the two-stage least squares estimator, provide evidence that the exogenous component of the variations in institutions extracted by PMD measures in 1500 AD significantly determines current income.

These estimates rest on the key premise that institutional development is the mechanism through which historical development in the pre-modern eras influences current economic performance. Hence, the exclusion restriction implied by our instrumental variable approach is that PMD in 1500 AD has no direct impact on current income, other than through institutional development. Test results of over-identifying assumptions indeed suggest that the effect of PMD on income only operates through institutions, thus satisfying the exclusion restriction. A major concern with this identification strategy, however, is that our measures of PMD could be correlated with some variables, which may have a direct effect on current economic performance. To ensure that our results are not driven by omitted factors, we control for a number of factors which are potentially correlated with PMD and current income. The estimates are remarkably consistent when we include controls for religion, human capital, early institutions, legal origins, geographic factors, and continent fixed effects.

Our work is closely related to the influential study of Acemoglu et al. (2001), who use data on European settler mortality rates, mostly in the 19th century, to provide evidence that changes in the institutional development resulting from European colonialism has a persistent effect on today's income. Instead of focusing on the role of the European expansion, we show in this paper that historical forces predating European settlement such as the timing of agricultural settlement, the historic presence of supratribal polities, the adoption rates of primitive technology, the accessibility to historical frontier technologies due to geographical and human genetic barriers, and past economic prosperity could have a long-term impact on current performance through influencing the subsequent institutional development. This paper is also related to the important contribution of Putterman and Weil (2010), who show that an early transition to agriculture and a longer state presence are both associated with higher levels of current income, and that state development is positively correlated with several measures of institutional quality, including executive constraint, expropriation risk and government effectiveness. However, the mechanism explaining how agricultural transition and state history, as well as other dimensions of early development considered in this paper, are causally related to income and institutions is not addressed in their study.

This paper proceeds as follows. Section 2 describes the data. The next section presents and discusses the empirical estimates. Several robustness checks are provided in Section 4. Section 5 conducts some further analyses to throw some light on how early development is linked to current income through various dimensions of governance and how different aspects of early technological development affect subsequent institutional development. Section 6 concludes.

2. Data

This section describes the key variables used before presenting the empirical estimates in the next section. A summary list of all variables used, their definitions and data sources is provided in the Appendix (see Table A1). Summary statistics and the correlation structure of these variables are also presented in the Appendix (see Tables A2 and A3, respectively).

2.1. Quality of institutions

The quality of institutions is a summary measure of several key dimensions of their development constructed using the World Bank's Worldwide Governance Indicators, including: 1) voice and accountability; 2) political stability; 3) rule of law; 4) control for corruption; 5) regulatory quality; and 6) government effectiveness. The data are provided for more than 200 countries over the period 1996–2009. These indicators are constructed using a wide variety of different sources, which reflect governance perceptions reported by survey respondents, public, private and other non-governmental organizations worldwide. A detailed description of the methodology used to construct this data set is provided by Kaufmann et al. (2010).

Data presented in percentile rank terms ranging from 0 to 100 for each country are used, where 0 corresponds to the lowest ranked institutions. Ranking scores for these six indicators are then averaged over the period 1996 to 2005 and combined into a composite index using the method of principal component analysis. This variable is then divided by the maximum value in order to give a measure that varies between 0 and 1. A larger value for the summary index signifies better institutions or greater institutional development. This measure is appropriate for the purpose of our study to provide an overall indicator of the quality of institutions that covers major dimensions of their development. Alternative measures including the social infrastructure index of Hall and Jones (1999) and the International Country Risk Guide (ICRG) composite index of Knack and Keefer (1995) are also used for robustness checks.

2.2. Pre-modern development indicators

We consider six related but distinct measures of PMD in 1500 AD as instruments for institutions. In addition to using these individual variables, we also extract their first principal component as a summary measure indicating the overall earlier development in 1500 AD. The details are as follows:

(a) *The timing of agricultural transition* [*Agr.Tran*].
The timing of agricultural transition reflects, in 1500 AD, the estimated thousands of years since the transition from hunting and gathering systems to sedentary agriculture had occurred. A higher value implies an earlier transition to agriculture. Using a large number of sources, the transition years are estimated by Putterman (2006) based on the first year in which more than half of a human's calorific needs were obtained from cultivated plants and domesticated animals. In the sample of 99 countries used in this study, the transition to agriculture is estimated to have first occurred in the Syrian Arab Republic (10 thousand years before 1500 AD) and last occurred in New Zealand (300 years before 1500 AD).

(b) *State history* [*State Hist.*].
The early development of political institutions is measured using the state antiquity index of Putterman (2004). The index gives a score between 0 and 50 for every fifty years from 1 AD to 1950 AD to reflect: 1) the presence of a government above the tribal level, 2) whether this government is foreign or locally based; and 3) the proportion of the current territory covered by this government. State history covering fifteen centuries since 1 AD is calculated as follows:

$$State\ Hist. = \frac{\sum_{t=1}^{30} (1.05)^{1-t} \cdot S_{i,t}}{\sum_{t=1}^{30} (1.05)^{1-t} \cdot 50} \qquad (1)$$

where $S_{i,t}$ is the state history for country *i* for the fifty-year period *t*. A five percent discount rate is applied to each of the half centuries to account for the diminishing effects of political institutions formed in the more distant past.[3] The use of alternative depreciation rates such as zero or ten percent does not change the results in any significant manner. The resulting index ranges between 0 and 1, with a higher value reflecting the presence of a longer state history or more developed political institutions.

(c) *Technology adoption* [*Tech.Adop.*].
Comin et al. (2010) provide data for the overall technology adoption rate in 1500 AD. The data cover technologies adopted in the following five sectors with a total of 24 state-of-the-art technologies: 1) agriculture; 2) transportation; 3) communications; 4) industry; and 5) military. The average adoption rate is first calculated for each sector. The overall adoption level is then taken as the unweighted average adoption rate for all sectors, which yields an index value between 0 and 1 for the extent of technological adoption. In the sample of countries considered in this study, Paraguay and Uruguay had not adopted any of the included technology in 1500 AD whereas France, Greece, Portugal and Spain achieved an adoption rate higher than 0.9.

(d) *Geographical proximity to the regional frontier* [*Geog.Prox.*].
Geographical distance between two countries is estimated using the 'Haversine' formula, which calculates the shortest distance between two countries on the surface of the globe using the longitudes and latitudes of their center points. Following Ashraf and Galor (2011, 2013), the regional frontier is identified as one of the two countries having the highest population density in 1500 AD in each continent. For example, France and the United Kingdom are chosen as the economic leaders for Europe, given that they had the highest levels of population density in 1500 AD. In this case, the frontier for Switzerland would be France rather than the United Kingdom since France is situated closer to Switzerland. Geographical proximity to the regional frontier for a country is then calculated as: $1-\left(\frac{Geog.Dist._{i,RF}}{Geog.Dist._{Max}}\right)$ where $Geog.Dist._{i,RF}$ is the geographical distance between country *i* and its regional frontier *RF* and $Geog.Dist._{Max}$ is the maximum distance in the sample. The results are almost identical if proximity is calculated using the largest distance between two countries in each continent instead. Countries located closer to the regional leader have greater opportunity to trade and interact with the frontier, thus facilitating the adoption and adaptation of the institutional framework created at the frontier.[4]

(e) *Genetic proximity to the global frontier* [*Genetic Prox.*].
This measure captures the ease of diffusing cultural traits and institutions across countries. Spolaore and Wacziarg (2009) measure genetic distance from the technological leader using the fixation index (F_{ST}), which reflects the degree of genetic dissimilarity or historical unrelatedness between the population of the U.S. (the leader) and the population of the country under consideration. F_{ST} takes a value between 0 and 1, where 0 indicates that two populations are genetically identical and 1 indicates that they are genetically unrelated. We modify their data and calculate genetic proximity to the global frontier in 1500 AD as $1-\left(\frac{F_{ST\,i,GF}}{F_{ST\,Max}}\right)$, where $F_{STi,GF}$ is the genetic distance between country *i* and the global frontier *GF* and F_{STMax} is the largest genetic distance in the sample. Following Spolaore and Wacziarg (2009), we choose the UK as the global frontier due to its sophisticated level of technological development in 1500 AD relative to the rest of the world.[5] Data on populations are matched to countries

[3] This approach of measuring state antiquity is consistent with Ang (2012, 2013), Bockstette et al. (2002), Chanda and Putterman (2007), Putterman (2008), Putterman and Weil (2010).

[4] However, using population density estimates in 1500 AD as the basis for determining the frontier country in each continent is not without criticisms. In particular, the use of this measure can be problematic insofar as larger countries such as Australia, Canada, China, Egypt and Russia have vast virtually uninhabited hinterlands or deserts whereas smaller countries such as Japan, Netherlands and the U.K. do not. To the extent that the majority of the population in each of these larger countries has always lived within a small part of the total land area, the use of population density to capture the extent of general economic development is imprecise. We use the original estimates since any adjustments to the data may be subject to some arbitrariness, and despite this limitation, China and Egypt still are amongst the most densely populated countries in their continents and are both chosen to be one of the regional leaders.

[5] According to the technology adoption index of Comin et al. (2010), the countries that had the highest adoption rates of technology in 1500 AD were Britain and Spain. We choose the UK as the global technological leader rather than Spain since, according to Maddison (2010), its per capita income and population density in 1500 AD were both higher than Spain. This is also consistent with the fact that an unprecedented explosion of new technological inventions occurred in the UK but not Spain over the next 200 years, leading to the onset of the British Industrial Revolution in the 1700s.

based on their ethnic composition as of 1500 AD. A higher value reflects greater genetic similarity between the global leader and the country under consideration in 1500 AD or a shorter period of separation between their populations.

(f) *Population density* [*Pop.Den.*].
Population density is the total population in 1500 AD divided by land area. It provides a basic measure for the level of prosperity, wealth and general well-being of an economy. Higher population density implies the emergence of populous and affluent societies, which have the resources to build good institutions. Data on population and land are obtained from McEvedy and Jones (1978) and the World Bank's World Development indicators, respectively. The historical population estimates of McEvedy and Jones (1978) are, in some cases, provided for groups consisting of several adjacent countries (e.g., Indonesia, Malaysia and Singapore). In these cases, population data for each country are estimated according to the relative proportions of their land areas. This procedure is also used to estimate the population data for contemporary countries which belonged to a larger political entity in 1975 such as the former Czechoslovakia and Yugoslavia.

2.3. The composite indicator of pre-modern development [PC]

In principle, these measures should be highly correlated as only countries with high agricultural productivity, well-developed political institutions, sophisticated technological development and low developmental diffusion barriers are relatively prosperous and could support a denser population, and vice versa. The correlation coefficients are all highly significant and show an average value of 0.6 (see Table A3). Hence, using all these indicators in the same regression may pose some estimation difficulties. Our identification strategy may also be considerably weakened with the use of too many instruments. One solution for this problem is to construct a summary indicator that captures all these dimensions of early development using the first principal component of these six indicators. Accordingly, all measures are standardized so that they represent deviations from the mean divided by the standard deviation to ensure comparability. The results are very similar if the simple average is used instead. The resulting composite index is significantly positively correlated with all indicators of PMD, with correlation coefficients ranging from 0.7 (population density) to 0.9 (technology adoption), thus suggesting that it is an appropriate measure of overall early development covering all its major dimensions.

2.4. Adjusting for the effects of global migration (ancestry adjustment)

In their seminal contribution, Putterman and Weil (2010) highlight the fact that significant movements of people across borders due to slavery, colonialism, wars of conquest and voluntary migration over the last five centuries may have important implications for comparative development today. Our estimates may therefore be biased due to the failure to account for dramatic changes in the composition of population in a region following large-scale movements of people. To address this concern, all indicators capturing different aspects of early historical development are adjusted using the global migration matrix constructed by Putterman and Weil (2010), who provide the estimated proportions by location, in 1500 AD, of the ancestors of each country's current population.

Accordingly, the ancestry-adjusted measures of early development are derived by pre-multiplying vectors of each early development indicator by this global migration matrix. The resulting migration-adjusted measures reflect the history of a population's ancestors, thereby allowing us to check whether the diffusion of ideas through cross-border movements of people has been an important channel shaping current levels of institutional development. In other words, this exercise sheds some light on whether current institutional development is related more to the people who brought in technology, human capital and knowledge through cross-border movements than to the actual location where historical development first took place.

The results of performing adjustments for migration on these measures are presented in Fig. 1. Take agricultural transition as an example. The adjusted and unadjusted values are similar for a large number of countries which have experienced little inward migration. However, there are also many countries that lie in the northwest quadrant of the diagram. These countries typically have relatively late transitions to agriculture, and yet their early development has benefited from the ancestors who migrated from more prosperous origins. The resulting mean values of all these ancestry-adjusted variables are, on average, 15% higher than their unadjusted counterparts, suggesting that the impact of global migration is quite substantial. Fig. 2 displays the distribution of the composite index of all early development measures across countries. As is evident, the distribution of the level of PMD (ancestry-adjusted) in 1500 AD is highly dispersed across the world.

3. Empirical estimates

The following linear regression model is estimated to investigate how institutional development is related to current economic performance:

$$\ln Y_i = \alpha + \beta INS_i + cv_i^{'}\gamma + \varepsilon_i \tag{2}$$

where Y denotes per capita GDP in 2005 measured in constant 2005 international dollars using PPP rates, INS is an indicator of the quality of institutions, cv' is a vector of control variables, and ε is an unobserved error term. β is the coefficient of interest and is expected to carry a positive sign. Note that INS and ε are likely to be correlated since institutional development is endogenous to income.

3.1. Correlation between income and institutions

Fig. 3 provides the scatter plots and reports the univariate least square regression results of log per capita income on institutions for the sample of 99 countries used in the present study. The selection of these countries is dictated by the data availability of all early development indicators. However, it should be highlighted that these countries are sufficiently representative of the whole world, given that they jointly accounted for 92% of global population in 2005. The diagram depicts a clear positive relationship between current output and institutions. The regression results confirm the visual impression that there is a very strong and significant correlation between income and institutions, with an estimated coefficient of 3.901 on institutions. Using data for all available countries (180 observations) produces an almost identical estimate of 3.918 with a similar robust standard error of 0.205 but a slightly lower R-squared value of 0.620.

However, these coefficients cannot be interpreted as reflecting a causal influence of institutions on income due to several reasons. First, it is likely that only affluent economies can afford, or are more capable of creating, better institutions and so causality can run from income to institutions. Second, there may be other unobserved omitted determinants of current income that also correlate with institutions. Finally, indicators of institutions may be measured with errors since they are often constructed ex post based on survey data (Glaeser et al., 2004), and this may create attenuation that biases the OLS estimate downwards. These problems, however, can be dealt with using an instrumental variable approach by isolating the exogenous source of variation in institutions so as to identify the causal impact of institutions on income.

3.2. Instrumental variable regressions

Our previous discussion suggests that indicators of PMD are appropriate instruments for institutional development. In this case, the

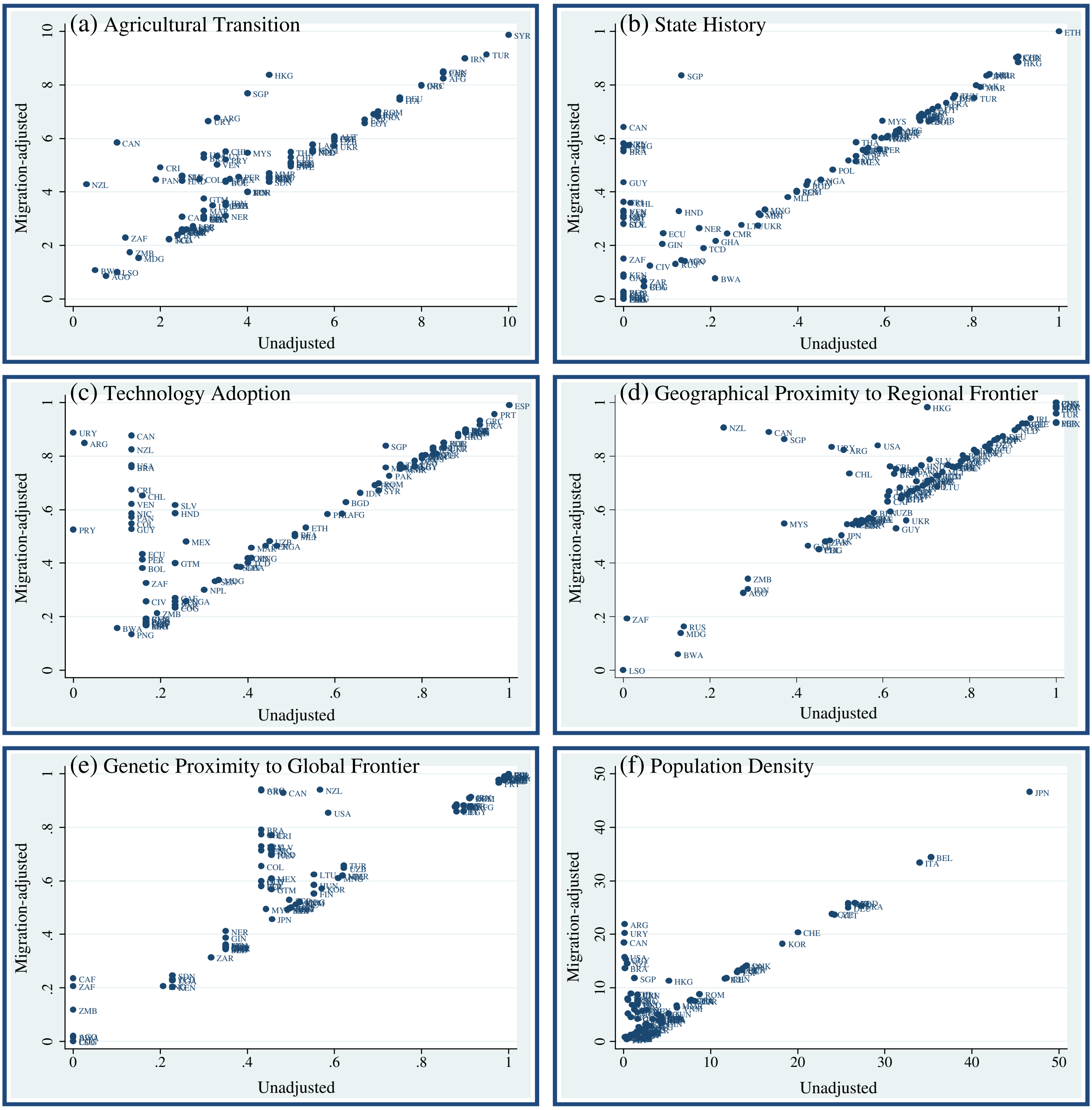

Fig. 1. Migration-adjusted against unadjusted measures of pre-modern development in 1500 AD. Notes: the above scatter plots illustrate the differences between the migration-adjusted and the unadjusted measures of pre-modern development in 1500 AD for the 99 countries used in the regressions. Larger values correspond to higher levels of economic development during the pre-modern eras.

variation in institutions that is exogenous due to history will be isolated by these instruments from the endogenous variation in institutions due to the unobserved error term. Our identification strategy will be valid as long as the PMD measures are uncorrelated with the residuals. In other words, PMD is assumed to have no influence on income today other than through its effect on institutional development.

The two-stage least square estimates of Eq. (2) are presented in Table 1. Here, institutions are treated as endogenous and the equation of institutions is specified as follows:

$$INS_i = \pi + \rho PMD_i + cv_i^{'}\sigma + \mu_i \quad (3)$$

where *PMD* is an indicator of pre-modern development in 1500 AD and μ is the residual.

The seven indicators of PMD, which capture different dimensions of early development in 1500 AD, will be used individually in the regressions. As discussed previously, all these indicators are adjusted for the effects of global migration in light of the findings of Putterman and Weil (2010) that ancestry-adjusted historical development measures have substantially stronger power in explaining variations in long-term development across countries. Although all original measures were also considered initially, three of them were found to have poor explanatory power, and thus would serve as weak instruments for institutions. These results are reported in Table A4 in the Appendix. When

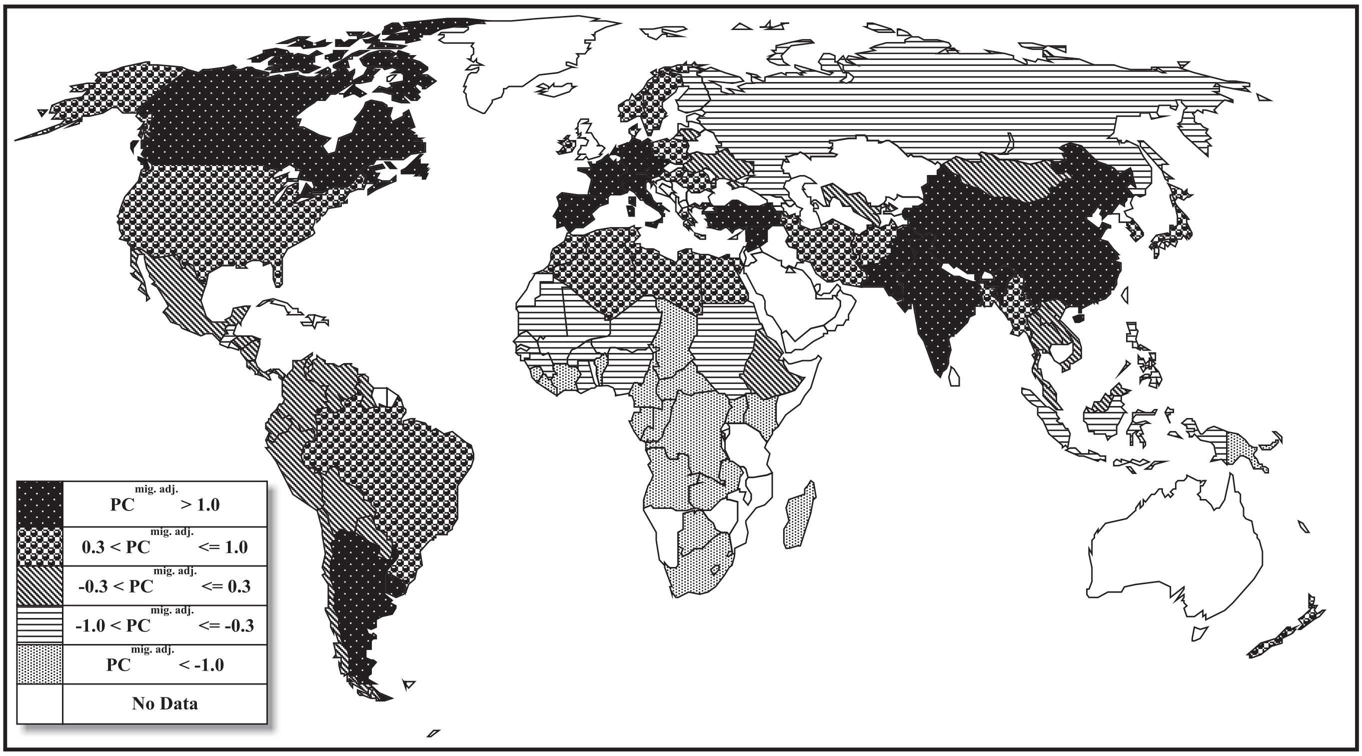

Fig. 2. Distribution of the 1st principal component of all pre-modern development indicators (ancestry-adjusted) in 1500 AD. Notes: the above show the levels of pre-modern development in 1500 AD, measured by $PC^{mig.\ adj.}$, for the 99 countries used in the regressions. $PC^{mig.\ adj.}$ is the first principal component of the following standardized measures of pre-modern development, all of which are measured as of 1500 AD and are adjusted for the global migration effects to reflect the history of the current population's ancestors: 1) the timing of agricultural transition (*Agr.Tran.*$^{mig.\ adj.}$), 2) state history (*State Hist.*$^{mig.\ adj.}$), 3) technology adoption (*Tech.Adop.*$^{mig.\ adj.}$), 4) geographical proximity to the regional frontier (*Geog.Prox.*$^{mig.\ adj.}$), 5) genetic proximity to the global frontier (*Genetic Prox.*$^{mig.\ adj.}$), and 6) population density (*Pop.Den.*$^{mig.\ adj.}$).

we regress institutions on both the original PMD measures and their ancestry-adjusted counterparts in the same specification to provide a horse race for them, as shown in Table A5 in the Appendix, only the adjusted measures turn out to be both economically and statistically significant. Hence, consistent with Putterman and Weil (2010), the results clearly indicate that the ancestry-adjusted measures are superior to their original counterparts. These findings suggest that a country that has more ancestors who lived in prosperous places tends to have better institutions today, highlighting the fact that knowledge transmission through migration has played a large part in improving institutional development.

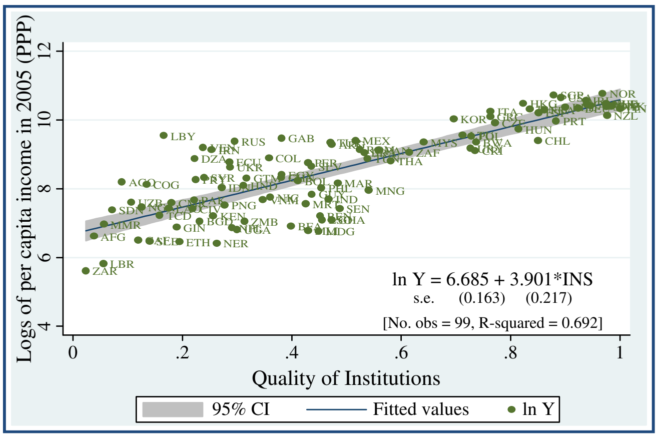

Fig. 3. Per capita income in 2005 (PPP) against average quality of institutions (1996–2005). Notes: *lnY* is GDP per capita (PPP) in 2005 whereas *INS* refers to the average quality of institutions over 1996–2005. *INS* is the first principal component of the six worldwide government indicators of Kaufmann et al. (2010). Figures in round parentheses indicate robust standard errors.

Fig. 4 plots current output against the first principal component of the seven indicators of PMD (migration-adjusted). It shows a strong positive reduced-form correlation. Our hypothesis is that this relationship reflects the effect of early development working through institutional development. Fig. 5 illustrates the relationship between the index of institutions and the first principal component of the seven indicators of PMD (migration-adjusted). The resulting first-stage relationship suggests that countries that were more developed in the pre-modern era tend to have better institutions today.

Next, to test our proposed hypothesis, we estimate the effect of the quality of institutions on current output, using the PMD measures as instruments for institutions. Panel A of Table 1 reports the 2SLS estimates of our coefficient of interests (*INS*) from Eq. (2) whereas panel B provides the corresponding first-stage regressions (Eq. (3)). Countries within the same continents tend to have similar early historical conditions and current performance, and these arbitrary correlations may bias our results. To address this concern, standard errors are clustered by continents to allow for these patterns within continents but not across continents. That is, the observations are assumed to be independent across continents but not within continents. Clustered standard errors by continent are reported below the conventional robust standard errors in each row.

The coefficients of institutions are found to be very precisely estimated, irrespective of which instrument is used for institutional development and whether intra-continent correlations are allowed for. The results suggest that a complete switch from the worst to best institutions could lead to an average 5.674 log-points increase in current income. The resulting coefficients are nearly 50% larger than those reported in Fig. 1, suggesting that the OLS estimates are likely to be plagued by measurement errors which subject the coefficients to attenuation bias.

These 2SLS estimates suggest that institutions can explain a larger fraction of variations in income across countries. For example, the

Table 1
Instrumental variable regressions for income, institutions, and ancestry-adjusted PMD.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var. = ln *Y*	*Panel A: 2SLS estimates*						
INS	7.497	6.427	5.517	5.637	5.654	4.378	5.696
	(1.696)***	(1.110)***	(0.495)***	(1.085)***	(0.702)***	(0.411)***	(0.629)***
	(2.573)**	(2.015)**	(0.884)***	(1.929)**	(0.811)***	(0.438)***	(1.114)***
R-squared	0.104	0.402	0.573	0.555	0.552	0.682	0.546
Dep. Var. = *INS*	*Panel B: 1st-stage results*						
Agr.Tran.$^{mig.\ adj.}$	0.040						
	(0.014)***						
	(0.015)**						
State Hist.$^{mig.\ adj.}$		0.332					
		(0.101)***					
		(0.103)***					
Tech.Adop.$^{mig.\ adj.}$			0.693				
			(0.088)***				
			(0.091)***				
Geog.Prox.$^{mig.\ adj.}$				0.476			
				(0.146)***			
				(0.148)***			
Genetic Prox.$^{mig.\ adj.}$					0.501		
					(0.092)***		
					(0.093)***		
Pop.Den.$^{mig.\ adj.}$						0.016	
						(0.003)***	
						(0.003)***	
PC$^{mig.\ adj.}$							0.153
							(0.027)***
							(0.027)***
R-squared	0.074	0.097	0.371	0.120	0.244	0.265	0.277
F-test on excluded instrument	7.001	10.869	62.578	10.694	29.427	30.779	32.907
	[0.009]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Wooldridge's endogeneity test	11.816	7.594	14.998	3.693	10.208	2.110	12.668
	[0.001]	[0.006]	[0.000]	[0.055]	[0.001]	[0.146]	[0.000]
Durbin's endogeneity test	15.047	10.001	22.602	6.029	14.530	1.205	18.135
	[0.000]	[0.002]	[0.000]	[0.014]	[0.000]	[0.273]	[0.000]
Regression-based endogeneity test	7.379	6.454	50.588	4.593	9.671	0.809	27.579
	[0.053]	[0.064]	[0.002]	[0.098]	[0.036]	[0.419]	[0.006]

Notes: *PC*$^{mig.\ adj.}$ is the first principal component of the following standardized measures of pre-modern development, all of which are measured as of 1500 AD and are adjusted for the global migration effects: 1) the timing of agricultural transition (*Agr.Tran.*$^{mig.\ adj.}$), 2) state history (*State Hist.*$^{mig.\ adj.}$), 3) technology adoption (*Tech.Adop.*$^{mig.\ adj.}$), 4) geographical proximity to the regional frontier (*Geog.Prox.*$^{mig.\ adj.}$), 5) genetic proximity to the global frontier (*Genetic Prox.*$^{mig.\ adj.}$), and 6) population density (*Pop.Den.*$^{mig.\ adj.}$). The total number of observations is 99 in all regressions. The null hypothesis of the endogeneity tests is that institutions can be treated as exogenous. The Wooldridge test, which allows for heteroskedastic and autocorrelated errors, is the robust version of Durbin's test. The regression-based approach is based on robust clustered standard errors (by continents). A constant is included in the regressions but not reported. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. Clustered standard errors, which allow for arbitrary correlations within continents, are reported below the conventional robust standard errors.

* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

Central African Republic had a rather poor quality of institutions of 0.119 out of a total maximum score of one and had a very low level of per capita income of $672. If the Central African Republic had an environment that produced a level of institutional quality similar to that experienced in Italy of 0.763, then the estimated income of the Central African Republic would be $25,960 per person. This new level of income is just slightly below what is enjoyed in Italy now, i.e., $28,282, but would exceed those of the Czech Republic ($20,362) and Greece ($24,348), which have quality of institutions very close to that of Italy. Hence, improving the Central African Republic's institutions to the level of Italy could result in a more than 38-fold increase in the former's income.

The regressions in panel B also show a very strong first-stage relationship between the PMD measures and current institutions. All coefficients of the PMD measures are found to be highly significant at the 1% level, and have the intuitive sign. The estimates are also robust to intra-continent correlation. The results provide evidence that countries that have an early transition to agriculture, a well-established polity and early experience with large-scale public administration, early achievement of technological superiority, greater accessibility to the frontiers' technologies due to lower geographical barriers or genetic differentiation, and the emergence of early populous societies enjoyed greater prosperity and are associated with a better quality of institutions today.

The first-stage *F*-test statistics on the excluded instrument, which has the null hypothesis that a particular PMD measure does not explain cross-country variations in institutions, provide evidence that all but one PMD measures are strong and valid instruments. These results reinforce the first-stage relationship between institutions and PMD observed in Fig. 5. In particular, *Tech.Adop.*$^{mig.\ adj.}$, which is found to be the best instrument, is able to explain more than one third of the variations in current institutions. Its *F*-statistic on the excluded instrument is also six times larger than the size of the usual rule of thumb of 10 (see also the regression results reported in Table A6 in the Appendix). Although *Tech.Adop.*$^{mig.\ adj.}$ is a very useful instrument, its focus on technological development alone is too narrow for our purpose of investigating the effect of early development in 1500 AD on current income via institutions. In light of this, we also choose *PC*$^{mig.\ adj.}$, which is an encompassing measure capturing several distinct dimensions of historical development, as an instrument for institutions in our remaining analyses. Clustered standard errors are not reported in the remaining tables to conserve space, given that the significance of all coefficients remains unchanged in nearly all cases when we allow for intra-continent correlation.

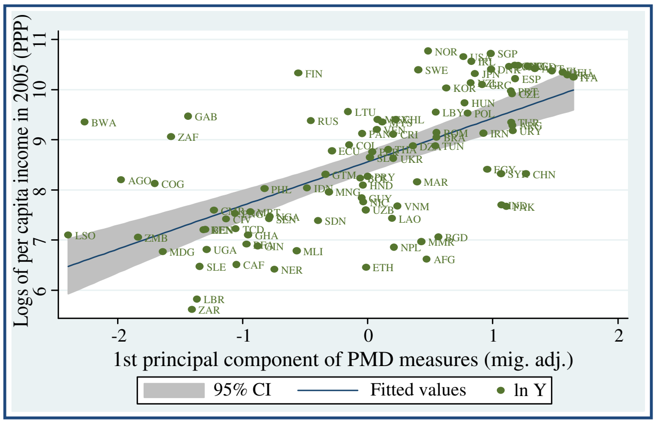

Fig. 4. Reduced-form relationship between income and ancestry-adjusted pre-modern development.

If institutions are in fact exogenous, the 2SLS estimator is less efficient than the OLS estimator. Thus, it is worthwhile performing a test of endogeneity for institutions to check if 2SLS is necessary. Accordingly, the last few rows of Table 1 report three tests of endogeneity, namely the Durbin, the Wooldridge and the regression-based tests. Both the Wooldridge and the regression-based tests allow for heteroskedastic and autocorrelated errors, but only the latter is amenable to clustering. As is evident, these tests reject the null hypothesis that institutional development is exogenous at conventional significance levels in nearly all cases, thus supporting the notion that institutions should be treated as endogenous and the use of instrumental variable techniques is appropriate here.

4. Robustness of results

4.1. Testing for the validity of over-identifying restrictions

Our identification strategy rests on the premise that the PMD measures have no direct statistical effect on income today other than through their effect on institutions. Under this condition, the reverse causality running from output to institutional development, measurement errors associated with institutions, and unobserved omitted variable bias would no longer pose any issue. However, we still need to establish that our identification strategy is valid, which can be facilitated by using tests of over-identifying restrictions. It is important to note, however, that the validity of the exclusion restriction cannot be tested directly because the condition involves the unobservable residual. Thus, we can only provide some partial evidence using tests of over-identifying restrictions to increase the plausibility of the exclusion restriction. The validity of our identification strategy will be rejected if PMD has a direct effect on current income (i.e., PMD is correlated with residuals) or PMD has an indirect effect on current income that works through a channel other than institutions.

To pursue this strategy, we require additional instruments since our model is exactly identified. The literature has established that settler mortality (Acemoglu et al., 2001),[6] tropical endowments (Easterly and Levine, 2003), the fraction of the population speaking a major European language as the first language (Hall and Jones, 1999), and ethnolinguistic fractionalization (Mauro, 1995) significantly explain institutional development. The tests of over-identifying restrictions will be performed under the assumption that the additional instruments are truly exogenous and will test for the exogeneity of the PMD measures. These tests not only partially examine whether our instruments are correlated with the error term, but also provide a mechanism to check whether the structural equation is correctly specified, in that the excluded exogenous variables should in fact be included in the structural equation.

The results of these over-identifying restriction tests are reported in Table 2. In each regression we use one instrument of institutions considered in previous work along with one of our preferred PMD measures, i.e., $Tech.Adop.^{mig.\ adj.}$ or $PC^{mig.\ adj.}$. Overall, the results support our notion that the effect of PMD on income works through institutions. In Panel A, we report the 2SLS estimates of the effect of institutions on per capita GDP. The results are remarkably similar to those reported in Table 1. All coefficients of institutions are both economically and statistically significant at the 1% level, indicating a very strong correlation between institutions and current income.

Panel B gives the corresponding first-stage estimates. Consistent with our previous results, all coefficients of $Tech.Adop.^{mig.\ adj.}$ or $PC^{mig.\ adj.}$ are highly significant. The additional instruments are also very precisely estimated and have the right signs. If these additional instruments are determined by early historical development, then including $Tech.Adop.^{mig.\ adj.}$ or $PC^{mig.\ adj.}$ would render their coefficients insignificant. There is no evidence to suggest that these variables are highly correlated, thus strengthening the credibility of the tests of over-identifying restrictions. The results show that the PMD measures are able to provide some differential power in explaining variation in institutions, and are thus complementary to other instruments of institutions established in the literature.

Panel C includes $Tech.Adop.^{mig.\ adj.}$ and $PC^{mig.\ adj.}$ as an exogenous regressor. The underlying principle of this test is simple. If a PMD indicator has a direct effect on current income, we would expect its coefficient to be positive and significant. On the other hand, if it is found to be statistically insignificant, then it is established that early historical development affects income today via institutions. The results give credence to our approach that measures of PMD are valid instruments for institutions, and that the effect of PMD on income works through institutions.

Panel D reports the results of two over-identification tests, namely Sargan's test and Wooldridge's (robust) test where the latter allows for heteroskedastic and autocorrelated errors. These procedures test whether $Tech.Adop.^{mig.\ adj.}$ and $PC^{mig.\ adj.}$ are uncorrelated with the structural error, under the assumption that those instruments of institutions already established in the literature (i.e., settler mortality, tropical endowments, the fraction of the population speaking a major European language as the first language, and ethnolinguistic fractionalization) are valid. The null hypothesis cannot be rejected at the conventional levels of significance, thus providing some evidence that the exogeneity condition for our instruments is satisfied.

Notwithstanding the above findings, the possibility that different causal mechanisms are involved cannot be ruled out, which would invalidate our identifying assumption. Historical factors may be associated

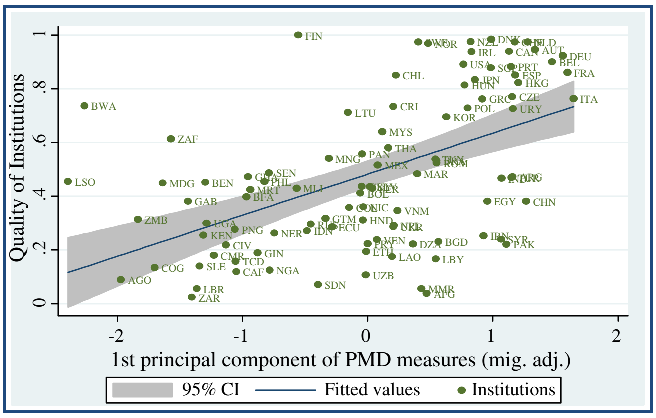

Fig. 5. First-stage relationship between institutions and ancestry-adjusted pre-modern development.

[6] The settler mortality data used in the estimations are based on the revised estimates of Albouy (2012), following his criticisms of Acemoglu et al.'s (2001) data. Using the original data of Acemoglu et al. (2001), however, gives almost identical results in our case.

Table 2
Over-identifying restriction tests.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var. = ln Y	*Panel A: 2SLS estimates with two instruments*							
INS	5.68***	5.42***	5.39***	5.33***	5.77***	5.44***	5.53***	5.47***
	(0.76)	(0.49)	(0.44)	(0.43)	(0.85)	(0.54)	(0.55)	(0.49)
R-squared	0.52	0.57	0.63	0.65	0.51	0.56	0.62	0.63
Dep. Var. = INS	*Panel B: 1st-stage results*							
$Tech.Adop.^{mig.\ adj.}$	0.40***	0.47***	0.66***	0.54***				
	(0.12)	(0.11)	(0.09)	(0.12)				
$PC^{mig.\ adj.}$					0.09**	0.08**	0.14***	0.09***
					(0.04)	(0.03)	(0.03)	(0.03)
ln(*settler mortality*)	−0.06***				−0.06*			
	(0.03)				(0.03)			
% of pop. in tropics		−0.17***				−0.22***		
		(0.06)				(0.06)		
% of pop. speaking European language			0.13**				0.13**	
			(0.06)				(0.06)	
Ethnolinguistic fractionalization				−0.23**				−0.35***
				(0.10)				(0.10)
R-squared	0.36	0.41	0.45	0.44	0.33	0.35	0.35	0.38
F-test on excluded instrument	17.62	37.81	42.77	46.15	15.14	27.87	25.28	35.58
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Wooldridge's endogeneity test	7.64	14.29	15.49	12.67	6.88	12.58	12.93	12.49
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]
Durbin's endogeneity test	10.85	23.94	21.93	19.49	10.61	19.19	17.45	18.48
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Dep. Var. = ln Y	*Panel C: 2SLS estimates treating* $Tech.Adop.^{mig.\ adj.}$ *or* $PC^{mig.\ adj.}$ *as exogenous*							
INS	6.82***	4.69***	5.35***	5.39***	6.79***	4.62***	5.13***	4.84***
	(2.28)	(1.19)	(1.75)	(1.86)	(2.49)	(0.95)	(1.70)	(1.08)
$Tech.Adop.^{mig.\ adj.}$	−0.78	0.56	0.04	−0.05				
	(1.31)	(0.83)	(1.31)	(1.40)				
$PC^{mig.\ adj.}$					−0.17	0.16	0.07	0.12
					(0.37)	(0.17)	(0.28)	(0.19)
R-squared	0.40	0.66	0.64	0.64	0.35	0.67	0.67	0.70
	Panel D: over-identification tests							
Wooldridge's OID test	0.50	0.34	0.00	0.00	0.32	0.65	0.05	0.31
	[0.48]	[0.56]	[0.98]	[0.97]	[0.57]	[0.42]	[0.82]	[0.58]
Sargan's OID test	0.49	0.30	0.00	0.00	0.31	0.79	0.05	0.42
	[0.48]	[0.58]	[0.98]	[0.97]	[0.58]	[0.38]	[0.82]	[0.52]
Observations	66	97	93	94	66	97	93	94

Notes: The over-identification (OID) tests examine whether the instruments are uncorrelated with the error term. The Wooldridge OID test, which allows for heteroskedastic and autocorrelated errors, is the robust version of Sargan's OID test. A constant is included in the regressions but not reported. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. See also notes to Table 1.

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

*** Indicates significance at the 1% level.

with current economic performance because they directly shape the evolution of institutional development and hence indirectly influence economic development, as proposed and tested in this paper. In contrast, they may also have a direct influence on economic development, which in turn affects institutional development. The latter is in line with the modernization hypothesis of Lipset (1959), who proposes that institutional change is initiated by economic development. In fact, Persson and Tabellini (2009) suggest a complex interactive relationship between institutions and economic development. They argue that the accumulation of democratic experience increases the rates of return on investment that favors economic development, and this creates a positive feedback loop through facilitating further democratic consolidation.

While the possibility that economic development leads to better institutional outcomes cannot be discounted, there are reasons to believe that this causal chain is less plausible. In particular, the empirical results of Acemoglu et al. (2001, 2002) clearly show that institutions are very persistent whereas income is not. Hence, it is more plausible that history affects the formation of early institutions, which persist and influence subsequent institutional development. Although the results in this paper do not provide any conclusive evidence to suggest that the opposite channel is not operative, Acemoglu et al. (2008, 2009) provide clear empirical evidence to suggest the lack of a causal effect of income on democracy, once country fixed effects that may capture the impact of time invariant unobserved historical differences or historical factors are taken into account. Their findings suggest that the positive correlation between income and democracy is due to historical events that affect both variables and result in different development trajectories, thus providing no support for the modernization view of Lipset (1959).

Indeed, when we regress institutions on per capita GDP in 1970 and instrument the latter with our composite index of early development ($PC^{mig.\ adj.}$), while controlling for regional dummies, we find no statistically significant impact of the exogenous component of income, isolated by history factors, on current institutions (results are not reported). The qualitative aspect of the results prevails even when $PC^{mig.\ adj.}$ is replaced with $Tech.Adop.^{mig.\ adj.}$. Hence, in line with Acemoglu et al. (2008, 2009), our findings also provide evidence in favor of the notion that history affects income via institutions, but none to support the view that income influences institutions.

4.2. Controlling for other effects

Our identification strategy rests on the premise that the PMD indicators are valid instruments for institutions, i.e., they are uncorrelated with the unobserved determinants of current economic performance in the output regression. Hence, identification is achieved as long as historical development has no direct effect on income. Although the tests of over-identifying restrictions suggest that this is the case, this channel of causation remains a rather strong assumption, as we cannot rule out the possibility that PMD has an effect on religion or education, rather than current institutions, which could affect output and hence violate exclusion restrictions (see Glaeser et al., 2004; Tabellini, 2010). Hence, to reduce the likelihood that our model is picking up this channel of causation, we control for these effects in the regressions to relax our identifying assumption.

Table 3 shows the findings. The upper panels (panels A1 and A2) report the estimates using *Tech.Adop.*$^{mig.\ adj.}$ as the instrument for institutions whereas results shown in the lower panels (panels B1 and B2) are based on using *PC*$^{mig.\ adj.}$ as the instrument. Column (1) adds measures of religious composition and treats them as exogenous variables to capture the influence of religion on current income (see Stulz and Williamson, 2003). Religious composition is measured as the proportion of the population that practices Catholic, Islam or other religions, with Protestants as the omitted group, in each country. The results show that the coefficients of institutions are still very precisely estimated, regardless of which measure of PMD is used. Moreover, coefficients of the PMD measures in the first-stage regressions remain highly significant, suggesting a weak correlation between early development and religion. Similar results are obtained when we add the average years of schooling in 1960 as a control variable in column (2). However, caveats should be exercised when interpreting these results. While the approach adopted here provides a simple and indirect way of checking the influence of other channels, it by no means rules out other plausible channels through which PMD affects current income. Identifying the most effective channel of influence is beyond the scope of the current paper and will be left as a potential avenue of future research.[7]

Our results may also be biased since the econometric specification is parsimonious where the analyses have been performed without including other factors which could be correlated with PMD and account for the estimated influence of institutions on current income. Thus, in the next three columns, we control for the effects of institutions at the time of independence (column (3)), legal origins (column (4)) and geography (column (5)) to reduce the risk of having invalid instruments. We use the first available index value of *Polity 2* since 1800 as a proxy for the quality of institutions at the time of independence (see Acemoglu et al., 2002).[8] The legal tradition of the company law or commercial code for each country is classified into French, German, Scandinavian or Socialist using dummy variables with English as the omitted group. The influence of geographic endowments is captured by absolute latitude, island dummy, landlockedness dummy, and terrain ruggedness. Moreover, continent dummies are also added to the regressions in column (6) to capture the potential effects of unobserved continent specific heterogeneity due to historical differences.

Finally, in column (7) all control variables are added together to account for their joint influence. These considerations, however, have little effect on our key findings. These regressions perform reasonably well in that the sign and significance of the coefficients on institutions remain stable across models, implying that the relationship uncovered is not sensitive to the inclusion of these control variables. In all cases, our instruments remain significant in the first-stage regressions. Above all, our key findings that the disparity in current income can be explained by the exogenous variation in institutions remain unchanged, suggesting that the previous findings are robust.

Fig. 6 presents the scatter plots of the orthogonalized residuals for institutional quality and the two ancestry-adjusted measures of PMD, while controlling for the influence of all control variables considered above. In other words, these scatter plots are obtained based on the regression results of column (7) in Table 3. As an illustration, in the left diagram the vertical axis plots the residuals obtained by regressing institutions on both a constant and all control variables. The horizontal axis reflects the residuals obtained from regressing technology adoption (ancestry-adjusted) on an intercept and all controls. As is evident, these scatter plots and the associated partial regression lines support the notion that *Tech.Adop.*$^{mig.\ adj.}$ and *PC*$^{mig.\ adj.}$ are robust predictors of current institutions, confirming the above findings.

4.3. Other sensitivity checks

This subsection performs several further checks to establish the robustness of our results. Firstly, the analyses so far have been based on the World Bank data of Kaufmann et al. (2010), who provide one of the most commonly used measures of institutions in the literature. It would be interesting to inquire whether the same findings are obtained when other common measures of institutions such as the social infrastructure index and the International Country Risk Guide (ICRG) index are used. The social infrastructure index of Hall and Jones (1999) is measured as the simple average of Sachs and Warner's (1995) trade openness index during the period 1950–1994 and Knack and Keefer's (1995) index of country risk to international investors over the period 1986–1995. The ICRG composite index of Knack and Keefer (1995) is based on several survey indicators of institutional quality, including risk of expropriation, rule of law, repudiation of contracts by government, corruption, and quality of bureaucracy. The data are collected over the 1980s and 1990s. Both variables are averaged over all their available years and rescaled to take values ranging from 0 to 1 where higher values correspond to having better institutional quality. Columns (1) and (2) of Table 4 show the regression results when the Kaufmann et al. (2010) institutional index is replaced with other measures of institutional quality. On the whole, the findings herein are consistent with the core results obtained previously, lending credence to the argument that the estimates are not sensitive to the use of alternative institution measures.

Secondly, although the literature on long-run comparative development tends to focus mostly on forces explaining the differences in income levels, it would be interesting to investigate how early development influences growth rates and total factor productivity (TFP). These estimates are provided in columns (3) and (4), respectively. The dependent variable in column (3) is the growth rate of real GDP per capita from 1996 to 2005. Initial GDP per capita in 1996 is included as a regressor to allow for convergence effects. Column (4) replaces income levels with the TFP measure of Hall and Jones (1999). It is evident that while the exogenous variations in institutions also positively affect TFP, it does not affect short-term growth.

Next, our results may be driven by the inclusion of neo-Europes and Africa in the sample. In column (5), we rerun the regressions without Canada, New Zealand and the United States (Australia is not included in our sample) which were once dominated by the Europeans who settled and introduced quality institutions. The results, again, remain fairly stable. In column (6), we repeat our basic regression by excluding countries in the African region, which have the worst institutions. While dropping all African countries makes the coefficients of institutions smaller, they remain very precisely estimated. On the whole, these estimates provide very similar qualitative

[7] In fact, when we replace our measure of institutions with the average years of schooling in 1960, the coefficient of schooling is found to be highly significant, suggesting that education may also be an effective channel. However, it loses significance when institutions are added as an exogenous regressor. When both variables are treated as endogenous using the summary PMD indicator as the instrument for human capital and settler mortality, the fraction of the population speaking a major European language as the first language or ethnolinguistic fractionalization as the instrument for institutions, only the effects of institutions are found to be statistically significant. These results suggest that while human capital does have some role to play in acting as a causal mechanism of how history affects current performance, its influence is perhaps not as prominent as that of institutions.

[8] It should be pointed that this measure does not fully capture institutions at the time of independence, given the fact that some countries achieved independence before 1800, notably the older states in Asia and Europe. However, more than 85% of countries achieved independence after 1800, according to the Colonial History Data Set of the Issue Correlates of War (ICOW) Project.

Table 3
Adding control variables.

	(1) Add religions	(2) Add human capital	(3) Add institutions at independence	(4) Add legal traditions	(5) Add geography	(6) Add continents	(7) Add all controls
	Panel A1: 2SLS with INS instrumented by Tech.Adop.$^{mig.\ adj.}$						
INS	5.570***	6.816***	5.416***	5.811***	7.377***	6.034***	5.115***
	(0.516)	(1.532)	(0.466)	(0.626)	(1.868)	(1.643)	(1.782)
religions [p-val]	[0.005]						
human capital [p-val]		[0.265]					
first Polity 2 [p-val]			[0.144]				
legal origins [p-val]				[0.003]			
geography [p-val]					[0.054]		
continents [p-val]						[0.245]	
all controls [p-val]							[0.000]
R-squared	0.619	0.398	0.597	0.602	0.334	0.534	0.727
	Panel A2: 1st-stage results						
Tech.Adop.$^{mig.\ adj.}$	0.675***	0.369***	0.710***	0.619***	0.316***	0.463***	0.425***
	(0.080)	(0.095)	(0.087)	(0.092)	(0.114)	(0.133)	(0.151)
R-squared	0.583	0.552	0.382	0.530	0.507	0.521	0.731
	Panel B1: 2SLS with INS instrumented by PC$^{mig.\ adj.}$						
INS	5.448***	6.719***	5.573***	5.951***	7.880***	6.231***	4.339***
	(0.539)	(1.457)	(0.588)	(0.757)	(2.873)	(2.330)	(1.349)
religions [p-val]	[0.006]						
human capital [p-val]		[0.261]					
first Polity 2 [p-val]			[0.155]				
legal origins [p-val]				[0.007]			
geography [p-val]					[0.075]		
continents [p-val]						[0.354]	
all controls [p-val]							[0.000]
R-squared	0.632	0.414	0.574	0.585	0.227	0.505	0.771
	Panel B2: 1st-stage results						
PC$^{mig.\ adj.}$	0.166***	0.087***	0.157***	0.137***	0.058*	0.082**	0.117***
	(0.022)	(0.023)	(0.026)	(0.027)	(0.031)	(0.036)	(0.035)
R-squared	0.554	0.554	0.287	0.476	0.493	0.490	0.739

Notes: The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. The religion variables are percentage of the population of each country that belonged to Protestant, Muslim or other religions (Catholic is the base group). Human capital is measured as the average years of total schooling in 1960. The presence of early institutions is captured by *Polity 2* in the first year of independence. Legal origins are measured using dummy variables that identify the legal tradition of a country as French, German, Scandinavia or Socialist with British as the omitted group. Geography variables include dummies for islandness, landlockedness, absolute latitude, and terrain ruggedness. Dummies for Asia, Africa, America and Europe (Oceania is the excluded group) are included to capture continent effects. These controls are also included in the first-stage regressions but not reported to conserve space. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. The *p*-values for the *t*-test on the significance of the coefficient of the control variables are reported for specifications involving only one additional regressor (e.g., human capital). For specifications involving more than one additional regressor (e.g., religions) they are based on the *F*-test of joint significance of all control variables.

* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

results to those obtained earlier, suggesting that our estimates are fairly robust to these alternative estimation strategies.

Finally, we also measure all indicators of PMD in 1 AD to check if development so long ago can still influence current income through affecting institutional outcomes. These variables are constructed in the same manner as those measured in 1500 AD. However, data on the composition of population in 1 AD are not available. We therefore continue to use the 1500 AD genetic distance data and assume that the population mixes in 1 AD were not significantly different from those in 1500 AD — before the major population movements began. In this case, Italy is chosen as the global technology leader instead of the UK. While coefficients of the early development measures and the R-squared values in the first-stage regressions are both, unsurprisingly, smaller than those found in the baseline results in most cases, the effects of history on institutions as well as institutions on income remain very precisely estimated. These results are reported in Table A7 in the Appendix.

5. Further analyses

This section performs some additional analyses by considering the individual components of the aggregate index of contemporary institutions and the aggregate index of technology adoption in 1500 AD. The Kaufmann et al. (2010) overall index of institutional quality is constructed based on six individual components. It would be interesting to gain some further insight into how the individual components of the overall institutions index are related to indicators of early development. As is evident in the size of their first-stage estimates and first-stage R-squared values, the results in Table 5 show that the measures of early historical development are most strongly correlated with the rule of law index (column (3)) and the government effectiveness index (column (6)), suggesting that these are the most effective channels through which early development impacts institutions.

Moreover, to shed some light on the adoption of which type of technology in 1500 AD is most effective in shaping institutional development, we use the individual components of the aggregate technology adoption index as instruments in the instrumental variable estimations. These sectors include agriculture, transportation, communications, industry and military. Table 6 provides the results of this exercise. Technological superiority in any of the five sectors considered is found to have a significant positive effect on institutional development, reinforcing our previous findings that a higher adoption rate of technology in early development is central for improving subsequent institutional environments. Specifically, higher adoption rates in transportation and communication technologies are found to be most strongly related to better quality of institutions today.

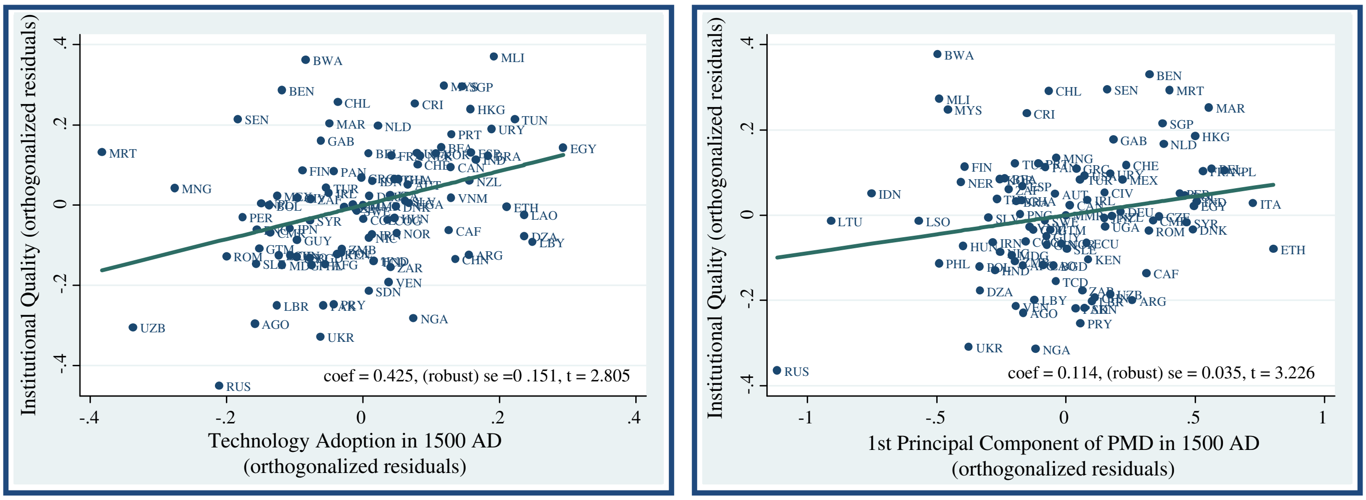

Fig. 6. Partial effects of ancestry-adjusted PMD measures on institutions. Notes: the above scatter plots illustrate the effects of ancestry-adjusted technology adoption or the 1st principal component of all PMD measures on institutions while partialing out the effects of all control variables. These partial regression lines are obtained based on the regressions of panel A2 and panel B2, respectively, in the last column of Table 3.

6. Conclusions

Recent contributions in the literature on long-run comparative development have often highlighted the importance of historical factors in shaping current economic performance. Since these findings are largely based on reduced-form estimations, they do not depend on any specific identifying assumption. Our results indicate that the exogenous component of institutions due to early development is a significant determinant of current output, supporting the notion that the channel running from early development to income largely goes through institutions. While all these historical factors are found to be important in understanding cross-country variations in the present-day quality of institutions, our results indicate that the technology adoption rate in 1500 AD and the composite index of all indicators have the strongest predictive power. Our results also show that measures adjusted for the global migration effect perform significantly better than their unadjusted counterparts in explaining the variations in institutions across countries, thus highlighting the fact that migration has played a significant part in shaping current economic performance.

In principle, historical development could affect current income other than through institutions, and if this occurs, identification of our model will not be achieved. To establish the robustness of our results, we conduct exclusion restriction tests and control for a number

Table 4
Other robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)
	INS is social infrastructure	*INS* is ICRG index	Dep. var. is income growth	Dep. var. is TFP	Exclude neo-Europes	Exclude Africa
	Panel A1: 2SLS with INS instrumented by Tech.Adop.$^{mig.\ adj.}$					
INS	6.297***	7.703***	38.353	2.329***	5.635***	4.295***
	(0.655)	(0.697)	(27.857)	(0.355)	(0.538)	(0.398)
lnGDP$_{1996}$			−6.914			
			(4.939)			
R-squared	0.499	0.583	0.001	0.184	0.539	0.760
	Panel A2: 1st-stage results					
Tech.Adop.$^{mig.\ adj.}$	0.728***	0.748***	0.704***	0.725***	0.660***	0.956***
	(0.088)	(0.085)	(0.086)	(0.088)	(0.089)	(0.130)
R-squared	0.424	0.477	0.396	0.426	0.356	0.367
	Panel B1: 2SLS with INS instrumented by PC$^{mig.\ adj.}$					
INS	6.510***	8.606***	54.450	2.840***	5.847***	4.113***
	(0.804)	(0.994)	(96.329)	(0.480)	(0.697)	(0.477)
lnGDP$_{1996}$			−9.753			
			(16.987)			
R-squared	0.464	0.469	0.001	0.001	0.504	0.775
	Panel B2: 1st-stage results					
PC$^{mig.\ adj.}$	0.157***	0.154***	0.158***	0.157***	0.144***	0.220***
	(0.026)	(0.028)	(0.026)	(0.026)	(0.027)	(0.044)
R-squared	0.322	0.320	0.305	0.326	0.259	0.241
Observations	89	81	97	88	96	66

Notes: A constant is included in the regressions but not reported. Figures in the parentheses are robust standard errors.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

Table 5
Sub-components of institutions.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var. = ln *Y*	*Panel A1: 2SLS with INS instrumented by Tech.Adop.$^{mig.\ adj.}$*					
voice & accountability (*VA*)	6.477***					
	(0.829)					
political stability (*PS*)		6.246***				
		(0.745)				
rule of law (*RL*)			4.997***			
			(0.447)			
controls of corruption (*CC*)				5.378***		
				(0.522)		
regulatory quality (*RQ*)					5.787***	
					(0.530)	
government effectiveness (*GE*)						5.065***
						(0.429)
R-squared	0.111	0.229	0.577	0.501	0.511	0.652
	Panel A2: 1st-stage results					
Dep. Var. =	*VA*	*PS*	*RL*	*CC*	*RQ*	*GE*
Tech.Adop.$^{mig.\ adj.}$	0.590***	0.612***	0.765***	0.711***	0.661***	0.755***
	(6.233)	(6.336)	(8.545)	(7.654)	(7.556)	(8.564)
R-squared	0.259	0.298	0.412	0.357	0.326	0.411
Dep. Var. = ln *Y*	*Panel B1: 2SLS with INS instrumented by PC$^{mig.\ adj.}$*					
voice & accountability (*VA*)	6.861***					
	(1.073)					
political stability (*PS*)		6.947***				
		(1.084)				
rule of law (*RL*)			5.008***			
			(0.535)			
controls of corruption (*CC*)				5.465***		
				(0.639)		
regulatory quality (*RQ*)					5.917***	
					(0.656)	
government effectiveness (*GE*)						5.142***
						(0.516)
R-squared	0.001	0.039	0.576	0.486	0.486	0.642
	Panel B2: 1st-stage results					
Dep. Var. =	*VA*	*PS*	*RL*	*CC*	*RQ*	*GE*
PC$^{mig.\ adj.}$	0.127***	0.125***	0.174***	0.159***	0.147***	0.169***
	(4.665)	(4.494)	(6.322)	(5.557)	(5.684)	(6.296)
R-squared	0.184	0.192	0.326	0.276	0.248	0.318

Notes: The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. Figures in the parentheses are robust standard errors.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

of potential omitted variables. However, the robustness of the relationship between institutions and income to the inclusion of these control variables and the fact that indicators of PMD turn out to be statistically insignificant when treated as an exogenous variable in the second-stage regressions provide supporting evidence to the hypothesis that the effect of historical development on current income largely works through institutions.

The results are also qualitatively robust to considering different indicators of institutional quality, using total factor productivity as the alternative dependent variable, excluding the Neo-Europes and African countries, and measuring pre-modern development in 1 AD instead of 1500 AD. Our further analyses suggest that the largest effect of early development on institutions works through the channels of the rule of law and government effectiveness. In addition, transportation and communications are the most influential sectors of ancient technology that facilitate institutional capacity building.

On the whole, the results of this paper are consistent with the view of Acemoglu et al. (2001) and Acemoglu and Robinson (2012) that institutions crucially influence economic outcomes. They are, however, incompatible with Acemoglu and Robinson's (2012) specific line of argument about critical junctures, which proposes that current performance is not historically predetermined. Rather, they are consequences of institutional development occurring during critical historical turning points that changed the development trajectory permanently and led to different long-run outcomes. Acemoglu and Robinson (2012) criticize Diamond's (1997) work by arguing that while his hypothesis may be useful to account for income differences up to 1500 AD it cannot be extended to explain the broad differences in economic prosperity around the world today, and that only institutional development occurring during critical historical junctures explains current outcomes. The finding of an important channel running from early development in 1500 AD to current institutions and then to current income in this paper therefore stands in sharp contrast to their critical juncture hypothesis, but provides some support to Diamond's (1997) thesis, in line with the previous findings of Hibbs and Olsson (2004) and Putterman (2008).

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Table 6
Individual components of technology adoption in 1500 AD.

	(1)	(2)	(3)	(4)	(5)
Dep. Var. $= \ln Y$	*Panel A: 2SLS estimates*				
INS	6.007***	5.037***	6.028***	5.599***	5.396***
	(1.035)	(0.397)	(0.682)	(0.508)	(0.572)
R-squared	0.490	0.634	0.486	0.561	0.590
Dep. Var. $=$ *INS*	*Panel B: 1st-stage results*				
Agricultural Tech.$^{mig.\ adj.}$	0.391***				
	(0.116)				
Communication Tech.$^{mig.\ adj.}$		0.565***			
		(0.066)			
Transportational Tech.$^{mig.\ adj.}$			0.616***		
			(0.086)		
Military Tech.$^{mig.\ adj.}$				0.513***	
				(0.063)	
Industrial Tech.$^{mig.\ adj.}$					0.519***
					(0.083)
R-squared	0.113	0.435	0.281	0.349	0.251

Notes: The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. Figures in the parentheses are robust standard errors.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

Appendix A

Table A1
Definition of variables and data sources.

Variable	Description	Source
Income levels	GDP per capita in 2005 converted to constant 2005 international dollars using PPP rates.	The World Bank (2012)
Institutional quality	The averaged ranking score of the following World Bank's Worldwide Governance Indicators: voice and accountability, political stability, rule of law, control for corruption, regulatory quality and government effectiveness (average of 1996–2005 and scaled to 0 and 1).	Kaufmann et al. (2010)
Years since agricultural transition	The number of years elapsed, in 1500 AD, since the transition to agriculture was estimated to occur (in thousand years).	Putterman (2006)
State antiquity	An index of state history covering the period from 1 AD to 1500 AD, scaled to take values between 0 and 1. More detailed description on its construction is provided in the main text.	Putterman (2004)
Technology adoption	The average adoption rate of technology in 1500 AD. It covers the following sectors: agriculture, transportation, communications, industry and military.	Comin et al. (2010)
Geographical proximity to the regional frontier	Geographical distance is calculated using the 'Haversine' formula, which calculates the shortest distance between two points on the surface of a sphere based on their longitudes and latitudes. Geographical proximity to the regional frontier of a country from one of its two frontiers in the same continent is calculated as: $1-\left(\frac{Geog.Dist._{i,RF}}{Geog.Dist._{Max}}\right)$ where $Geog.Dist._{i,RF}$ is the geographical distance between country i and its regional frontier RF and $Geog.Dist._{Max}$ is the maximum distance in the sample. The frontiers are identified based on their population density (measured as the population divided by land area) in 1500 AD.	Author's own calculation. Population and land area data are from McEvedy and Jones (1978) and The World Bank (2012), respectively.
Genetic proximity to the global frontier	The degree of genetic similarities or historical relatedness for the population of a particular country relative to that of the technological frontier in 1500 AD, i.e., the UK. It is measured as $1-\left(\frac{F_{ST\,i,GF}}{F_{ST\,Max}}\right)$, where $F_{STi,GF}$ is the fixation index reflecting the genetic distance between population of country i and population of the UK and F_{STMax} is the largest genetic distance in the sample. Data on populations are matched to countries based on their ethnic composition as of 1500 AD.	Spolaore and Wacziarg (2009)
Population density	The population divided by land area.	Population data are from McEvedy and Jones (1978); land area data are from The World Bank (2012).
Global migration matrix	A matrix that provides the estimated proportions of where the ancestors of each country's current population were living in 1500 AD.	Putterman and Weil (2010)
Settler mortality rate	European settler mortality rates in the 19th century.	Acemoglu et al. (2001)
Percentage of population in tropics	The percentage of the population of each country living in tropical climate areas.	Gallup et al. (2010)
Percentage of population speaking European language	The fraction of the population speaking major European languages as first languages.	Hall and Jones (1999)
Ethnolinguistic fractionalization	An index capturing the extent of ethnic and linguistic heterogeneity within the population.	La Porta et al. (1999)

Table A1 (*continued*)

Variable	Description	Source
Religion variables	Percentage of the population of each country that belonged to Catholic, Protestant, Muslim or others in 1980 (or 1990–95 for countries formed more recently).	La Porta et al. (1999)
Human capital	The average years of total schooling for population aged 25 and above in 1960.	Barro and Lee (2010)
First polity	The first available index value of Polity 2 since 1800. Polity 2 is given as the difference between the degree of democracy and autocracy, where a higher value reflects the presence of a more democratic regime.	Marshall and Jaggers (2010)
Legal origins	Dummy variables that identify the legal tradition of the company law or commercial code of a country as British, French, German or Scandinavian.	La Porta et al. (2008)
Island	A dummy variable that equals 1 if a country is an island and 0 otherwise.	Acemoglu et al. (2002)
Landlocked	A dummy variable that equals 1 if a country is fully enclosed by land and 0 otherwise.	Acemoglu et al. (2002)
Latitude	Absolute value of the latitude of a country.	La Porta et al. (1999)
Terrain ruggedness	An index that quantifies small-scale terrain irregularities in each country.	Nunn and Puga (2012)
Social infrastructure	The simple average of Sachs and Warner's (1995) trade openness index during the period 1950–1994 and Knack and Keefer's (1995) index of country risk to international investors over the period 1986–1995.	Hall and Jones (1999)
ICRG index	A composite index based on several survey indicators of institutional quality, including the risk of expropriation, the rule of law, repudiation of contracts by the government, corruption, and the quality of bureaucracy. The data are collected over the 1980s and 1990s.	Knack and Keefer (1995)
Income growth	Annual growth rate of real GDP per capita	The World Bank (2012)
TFP	Total factor productivity	Hall and Jones (1999)

Table A2
Summary statistics.

Variable	Obs	Mean	Std. dev.	Min	Max
Real GDP per capita (logs)	99	8.578	1.339	5.612	10.771
Institutions index	99	0.485	0.286	0.023	1.000
Years of agricultural transition	99	4.725	1.960	0.857	9.873
State history index	99	0.450	0.267	0.000	1.000
Technology adoption index	99	0.602	0.251	0.133	0.991
Geographical proximity index	99	0.693	0.208	0.000	1.000
Genetic proximity index	99	0.630	0.282	0.000	1.000
Population density	99	8.783	8.975	0.328	46.639
1st principal component (standardized)	99	0.000	1.000	−2.395	1.644

Notes: the 1st principal component is constructed based on the following six standardized measures of pre-modern development in 1500 AD: 1) the timing of agricultural transition (*Agr.Tran.*), 2) state history (*State Hist.*), 3) technology adoption (*Tech.Adop.*), 4) geographical proximity to the regional frontier (*Geog.Prox.*), 5) genetic proximity to the global frontier (*Genetic Prox.*), and 6) population density (*Pop.Den.*). See descriptions in the text for detailed descriptions of all variables.

Table A3
Correlation structure of the variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) ln *Y*	1.00								
(2) *INS*	0.83***	1.00							
(3) *Agr.Tran.*$^{mig.\ adj.}$	0.43***	0.27***	1.00						
(4) *State Hist.*$^{mig.\ adj.}$	0.43***	0.31***	0.67***	1.00					
(5) *Tech.Adop.*$^{mig.\ adj.}$	0.72***	0.61***	0.71***	0.68***	1.00				
(6) *Geog.Prox.*$^{mig.\ adj.}$	0.42***	0.35***	0.54***	0.55***	0.50***	1.00			
(7) *Genetic Prox.*$^{mig.\ adj.}$	0.60***	0.49***	0.67***	0.56***	0.81***	0.56***	1.00		
(8) *Pop.Den.*$^{mig.\ adj.}$	0.48***	0.51***	0.46***	0.51***	0.54***	0.31***	0.50***	1.00	
(9) *PC*$^{mig.\ adj.}$	0.64***	0.53***	0.84***	0.83***	0.89***	0.72***	0.86***	0.67***	1.00

Notes: the 1st principal component is constructed based on the following six standardized measures of pre-modern development in 1500 AD: 1) the timing of agricultural transition (*Agr.Tran.*), 2) state history (*State Hist.*), 3) technology adoption (*Tech.Adop.*), 4) geographical proximity to the regional frontier (*Geog.Prox.*), 5) genetic proximity to the global frontier (*Genetic Prox.*), and 6) population density (*Pop.Den.*). See descriptions in the text for detailed descriptions of all variables. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A4
Instrumental variable regressions based on unadjusted pre-modern development indicators.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var. = ln Y	*Panel A: 2SLS estimates*						
INS	10.920	7.309***	5.393***	7.143**	5.603***	4.075***	5.874***
	(7.534)	(2.577)	(0.753)	(2.932)	(0.792)	(0.465)	(0.971)
R-squared	0.000	0.164	0.591	0.214	0.560	0.691	0.515
Dep. Var. = INS	*Panel B: 1st-stage results*						
Agr.Tran.	0.014						
	(0.014)						

(*continued on next page*)

Table A4 (*continued*)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
State Hist.		0.142 (0.090)					
Tech.Adop.			0.351*** (0.087)				
Geog.Prox.				0.199 (0.127)			
Genetic Prox.					0.418*** (0.092)		
Pop.Den.						0.012*** (0.003)	
PC							0.097*** (0.029)
R-squared	0.011	0.025	0.148	0.024	0.181	0.149	0.112
F-test on excluded instrument	0.971 [0.327]	2.491 [0.118]	16.304 [0.000]	2.448 [0.121]	20.477 [0.000]	20.524 [0.000]	11.391 [0.001]

Notes: the results in this table provide evidence that the unadjusted measures of pre-modern development (PMD) have relatively low predictive power on subsequent institutional development, given that only about half of the PMD measures are statistically significant and fulfill the condition of being good instruments. *PC* is the first principal component of the following standardized measures of pre-modern development, all of which are measured as of 1500 AD: 1) the timing of agricultural transition (*Agr.Tran.*), 2) state history (*State Hist.*), 3) technology adoption (*Tech.Adop.*), 4) geographical proximity to the regional frontier (*Geog.Prox.*), 5) genetic proximity to the global frontier (*Genetic Prox.*), and 6) population density (*Pop.Den.*). The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A5
Instrumental variable regressions for adjusted versus unadjusted pre-modern development indicators.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var. = ln Y	*Panel A: 2SLS estimates*						
INS	6.265*** (0.956)	6.079*** (0.900)	5.533*** (0.493)	5.042*** (0.717)	5.663*** (0.700)	4.475*** (0.429)	5.655*** (0.611)
R-squared	0.438	0.476	0.571	0.633	0.551	0.677	0.552
Dep. Var. = INS	*Panel B: 1st-stage results*						
Agr.Tran.	−0.062*** (0.020)						
Agr.Tran. $^{mig.\ adj.}$	**0.095***** **(0.019)**						
State Hist.		−0.288** (0.128)					
State Hist. $^{mig.\ adj.}$		**0.617***** **(0.147)**					
Tech.Adop.			−0.118 (0.100)				
Tech.Adop. $^{mig.\ adj.}$			**0.800***** **(0.120)**				
Geog.Prox.				−0.612*** (0.120)			
Geog.Prox. $^{mig.\ adj.}$				**1.027***** **(0.158)**			
Genetic Prox.					−0.104 (0.189)		
Genetic Prox. $^{mig.\ adj.}$					**0.597***** **(0.185)**		
Pop.Den.						−0.007 (0.005)	
Pop.Den. $^{mig.\ adj.}$						**0.023***** **(0.006)**	
PC							−0.058 (0.037)
PC $^{mig.\ adj.}$							**0.199***** **(0.037)**
R-squared	0.131	0.129	0.379	0.186	0.246	0.279	0.293
F-test on excluded instrument	13.029 [0.000]	9.719 [0.000]	32.574 [0.000]	23.478 [0.000]	15.661 [0.000]	17.254 [0.000]	19.072 [0.000]

Notes: the results in this table provide evidence that the ancestry-adjusted measures of pre-modern development (PMD) indicators are far superior to their unadjusted counterparts in explaining the variation in institutional quality across countries. When institutions are regressed on both the original PMD measure and its ancestry-adjusted counterpart in each regression, only the coefficients of the adjusted measures are found to have both economic and statistical significance. *PC* is the first principal component of the following standardized measures of pre-modern development, all of which are measured as of 1500 AD: 1) the timing of agricultural transition (*Agr.Tran.*), 2) state history (*State Hist.*), 3) technology adoption (*Tech.Adop.*), 4) geographical proximity to the regional frontier (*Geog.Prox.*), 5) genetic proximity to the global frontier (*Genetic Prox.*), and 6) population density (*Pop.Den.*). Variables marked with the superscript "*mig.adj.*" are pre-modern development indicators adjusted for the effects of global migration using the migration matrix of Putterman and Weil (2010). The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A6
Horserace for various (standardized) pre-modern development measures.

	(1)	(2)	(3)	(4)	(5)
Dep. Var. $= \ln Y$	*Panel A: 2SLS estimates*				
INS	0.994***	1.101***	1.178***	0.997***	1.099***
	(14.721)	(12.780)	(11.011)	(10.060)	(12.991)
R-squared	0.666	0.620	0.573	0.665	0.621
Dep. Var. $=$ *INS*	*Panel B: 1st-stage results*				
Agr.Tran.	−0.359***				
	(−3.559)				
State Hist.	−0.237**				
	(−2.352)				
Tech.Adop.	0.776***	0.449***	0.582***		0.468***
	(5.672)	(4.559)	(7.571)		(4.650)
Geog.Prox.	−0.032				
	(−0.233)				
Genetic Prox.	0.193*	0.040	0.054	0.205**	
	(1.827)	(0.387)	(0.495)	(2.031)	
Pop.Den.	0.333***	0.258**		0.450***	0.260**
	(3.744)	(2.589)		(5.210)	(2.598)
R-squared	0.524	0.420	0.373	0.303	0.419
F-test on excluded instrument	25.409	30.744	33.691	22.008	42.336
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: unlike results reported in all other tables, standardized pre-modern development (PMD) measures are used here so that magnitudes of the coefficients can be interpreted in terms of standard deviation to gauge the relative importance of each PMD indicator. The first principal component is not used here since it is a linear combination of all six PMD measures. The results clearly suggest that technology adoption and population density have the strongest predictive power among all PMD measures, and that technology adoption is both economically and statistically more significant than population density in predicting institutional improvements. The total number of observations is 99 in all regressions. A constant is included in the regressions but not reported. Robust standard errors are used. Figures in round parentheses are *t*-statistics whereas those in square brackets are *p*-values. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table A7
Instrumental variable regressions for income, institutions, and ancestry-adjusted PMD in 1 AD.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var. $= \ln Y$	*Panel A: 2SLS estimates*						
INS	8.385***	−1.624	5.282***	6.023***	6.286***	4.690***	6.585***
	(2.370)	(6.659)	(1.429)	(1.267)	(0.877)	(0.682)	(1.141)
R-squared	0.001	0.001	0.557	0.424	0.364	0.626	0.288
Dep. Var. $=$ *INS*	*Panel B: 1st-stage results*						
Agr.Tran.$^{mig.\ adj.}$	0.031**						
	(0.014)						
State Hist.$^{mig.\ adj.}$		−0.002					
		(0.002)					
Tech.Adop.$^{mig.\ adj.}$			0.366**				
			(0.151)				
Geog.Prox.$^{mig.\ adj.}$				0.514***			
				(0.140)			
Genetic Prox.$^{mig.\ adj.}$					0.420***		
					(0.079)		
Pop.Den.$^{mig.\ adj.}$						0.032***	
						(0.008)	
$PC^{mig.\ adj.}$							0.056***
							(0.015)
R-squared	0.043	0.009	0.047	0.090	0.191	0.143	0.107
F-test on excluded instrument	5.118	1.029	5.855	13.492	28.201	14.466	14.490
	[0.026]	[0.313]	[0.017]	[0.000]	[0.000]	[0.000]	[0.000]
Endogeneity test	11.409	3.597	1.314	5.249	13.980	2.683	11.214
	[0.001]	[0.058]	[0.252]	[0.022]	[0.000]	[0.101]	[0.001]

Notes: $PC^{mig.\ adj.}$ is the first principal component of the standardized measures of the above six pre-modern development, all of which are measured as of 1 AD and are adjusted for the global migration effects. The results show that, except for state antiquity, all indicators of PMD have a significant effect on institutions. Moreover, the exogenous variation in institutions is also found to have a significant positive impact on current income, except when the exogenous influence is isolated by state antiquity (column (2)). These findings do not necessarily imply that the age of the state is unimportant in accounting for institutional changes, but rather they reflect the fact that measuring state history using data on state presence only for the period 1–50 AD is potentially misleading. The period under consideration is too short to provide a meaningful measure of the length of state history. Although there is mounting evidence suggesting that many older states were present before 1 AD, data on state presence prior to 1 AD are currently unavailable. The total number of observations is 98 in all regressions. The endogeneity test is performed using the Wooldridge robust score test. A constant is included in the regressions but not reported. Figures in round parentheses are robust standard errors whereas those in square brackets are *p*-values. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

References

Acemoglu, D., Johnson, S., 2005. Unbundling institutions. Journal of Political Economy 113, 949–995.

Acemoglu, D., Robinson, J., 2012. Why Nations Fail: The Origins of Power, Prosperity, and Poverty. Crown Business, New York.

Acemoglu, D., Johnson, S., Robinson, J.A., 2001. The Colonial Origins of Comparative Development: An Empirical Investigation. The American Economic Review 91, 1369–1401.

Acemoglu, D., Johnson, S., Robinson, J.A., 2002. Reversal of Fortune: Geography and institutions in the Making of the Modern World Income Distribution. Quarterly Journal of Economics 117, 1231–1294.

Acemoglu, D., Johnson, S., Robinson, J.A., Yared, P., 2008. Income and democracy. The American Economic Review 98, 808–842.

Acemoglu, D., Johnson, S., Robinson, J.A., Yared, P., 2009. Reevaluating the modernization hypothesis. Journal of Monetary Economics 56, 1043–1058.

Albouy, D.Y., 2012. The colonial origins of comparative development: an empirical investigation: comment. The American Economic Review 102, 3059–3076.

Ang, J.B., 2012. What drives the formation and persistent development of territorial states since 1 AD? MPRA Paper 42357.

Ang, J.B., 2013. Are modern financial systems shaped by state antiquity? Monash University, Department of Economics Discussion Paper Series.

Ashraf, Q., Galor, O., 2011. Dynamics and stagnation in the Malthusian Epoch. The American Economic Review 101, 2003–2041.

Ashraf, Q., Galor, O., 2013. The "Out of Africa" hypothesis, human genetic diversity, and comparative economic development. The American Economic Review 103, 1–46.

Barro, R.J., Lee, J.W., 2010. A new data set of educational attainment in the world, 1950–2010. NBER Working Paper No. 15902.

Bockstette, V., Chanda, A., Putterman, L., 2002. States and markets: the advantage of an early start. Journal of Economic Growth 7, 347–369.

Burkett, J.P., Humblet, C., Putterman, L., 1999. Preindustrial and postwar economic development: is there a link? Economic Development and Cultural Change 47, 471–495.

Chanda, A., Putterman, L., 2005. State effectiveness, economic growth, and the age of states. In: Lange, M., Rueschemeyer, D. (Eds.), States and Development: Historical Antecedents of Stagnation and Advance. Palgrave McMillan, New York, pp. 69–91.

Chanda, A., Putterman, L., 2007. Early starts, reversals and catch-up in the process of economic development. The Scandinavian Journal of Economics 109, 387–413.

Comin, D., Hobijn, B., 2010. An exploration of technology diffusion. The American Economic Review 100, 2031–2059.

Comin, D., Easterly, W., Gong, E., 2010. Was the wealth of nations determined in 1000 BC? American Economic Journal: Macroeconomics 2, 65–97.

Diamond, J., 1997. Guns, Germs and Steel: The Fates of Human Societies. Norton, New York.

Easterly, W., Levine, R., 2003. Tropics, germs, and crops: how endowments influence economic development? Journal of Monetary Economics 50, 3–39.

Engerman, S.L., Sokoloff, K.L., 1997. Factor endowments, institutions, and differential paths of growth among new world economies: a view from economic historians of the United States. In: Haber, S. (Ed.), How Latin America Fell Behind. Stanford University Press, Stanford, pp. 260–304.

Gallup, J.L., Mellinger, A.D., Sachs, J.D., 2010. Geography Datasets. Centre for International Development, Harvard University.

Glaeser, E.L., La Porta, R., Lopez-de-Silanes, F., Shleifer, A., 2004. Do institutions cause growth? Journal of Economic Growth 9, 271–303.

Hall, R.E., Jones, C.I., 1999. Why do some countries produce so much more output per worker than others? Quarterly Journal of Economics 114, 83–116.

Hibbs Jr., D.A., Olsson, O., 2004. Geography, biogeography and why some countries are rich and others poor. Proceedings of the National Academy of Sciences of the United States of America 101, 3715–3720.

Kaufmann, D., Kraay, A., Mastruzzi, M., 2010. The worldwide governance indicators: methodology and analytical issues. Policy Research Working Paper Series 5430. The World Bank.

Knack, S., Keefer, P., 1995. Institutions and economic performance: cross-country tests using alternative institutional measures. Economics and Politics 7, 207–227.

La Porta, R., Florencio, L.-d.-S., Shleifer, A., Vishny, R.W., 1997. Legal determinants of external finance. Journal of Finance 52, 1131–1150.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1999. The quality of government. Journal of Law, Economics and Organization 15, 222–279.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., 2008. The economic consequences of legal origins. Journal of Economic Literature 46, 285–332.

Lipset, S.M., 1959. Some social requisites of democracy: economic development and political legitimacy. American Political Science Review 53, 69–105.

Maddison, A., 2010. Historical Statistics of the World Economy: 1–2008 AD. http://www.ggdc.net/maddison/.

Marshall, M.G., Jaggers, K., 2010. Polity IV Project. Center for International Development and Conflict Management, University of Maryland.

Mauro, P., 1995. Corruption and growth. Quarterly Journal of Economics 110, 681–712.

McEvedy, C., Jones, R., 1978. Atlas of World Population History. Facts on File, New York.

Mokyr, J., 2003. Thinking about technology and institutions. Macalester International 13, 33–66.

North, D.C., 1981. Structure and Change in Economic History. W. W. Norton & Company, New York.

North, D.C., Thomas, R.P., 1973. The Rise of the Western World: A New Economic History. Cambridge University Press, Cambridge.

Nunn, N., 2008. The long-term effects of Africa's slave trades. Quarterly Journal of Economics 123, 139–176.

Nunn, N., 2009. The importance of history for economic development. Annual Review of Economics 1, 65–92.

Nunn, N., Puga, D., 2012. Ruggedness: the blessing of bad geography in Africa. The Review of Economics and Statistics 94, 20–36.

Persson, T., Tabellini, G., 2009. Democratic capital: the nexus of political and economic change. American Economic Journal: Macroeconomics 1, 88–126.

Putterman, L., 2000. Can an evolutionary approach to development predict post-war economic growth? Journal of Development Studies 36, 1–30.

Putterman, L., 2004. State Antiquity Index (Statehist) Version 3. http://www.econ.brown.edu/fac/louis_putterman/.

Putterman, L., 2006. Agricultural Transition Year Country Data Set. http://www.econ.brown.edu/fac/louis_putterman.

Putterman, L., 2008. Agriculture, diffusion and development: ripple effects of the neolithic revolution. Economica 75, 729–748.

Putterman, L., Weil, D.N., 2010. Post-1500 population flows and the long-run determinants of economic growth and inequality. Quarterly Journal of Economics 125, 1627–1682.

Sachs, J.D., Warner, A., 1995. Economic reform and the process of global integration. Brookings Papers on Economic Activity 26, 1–118.

Spolaore, E., Wacziarg, R., 2009. The diffusion of development. Quarterly Journal of Economics 124, 469–529.

Stulz, R.M., Williamson, R., 2003. Culture, openness, and finance. Journal of Financial Economics 70, 313–349.

Tabellini, G., 2010. Culture and institutions: economic development in the regions of Europe. Journal of the European Economic Association 8, 677–716.

The World Bank, 2012. World Development Indicators (online database). The World Bank, Washington D.C.