serie ad

WP-AD 2011-13

Institutions, culture and the onset of the demographic transition

Alberto Basso and David Cuberes

Ivie

Working papers

Working papers

Working papers

Los documentos de trabajo del Ivie ofrecen un avance de los resultados de las investigaciones económicas en curso, con objeto de generar un proceso de discusión previo a su remisión a las revistas científicas. Al publicar este documento de trabajo, el Ivie no asume responsabilidad sobre su contenido.

Ivie working papers offer in advance the results of economic research under way in order to encourage a discussion process before sending them to scientific journals for their final publication. Ivie's decision to publish this working paper does not imply any responsibility for its content.

La Serie AD es continuadora de la labor iniciada por el Departamento de Fundamentos de Análisis Económico de la Universidad de Alicante en su colección "A DISCUSIÓN" y difunde trabajos de marcado contenido teórico. Esta serie es coordinada por Carmen Herrero.

The AD series, coordinated by Carmen Herrero, is a continuation of the work initiated by the Department of Economic Analysis of the Universidad de Alicante in its collection "A DISCUSIÓN", providing and distributing papers marked by their theoretical content.

Todos los documentos de trabajo están disponibles de forma gratuita en la web del Ivie http://www.ivie.es, así como las instrucciones para los autores que desean publicar en nuestras series.

Working papers can be downloaded free of charge from the Ivie website http://www.ivie.es, as well as the instructions for authors who are interested in publishing in our series.

Edita / Published by: Instituto Valenciano de Investigaciones Económicas, S.A.

Depósito Legal / Legal Deposit no.: V-2190-2011

Impreso en España (junio 2011) / Printed in Spain (June 2011)

Institutions, culture and the onset of the demographic transition

Alberto Basso and David Cuberes*
University of Alicante

This version: March 2011

Abstract

This paper uses new estimates of the dates on which different countries experienced their demographic transition to examine the main historical determinants of these transitions. Our results indicate that countries with better historical institutions reached the onset of the transition earlier. This is the case after controlling for the effects of geography, climate, religion, and legal origins. We distinguish between the roles played by formal and informal institutions, where the latter are proxied by culture, using the genetic distance between populations from Spolaore and Wacziarg (2009). We find that both types of institutions are significant predictors of the timing of demographic transition. Our results are robust to endogeneity issues, measurement error, and alternative specifications.

JEL classification: J10, N10, O18

Keywords: institutions, culture, demographic transition, unified growth theory

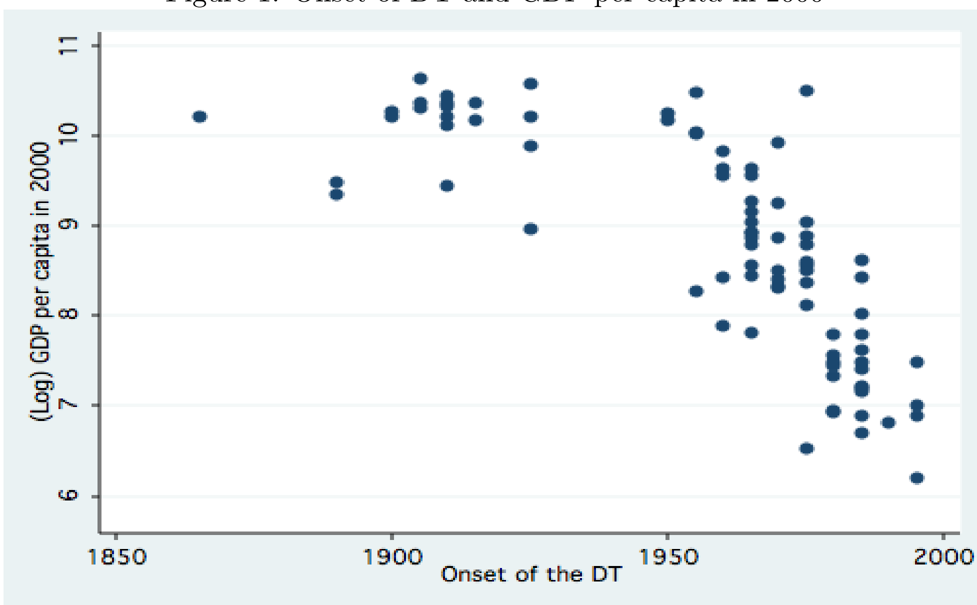
1 Introduction

The transformation of an economy from a regime of Malthusian stagnation to one of sustained growth has often been linked in the literature to the process of demographic transition. By turning to the negative relation between income and fertility, this transition plays a key role in fostering human-capital investment and thus income growth (e.g. Galor and Weil, 1999; 2000). As a consequence, one would expect that countries that first experienced the onset of demographic transition would be relatively richer than those that experienced it later on or that have not yet experienced it.

*Corresponding author: David Cuberes (e-mail: cuberes@merlin.fae.ua.es)

Figure 1 shows a scatterplot of per-capita income in the year 2000 and the year at which each country experienced its demographic transition.[1] The relation between these two variables is strongly negative.[2]

Figure 1: Onset of DT and GDP per capita in 2000



At the same time, however, the literature on comparative economic development has emphasized the role of institutions in explaining cross-country differences in per-capita income (e.g., Hall and Jones, 1999; Acemoglu et al., 2001). Acemoglu et al. (2001) argue that the various environments faced by European colonizers are key in explaining their colonization policies in different territories. In colonies where settlers faced high mortality rates, they tended to establish extractive institutions that hindered economic development and long-run growth. In places where conditions for settlement were favorable, colonizers settled in large numbers, introducing institutions that protected property rights, inducing innovation and technological progress and thereby economic development. The channel identified by these authors works from early institutions (at the time of colonization) to current institutions and on levels of current per-capita gross domestic product (GDP).

Early institutions might have had an effect on current per-capita GDP levels through other channels, however. In this paper, we investigate the importance of historical institutions as determinants

[1]These dates have been estimated by Reher (2004) and identify permanent declines in total fertility rates in a sample of countries. He assigns the year 2000 as the transition date for countries that had not yet experienced the onset. We drop these 12 observations to avoid arbitrariness.

[2]Another channel through which the demographic transition may spur a country's per-capita income is the so-called demographic gift, by which a lower population-growth rate decreases the dependency rate through its effect on the population age structure (Bloom and Williamson, 1998).

of the timing of demographic transitions. Our reasoning, closely related to that of Acemoglu et al. (2001), goes as follows. In countries where settler mortality was high, European colonizers introduced extractive institutions, and as a result, most economic activities became labor intensive (e.g., large plantations and extraction of natural resources). Arguably, these economic regimes were conducive to neither technological progress nor a high demand for human capital. Conversely, European settlers developed private-property institutions–similar in spirit to their home country institutions–where they settled in large numbers; in these colonies, entrepreneurial economic activity stimulated both technological progress and human-capital accumulation. These different incentives to innovate and acquire education were, in turn, crucial factors in explaining the onset of demographic transitions. As Galor and Weil (2000) explain, increasing technological progress boosts the demand for human capital and, because of the higher return to education, households eventually trade quantity for quality of children. When a significant fraction of families decides to have fewer and more educated children, the onset of demographic transition takes place. Therefore, institutions, by affecting incentives to innovate and accumulate human capital, might have shaped the timing of demographic transitions and, consequently, the current distribution of income across countries throughout the world.[3]

The timing of demographic transition differs widely across countries, as shown in Figure 2, which plots a histogram of these dates. As the data show, those countries that first experienced the transition in the late 19th and early 20th centuries, with exceptions, all were in western Europe and North America.[4] In contrast, most countries belonging to Asia, Africa, and Latin America experienced a late transition (that is, after 1950).

Several mechanisms have been proposed to explain the fertility transition's onset: a rise in income during industrialization (Becker and Lewis, 1973; Becker, 1981), a reduction in child and infant mortality rates (Kalemli-Ozcan, 2002), and a rise in the demand for human capital (Galor and Weil, 2000). We argue here that (early) institutions and cultural environment played a crucial role in the timing of demographic transitions, which is in line with the reasoning of Acemoglu et al. (2001).

To test our hypothesis empirically, we use different proxies for historical institutions. Our main measure of formal institutions is settler mortality rates in colonized countries, from Acemoglu et al. (2001). As stated above, variations in these rates are meant to measure the different types of institutions introduced by Europeans at the time of colonization. Figure 3 displays the raw correlations between the demographic transition dates and settler mortality. As the correlations indicate, the relation between the two variables is clearly positive. Our second test is whether there is a significant relation between informal institutions (or culture) and the onset of a country's demographic transition. It might well be the case that some countries experienced similar patterns of fertility decline not only because of similar formal institutions but also because of cultural relatedness. This exercise relates to a recent literature that highlights culture's role in explaining economic development across countries (Guiso et al., 2006; Spolaore and Warcziarg, 2009). Following Spolaore and

[3] A recent paper related to our discussion is Galor et al. (2009): They argue that inequality in the distribution of landownership adversely affected the emergence of human-capital promoting institutions (e.g., public schooling) and the transition from an agricultural to an industrial economy, thus determining the divergence in per-capita incomes across countries.

[4] According to Reher (2004), Sweden was the first country to experience the onset of the transition, in 1865.

Warcziarg (2009), we use genetic distance to the United Kingdom (UK) as a proxy for cultural relatedness. More specifically, this measure captures the general relatedness between populations: The closer two populations are in terms of genetic distance, the smaller the difference in their traits and social norms (e.g., beliefs, habits, biases, etc.).[5] Figure 4 shows a strong positive correlation between the demographic transition years and genetic distance to the UK. Although the main results in Spolaore and Wacziarg (2009) use the United States as the reference country with respect to which distance is measured, we believe that in our case it is more appropriate to calculate distances with respect to the UK, because it was the country where the industrial revolution first took place and consequently represented the technological frontier in the 18th and 19th centuries. We assume that the traits and norms of the British population should therefore entail characteristics favorable to–or at least compatible with–technological change and investment in human capital.[6] Finally, among countries that have been colonized, genetic distance should also partially account for the colonization strategy adopted by European colonists: Countries where Europeans settled are likely to be genetically closer to European countries (including the UK) than countries where settler mortality was high.

In our first exercise, we correlate demographic transition dates with historical formal and informal institutions, as well as other covariates that we describe in detail in the next section. Next, we use a bilateral approach similar to the one described in Spolaore and Warcziarg (2009), in which countries are considered by pair, to fully exploit the genetic distance data.

The main findings of our paper are the following. The pure cross-sectional exercise suggests that colonies with high rates of settler mortality experienced a demographic transition later on than similar territories with low mortality rates. Second, a larger genetic distance with respect to the UK also delayed the demographic transition. Interestingly, the impact of this measure of informal institutions is much larger than that of formal ones. Findings from the bilateral approach are consistent with the first result: The larger the genetic distance between two countries relative to the UK, the larger the lag between their transition dates.

The paper is organized as follows. Section 2 summarizes the sparse empirical literature that has attempted to isolate different triggers of demographic transitions across countries. Section 3 describes the data and methodology used in both the cross-section and bilateral approaches. Section 4 presents the results. Section 6 describes some robustness checks, and Section 7 concludes.

[5]Spolaore and Warcziarg (2009) explain income differences across countries by their genetic distance (relative to the technological frontier), which, according to their reasoning, should measure barriers to the adoption and diffusion of new technology from the frontier.

[6]Besides, genetic distance to the UK should also capture barriers to the adoption and assimilation of new technologies, which would delay the onset of the demographic transition..

Figure 2: Year of the onset of the demographic transition (Reher, 2004)

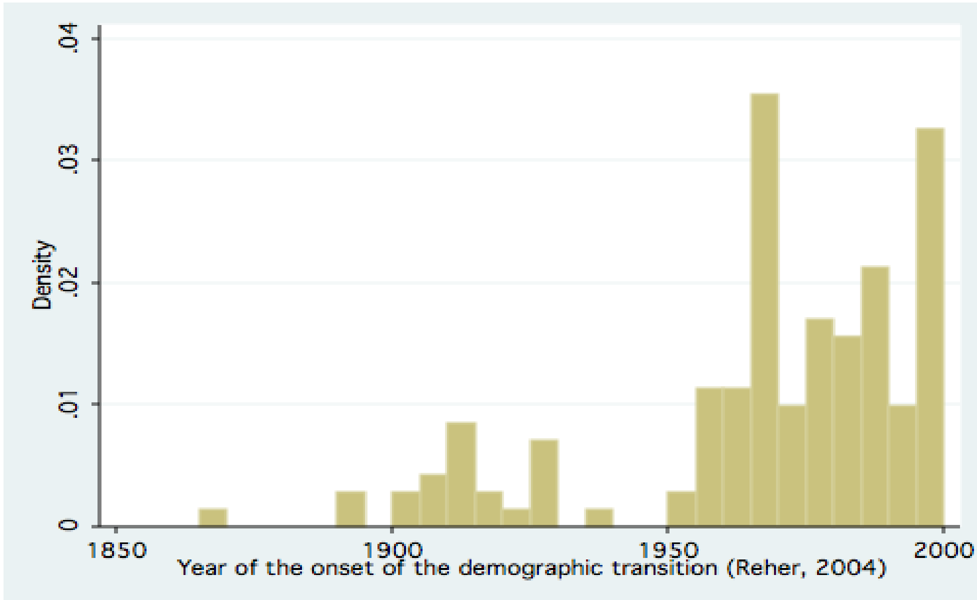


Figure 3: Settler mortality and the onset of the DT

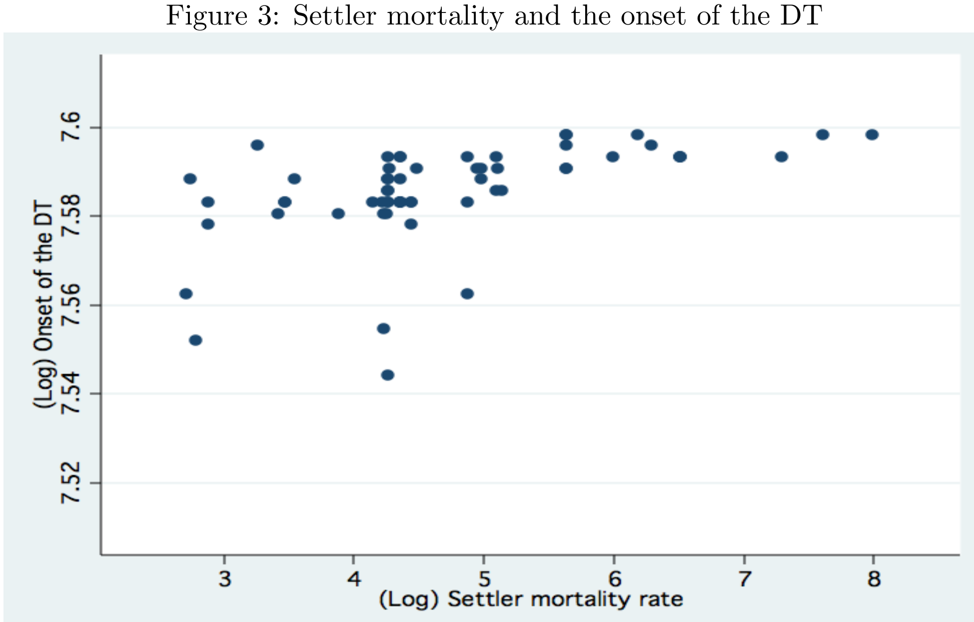
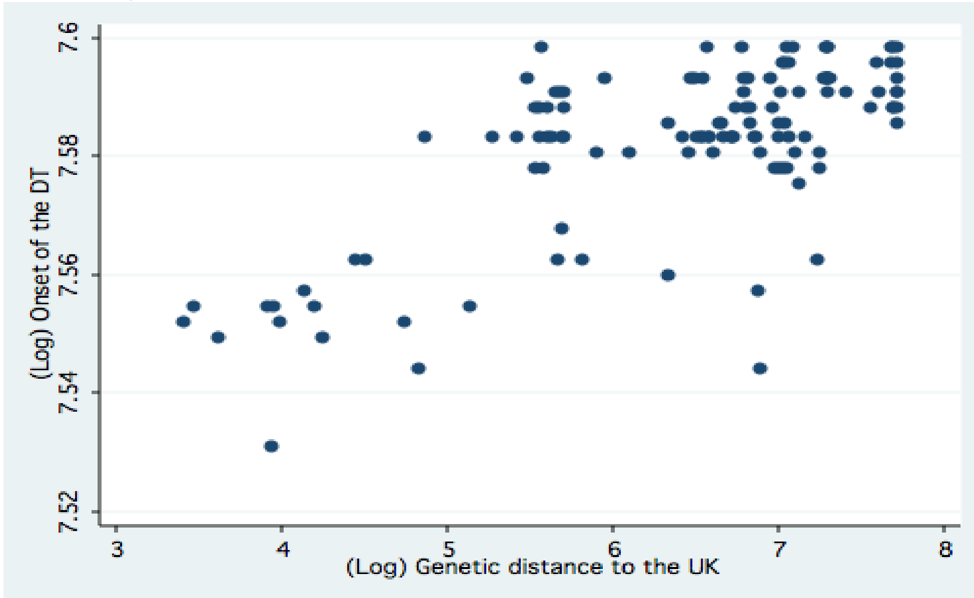


Figure 4: Genetic distance to the UK and the onset of the DT



2 Literature Review

In this section, we limit ourselves to discussing the empirical papers that examine the cross-country correlation between fertility and income and those that directly analyze possible triggers of demographic transitions.[7] In the tradition of so-called "demographic transition theory" (Notestein, 1945), the Princeton European Fertility Project (e.g., see Coale and Watkins, 1986) was one of the first studies that used data from the 19th century to document different episodes of demographic transitions in Europe and analyze their possible triggers. The emphasis in this project, however, was mainly on cultural and sociological explanations, ignoring potential economic factors.

Much more recently, the development of unified growth theories has spurred interest in identifying the role of different economic factors in triggering demographic transitions. The first–and most common–approach has been to study the correlation between fertility and income during different periods. For instance, using a sample of countries in the 1960-1999 period, Lehr (2009) examines the existence of different regimes in terms of fertility dynamics. She finds that, at early stages of development, increases in productivity and primary schooling-enrollment are typically associated with increases in fertility. In contrast, at higher levels of development, productivity reduces fertility, whereas the level of parents' human capital has a somewhat positive effect. In all periods, increases in secondary-schooling enrollment are correlated with drops in fertility rates. Murtin (2009) proposes a theoretical model in which health improvements and modernization affect a country's birth rate.

[7]A more detailed review can be found in Galor (2011). Schultz (2008) provides a review of evidence on the related quantity-quality tradeoff.

He then uses data for a large panel of countries since 1870 and concludes that education is the main trigger of changes in the birth rate and that the effect of health improvements are of second order. Other papers focus on the experiences of specific countries. Becker et al. (2009), for example, use data on Prussian counties in 1849 and identify a positive relation between child quantity and education in a context in which the demographic transition has not yet taken place. Another finding of their study is that the initial level of education is a good predictor of the demographic transition that occurred in Prussia during the 1880-1905 period. Murphy (2009) analyzes historical French département data and finds that both economic and cultural factors had an effect on different fertility patterns across these geographical units. In particular, education, measured as female literacy and child enrolment in primary schools, has a negative impact on fertility, whereas wealth is correlated with larger family size. Finally, the degree of religiosity–a proxy for culture–is also found to be an important determinant of fertility rates.[8]

A very different approach is to use information on the year of the onset of demographic transitions in different countries to directly identify their main historical determinants. Andersen et al. (2010) use this strategy to analyze the effect of cataract incidence on cross-country differences in labor productivity. They argue that an earlier onset of vision loss reduces the return to human capital, and hence delays demographic transition. To our knowledge, we are the first to use demographic transition dates to explore the impact of formal and informal institutions on the timing of these transitions.

As mentioned in Guinnane (2010), a difficulty in identifying which variables have been most responsible for the secular decline in fertility is that most changes in potential candidates took place around the same time. We consider the impact of institutions much before the onset of any of the demographic transitions in our sample, and therefore we are able to avoid this problem. Note that for this argument to work, it is important that institutions are persistent enough so that colonial institutions still have an impact a few hundred years later, i.e., around the dates of the demographic transitions. Acemoglu and Robinson (2008) argue that it is meaningful to assume that this is indeed the case. They present a model in which changes in political institutions that alter the distribution of de jure power do not necessarily lead to significant changes in de facto institutions (e.g., bribes, the capture of political parties, or the use of paramilitaries). According to their analysis, this can explain why prominent examples of radical changes in political institutions, such as the end of colonial rule in Latin America or the abolishment of slavery in the U.S. South, had little impact on actual policy and economic changes.

Our measure of culture, the genetic distance between two countries relative to the UK, is measured in the 20th century. Our implicit assumption is that cultural distance between countries did not change much from the end of the 19th century onwards. As Spolaore and Wacziarg (2009) argue, however, this assumption may be invalidated by the large migration flows between countries that began at the end of the 15th century. We address this endogeneity issue in Section 5.

[8] Using microeconomic data, Rosenzweig and Wolpin (1980) were the first to exploit exogenous variations in fertility to identify the effect of child quantity on child quality. They instrument child quantity with increases in family size resulting from multiple births and show that child quantity significantly reduces child quality. Bleakley and Lange (2009) explore the causal effect of education on fertility by exploiting the eradication policy of the hookworm disease in South America. Their paper argues that this eradication increased the return to schooling and hence reduced the price of child quality. This exogenous change, in turn, increased school attendance and reduced fertility. Other papers that follow similar strategies are Angrist et al. (2005), Black et al. (2005), and Qian (2009).

3 Data and Methodology

3.1 Cross-Section

Reliable measures of historical institutional quality are scarce. As mentioned in the previous section, our variables of interest are different measures of formal and informal historical institutions. We measure the former with settler mortality rates collected by Acemoglu et al. (2001), and in the robustness section, we also consider the variable constraints on the executive in 1900 from the Polity IV project (see Marshall and Jaggers, 2008).[9] Our measure of cultural relatedness is genetic distance to the UK, taken from Spolaore and Wacziarg (2009).[10]

We also include in the analysis different sets of determinants of long-run development and productivity. To account for the potential effect of geography and climate, we control for the absolute latitude of a country's centroid, the average distance to the nearest ice-free coast, the percentage of land area in a tropical climate, and a set of continental dummies (Africa, Asia, Europe, North America, and South America). The historical variables are population density in 1400 and the years passed since the Neolithic revolution (i.e., the agricultural transition).[11] We also control for the type of legal origins (British common law, French civil law, socialist law, German civil law, and Scandinavian law) and the shares of religious followers in 1900.[12] Table 8 in the Appendix contains the definitions and sources of all the variables used in the cross-sectional exercise. As Norton and Tomal (2009) point out, adherence to some religions is associated with larger gender gaps in education. Hence, as being female education is a relevant factor in shaping fertility decisions, we also add as controls the share of religious adherents in 1900.

Some authors (Caldwell, 1980; Murtin, 2009) highlight the empirical importance of education as a trigger of demographic transitions. We omit education as a control for the following reasons. First, we seek to explore the ultimate causes of demographic transitions. In order to do so, we use covariates that are measured before the onset of demographic transitions or that capture countries' characteristics that were likely to be stable before and around the demographic transition's onset.[13] Second, our reasoning is that historical institutions created the appropriate environment to stimulate technological progress and the subsequent demand for human capital, which, assuming an elastic supply of human capital, would result in higher levels of education in equilibrium.

We first investigate the effect of settler mortality on the timing of the fertility transition across

[9]In Section 5, we also consider a modification of the settler mortality variable to account for the criticism raised by Albouy (2011).

[10]Throughout our analysis, we use the measure of weighted genetic distance that accounts for sub-populations' genetic groups. The other measure provided by Spolaore and Wacziarg (2009), named dominant genetic distance, considers only the largest groups of each country's population.

[11]Data on the agricultural transition are from Louis Putterman's Agricultural Transition Year Country Data Set.

[12]Norton and Tomal (2009) find evidence that adherence to some religions is associated with large gender gaps in education. Since female education has been found to be a relevant factor in shaping fertility decisions, we account for the effect of religion adherence by including the percentage of followers in 1900 for the following categories: Catholic, Protestant, Muslim, Hindu, Buddhist, Orthodox, other Christians, Jews, ethno-religions, and other religions.

[13]An alternative use of our data would be to explore the dynamic effect of different time series on the timing of demographic transitions. These effects could be estimated, for instance, with a panel data probit, using as covariates schooling enrollment and infant mortality rates, among others. Since this differs significantly from the objective of the present paper, we have relegated this to a companion paper (see Basso and Cuberes, 2011).

countries by estimating the following model using ordinary least squares (OLS):

$$log\,onset_i = \beta_1 + \beta_2 * log\,sm_i + \beta_3' X_i + \varepsilon_i \tag{1}$$

where $log\,onset_i$ represents (the log of) the year of the onset of the demographic transition in country i, $log\,sm_i$ represents (the log of) settler mortality rates faced by European colonists in country i, X is a set of control variables, and ε is a standard error term.

Our next step is to add a measure of informal institutions as a possible additional determinant of the cross-country variation in the timing of demographic transitions. Perhaps not surprisingly, the two measures are positively correlated. In our sample, the correlation coefficient is 0.47. As stated above, we measure a country's culture in relative terms, i.e., its cultural relatedness to the UK. Countries characterized by informal institutions that are similar to those in the UK (proxying for a cultural environment favorable to technological progress and the adoption of new technologies) should experience an earlier onset:

$$log\,onset_i = \gamma_1 + \gamma_2 * log\,sm_i + \gamma_3 * log\,gendist_{i,UK} + \gamma_4' X_i + e_i \tag{2}$$

where $log\,gendist_{i,UK}$ represents (the log of) a country i's genetic distance to the UK and e is a standard error term. Since the inclusion of settler mortality largely reduces the sample size, we also estimate the same model as in (2) but omitting settler mortality rates. By doing so, we are able to assess the isolated effect of our proxy for cultural similarity on the transition dates in a much larger sample of countries.

$$log\,onset_i = \rho_1 + \rho_2 * log\,gendist_{i,UK} + \rho_3' X_i + \nu_i \tag{3}$$

3.2 Bilateral Analysis

In this section, we assess the role of cultural relatedness using a bilateral approach considering countries pair by pair. To do so, we regress the distance in the onset of the demographic transition between each pair of countries on their genetic distance relative to the UK[14] and on a set of controls aimed at capturing geographical, climatic, and historical differences (distances). In terms of controls, we closely follow Spolaore and Wacziarg (2009) and include a variety of measures capturing similarities (or differences) between countries: We account for the effect of geographical distances by including the absolute difference in latitudes and longitudes, the geodesic distance between countries,[15] a dummy that takes a value of one if both countries in the pair are contiguous, a dummy that takes a value of one if at least one country is landlocked, a dummy that takes a value of one if at least one country is an island, and a measure of climatic similarity based on 12 Koeppen-Geiger climate zones.[16]. We also add as covariates a set of dummies that take a value of one if two countries in a pair are located in the same continent. Finally, we add a measure of transportation costs based on freight rates for surface transport (sea or land).[17] All variables used in this section, along with their sources, are listed in Table 9 of the Appendix. Our estimation model is the following:

$$|log\, onset_i - log\, onset_j| = \alpha + \beta |log\, gendist_{i,UK} - log\, gendist_{j,UK}| + \gamma' Q_{i,j} + \epsilon_{i,j} \qquad (4)$$

where $|log\, onset_i - log\, onset_j|$ represents the absolute value of the log difference in the year of the onset of the demographic transition between country i and j, $|log\, gd_{i,UK} - log\, gd_{j,UK}|$ represents the absolute value of the genetic (log) distance relative to the UK between country i and j and $Q_{i,j}$ includes mesures of geographical, climatic and historical distances between country i and j. Finally, $\epsilon_{i,j}$ is the error term associated with the country pair ij.[18]

This approach allows us to investigate whether differences (and similarities) in culture (relative to the UK) explain the distance in the timing of the onset of demographic transitions between pairs of countries. Specifically, we ask whether similar (different) timing in the onset is explained by similar (different) culture (relative to the UK), controlling for the effect of similar (different) geographical, climatic, and historical contexts.

[14] We take logs of this measure to be consistent with the analysis of the previous section. Although their results do not change much if they use the log specification, Spolaore and Wacziarg (2009) prefer not to do so to avoid losing those observations for which this distance is equal to zero. In our sample, no pair of countries has a genetic distance to the UK equal to zero.

[15] This variable is a measure of the great circle (geodesic) distance between the major cities of two countries.

[16] This is measured as the average absolute value difference in the percentage of land area in each of the 12 climate zones between two countries.

[17] Similar to Spolaore and Wacziarg (2009), we collect transportation-cost data from http://www.importexportwizard.com/. The measure refers to 1000kg of unspecified freight transported over sea or land, with no special handling.

[18] As Spolaore and Wacziarg (2009) point out, spatial correlation results from the construction of the dependent variable. We follow their strategy to address this issue by using two-way clustered standard errors.

4 Results

4.1 Cross-Section Analysis

Table 1 displays the results using the original settler mortality data from Acemoglu et al (2001). Extractive early institutions (proxied by high settler mortality rates) delayed the onset of demographic transition, even controlling for geography, climate, history, and legal origins. This supports our hypothesis that institutions created in the 18th and 19th centuries played an important role in explaining the cross-country variation in the timing of the onset of demographic transitions. One mechanism through which this may have happened is that alternative institutional environments affected the allocation of resources across economic activities, hence providing different incentives for technological progress and human-capital accumulation.

The measures we have considered so far are proxies for formal institutions. We now explore whether our proxy of informal institutions is also an important historical determinant of demographic transitions. As we pointed out in the previous section, following Spolaore and Wacziarg (2009), we use genetic distance to the UK as a measure of a cultural environment favorable to technological progress and adoption of innovations. Table 2 shows the estimation results obtained by regressing the timing of the fertility transition on settler mortality rates and genetic distance to the UK. Specification (1) simply uses the log of settler mortality and the log of genetic distance to the UK as regressors. The impact of both variables is positive and statistically significant, suggesting that a higher mortality rate (i.e. a lower quality of historical formal institutions) and a larger genetic distance from the UK (i.e. a larger "distance" from the ideal cultural environment) delay the onset of demographic transition. These estimates are very similar if one adds geography and climate, history, or legal origins as controls. The inclusion of these religion controls do not affect the qualitative results of the estimation (column (5)), nor does the inclusion of all the previous covariates simultaneously (column (6)). Interestingly, the sizes of the estimates associated with culture (norms, values) are larger than those of formal institutions by a factor of about three. To extend our analysis, we next eliminate settler mortality rates as a control and consider only the effect of genetic distance in a larger sample of countries (Table 3). Again, the explanatory power of culture is very large in all specifications.

Table 1: Cross-section OLS. Dependent variable: (Log of) Onset of DT as in Reher (2004)

	(1)	(2)	(3)	(4)	(5)
(Log of) Settler mortality	0.005***	0.002**	0.0051***	0.0048***	0.002**
	[0.0010]	[0.0010]	[0.0011]	[0.0009]	[0.0009]
Geography and climate	no	yes	no	no	yes
History	no	no	yes	no	yes
Legal origins	no	no	no	yes	yes
R-squared	0.27	0.54	0.35	0.30	0.64
Observations	60	60	56	60	56

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Estimation with robust standard errors (reported in squared brackets). All regressions include a constant.

Table 2: Cross-section OLS. Dependent variable: (Log of) Onset of DT as in Reher (2004)

	(1)	(2)	(3)	(4)	(5)	(6)
(Log of) Settler mortality	0.0029***	0.0017*	0.0033***	0.0023***	0.0019**	0.0021**
	[0.0007]	[0.0009]	[0.0008]	[0.0007]	[0.0009]	[0.0010]
(Log of) Genetic distance to the UK	0.0074***	0.004*	0.0064***	0.0081***	0.0081***	0.0076***
	[0.0025]	[0.0021]	[0.0022]	[0.0025]	[0.0025]	[0.0021]
Geography and climate	no	yes	no	no	no	yes
History	no	no	yes	no	no	yes
Legal origins	no	no	no	yes	no	yes
Religion	no	no	no	no	yes	yes
R-squared	0.48	0.58	0.52	0.54	0.78	0.85
Observations	60	60	56	60	60	56

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Estimation with robust standard errors (reported in squared brackets). All regressions include a constant.

Table 3: Cross-section OLS. Dependent variable: (Log of) Onset of DT as in Reher (2004)

	(1)	(2)	(3)	(4)	(5)	(6)
(Log of) Genetic distance	0.0094***	0.0026**	0.0106***	0.0085***	0.0073***	0.0045**
to the UK	[0.0008]	[0.0012]	[0.0012]	[0.0009]	[0.0011]	[0.0017]
Geography and climate	no	yes	no	no	no	yes
History	no	no	yes	no	no	yes
Legal origins	no	no	no	yes	no	yes
Religion	no	no	no	no	yes	yes
R-squared	0.49	0.73	0.53	0.61	0.74	0.83
Observations	122	121	113	122	121	111

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Estimation with robust standard errors (reported in squared brackets). All regressions include a constant.

4.2 Bilateral Approach

The results of the previous section strongly support the role of a cultural environment favorable to technological progress and adoption of innovations. To fully exploit the distance-based approach, however, we now consider the bilateral framework of Spolaore and Wacziarg (2009). We examine a specification where the absolute log difference in the timing of the onset of demographic transitions between pairs of countries is regressed on measures of similarity (and distance) between the countries described in Section 3.2.

Table 4 shows the OLS estimates obtained from the regression in equation (4).[19] In column (1), where we do not add any control variable, larger differences in genetic distance (relative to the UK) are associated with larger time distances in the onset of demographic transitions. In columns (2) to (5), we add different controls capturing geographically related measures. In particular, column (2) adds measures of geographical differences. Column (3) includes a measure of climatic similarity (see Section 3.2). Column (4) includes a set of continental dummies, whereas column (5) adds the measure of transportation costs described above. Throughout all specifications, including column (6) where we add all the controls, larger genetic distances (relative to the UK) are associated with wider differences in the timing of the fertility transition.

These results again provide very strong evidence of the importance of cultural differences–or differences in informal institutions–in determining international differences in the onset of demographic transition.

Table 4: Bilateral analysis: OLS

Dependent variable: Absolute log difference in the onset of the DT

	(1)	(2)	(3)	(4)	(5)	(6)
Genetic log distance	0.0081***	0.0071***	0.0078***	0.0075***	0.0081***	0.006***
relative to the UK	[0.0008]	[0.0008]	[0.0008]	[0.0008]	[0.0008]	[0.0008]
Geography	no	yes	no	no	no	yes
Climate	no	no	yes	no	no	yes
Continental dummies	no	no	no	yes	no	yes
Transportation costs	no	no	no	no	yes	yes
Observations	7260	6328	6328	7260	7260	6328

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Errors are clustered (two-way) and reported in squared brackets. All regressions include a constant.

[19] Since in this section we closely follow Spolaore and Wacziarg's (2009) methodology, we focus on the role of cultural relatedness (i.e., informal institutions) in shaping the timing of the onset of the fertility transition.

5 Robustness Checks

5.1 Measurement Error in Settler Mortality

The dataset on settler mortality rates used in Acemoglu et al. (2001) has been recently criticized on the grounds that it is not a valid instrument for institutional quality (Albouy, 2011). More specifically, Albouy (2011) argues that in the original dataset, several countries' mortality rates were assigned based on conjectures about countries that had similar disease environments. He also warns about the comparability of mortality rates from different populations (laborers, bishops, and soldiers). To account for this critique, we use a modified subset of the original data to estimate equation (1). This modified dataset specifically drops 36 countries for which settler mortality rates were conjectured and assigns a value of 280 (instead of 2,940) to Mali. The estimates shown in Table 5 confirm that, despite the strong reduction in sample size (from 60 to 24), settler mortality rates still have a positive and significant effect on the timing of the fertility decline throughout all specifications, even though the coefficient turns marginally insignificant in column (5).

5.2 An Alternative Measure of Formal Historical Institutions

In this section, we study the effect of the variable executive constraints in 1900 on the timing of demographic transition. Many researchers have used this variable (from the data set Polity IV, see Marshall and Jaggers 2008) as a proxy for the quality of institutions (see Acemoglu et al., 2001). The question we ask here is whether countries with better institutions in 1900 experienced the onset of the fertility transition earlier on than countries with lower-quality institutions in that initial year, i.e., we estimate:[20]

$$log\, onset_i = \alpha_1 + \alpha_2 * log\, xconst1900_i + \alpha_3' X_i + u_i \qquad (5)$$

where $log\, xconst1900_i$ represents (the log of) executive constraints in 1900 in country i, and u is a standard error term.

Consistent with our hypothesis, Table 6 shows that this proxy is negative and significant throughout all specifications, except for column (5), where it is estimated less precisely. The main reason why we prefer not to use this variable as a measure of institutional quality in our main exercise is that it is subject to sudden and large changes, and hence it is a less reliable measure of institutional characteristics that are reasonably stable over time.

[20] We exclude five countries that experienced the onset of the transition before 1900.

Table 5: Cross-section OLS. Dependent variable: (Log of) Onset of DT as in Reher (2004)

	(1)	(2)	(3)	(4)	(5)
(Log of) Settler mortality rates (not conjectured)	0.0048*** [0.0016]	0.0032*** [0.0011]	0.0052*** [0.0018]	0.0047*** [0.0015]	0.0021 [0.0012]
Geography and climate	no	yes	no	no	yes
History	no	no	yes	no	yes
Legal origins	no	no	no	yes	yes
R-squared	0.32	0.81	0.39	0.40	0.87
Observations	24	24	24	24	24

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Estimation with robust standard errors (reported in squared brackets). All regressions include a constant.

Table 6: Cross-section OLS. Dependent variable: (Log of) Onset of DT as in Reher (2004)

	(1)	(2)	(3)	(4)	(5)
(Log of) executive constraints in 1900	-0.011*** [0.0025]	-0.0038*** [0.0014]	-0.011*** [0.0028]	-0.0111*** [0.0026]	-0.0031 [0.0021]
Geography and climate	no	yes	no	no	yes
History	no	no	yes	no	yes
Legal origins	no	no	no	yes	yes
R-squared	0.28	0.86	0.41	0.44	0.86
Observations	41	40	41	41	40

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Estimation with robust standard errors (reported in squared brackets). All regressions include a constant.

5.3 Additional Controls and Specifications in the Bilateral Approach

Until now, our analysis has focused on controlling for geographically related measures of distance. Historical and cultural differences, however, also might be important factors in explaining the timing in the onset of demographic transitions between countries. In Table 7, we add a control for similar legal origins, colonial history, and language. Column (1) includes a dummy taking a value of one if both countries in a pair share the same legal origins, and zero otherwise; a dummy taking a value of one if both countries in a pair share the same colonial origins, and zero otherwise; and a dummy taking a value of one if both countries share a common official language. Column (2) adds a measure accounting for religious differences; as for climate, our measure is the average absolute value difference, between two countries, in the percentages of religions followers in 1900 in each of 10 religious categories. The inclusion of these variables affects neither the significance nor the size of the coefficient associated with the difference in genetic distance relative to the UK, even after controlling for all of them (column (3)).

As Spolaore and Wacziarg (2009) note, there might be an endogeneity problem concerning the measure of current genetic distance. Migration flows starting in 1500 could have affected genetic distance in such a way that *'genetic distance today could be positively related to income distance not because genetic distance precluded the diffusion of development, but because similar populations settled in regions prone to generating similar incomes'* (Spolaore and Wacziarg, 2009). In our context, the issue is that two countries could share a similar timing in the onset of demographic transition, not because they are culturally similar (relative to the British), but because similar populations settled in countries that share similar geographical and climatic characteristics that favored the fertility transition's onset. To account for this possibility, we instrument current genetic distance (relative to the UK) with genetic distance (relative to the British population) in 1500. Table 7 (column 4) displays the results from the second stage of the two-stage least squares regression: The role of cultural relatedness in explaining the timing of the fertility transition is confirmed. Also, when excluding from the sample all pairs of countries in which at least one country belongs to North and South America (column 5) and for which endogeneity is likely to be more severe, results are not affected.

6 Conclusion

This paper contributes to our understanding of the main determinants of demographic transitions across a large sample of rich and developing countries. We provide evidence that (early) institutions and culture are crucial factors of the timing of the fertility transition across these economies. Although we do not test the channel through which institutions affect the timing of these transitions, we suggest, as in Spolaore and Wacziarg (2009), that better institutions help generate an appropriate environment to enhance technology adoption and human-capital formation.

Our finding that both formal and informal institutions matter as triggers of demographic transitions may be seen as a bridge between the literature that emphasizes the importance of economic determinants of these transitions (e.g., Galor 2011) and the one that points to purely cultural factors (e.g., Coale and Watkins 1986).

7 Acknowledgements

We thank Nick Crafts, Oded Galor, and Andrew Mountford for helpful comments on an earlier version of this paper. Cuberes acknowledges the financial support of IVIE and the Ministerio de Ciencia e Innovacion and FEDER funds (proyecto SEJ2007-62656).

Table 7: Bilateral analysis: Robustness checks

Dependent variable: Absolute log difference in the onset of the DT

	(1)	(2)	(3)	(4) 2SLS	(5) No new world
Genetic log distance relative to the UK	0.006*** [0.0008]	0.0058*** [0.0009]	0.0057*** [0.0008]	0.0056*** [0.0014]	0.0051*** [0.0011]
Geography	yes	yes	yes	yes	yes
Climate	yes	yes	yes	yes	yes
Continental dummies	yes	yes	yes	yes	yes
Transportation costs	yes	yes	yes	yes	yes
Legal origins, colonial history and language	yes	no	yes	yes	yes
Religion	no	yes	yes	yes	yes
Observations	6328	5995	5995	5671	3403

***, **,* denotes statistical significance at 1% , 5% and 10% levels, respectively. Errors are clustered (two-way) and reported in squared brackets. All regressions include a constant. In column (4), the instrument for the genetic log distance relative to the UK is the genetic log distance relative to the English in 1500.

References

[1] Acemoglu, D., and J. A. Robinson (2008), "Persistence of Power, Elites, and Institutions," *American Economic Review*, 98:1, 267–293

[2] Acemoglu D., Johnson S. and J. A. Robinson (2001). "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review*, 91 (5), pp. 1369-1401.

[3] Albouy, D. Y. (2011), "The Colonial Origins of Comparative Development: An Empirical Investigation: Comment," forthcoming, *American Economic Review.*

[4] Andersen, T. B., C-J. Dalgaard, and P. Selaya (2010), "Eye Disease and Development," *LEPAS Conference Papers*, vol. 1: The Mechanics of Aging, Vienna.

[5] Angrist, J. D. , V. Lavy, and A. Schlosser (2005), "New Evidence on the Causal Link between the Quantity and Quality of Children," *NBER working paper* 11835. Cambridge, MA..

[6] Basso, A., and D. Cuberes (2011), "On the Determinants of the Demographic Transition: A Probit Approach," *working paper.*

[7] Black, S. E., P. J. Devereux, and K. G. Salvanes (2005), "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education," *Quarterly Journal of Economics* 120 (2): 669-700.

[8] Becker, G. S. (1981), *A Treatise on the Family.* Harvard University Press, Cambridge, MA.

[9] Becker, G. S., and H. G. Lewis (1973), "On the Interaction between the Quantity and Quality of Children," *Journal of Political Economy*, 81, S279–S288.

[10] Becker, S. O., F. Cinnirella, and L. Woessmann, (2009), "The Trade-off between Fertility and Education: Evidence from Before the Demographic Transition," *CESifo Working Paper* No. 2775.

[11] Bleakly, H., and F. Lange (2009), "Chronic Disease Burden and the Interaction of Education, Fertility, and Growth," *Review of Economics and Statistics* 91 (1): 52-65.

[12] Bloom, D., and J. Williamson (1998). "The Demographic Transition and Economic Miracles in Emerging Asia," *The World Bank Economic Review*, 12(3), pp. 419-455.

[13] Caldwell, J.C. (1980). "Mass education as a determinant of the timing of fertility decline," *Population and Development Review* 6(2), pp. 225-255.

[14] Coale, A. J., and S. C. Watkins (1986), *The Decline of Fertility in Europe.* Princeton, NJ: Princeton University Press.

[15] Gallup, J. L, J. D. Sachs, and A. Mellinger (1999), "Geography and Economic Development," *CIDHarvard University Working Paper* No. 1, March 1999.

[16] Galor, O. and Weil, D. N. (1999), "From Malthusian Stagnation to Modern Growth," *American Economic Review*, 89(2), 150-154.

[17] Galor, O. and Weil, D N. (2000). "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond,"*American Economic Review*, 90 (4), pp. 806-828.

[18] Galor O., Moav O. and Vollrath D. (2009). "Inequality in Landownership, the Emergence of Human-Capital Promoting Institutions, and the Great Divergence," *Review of Economic Studies*, 76(1), pp. 143-179.

[19] Galor, O. (2011). "The Demographic Transition: Causes and Consequences," Working Papers 2010-12, Brown University.

[20] Guinnane, T. W. (2010), "The Historical Fertility Transition and Theories of Long-Run Growth: A Guide for Economists," manuscript.

[21] Guiso L., Sapienza P. and Zingales L. (2006), "Does Culture Affect Economic Outcomes?" *Journal of Economic Perspectives*, 20 (2), pp. 23-48.

[22] Hall R. E. and C. I. Jones (1999). "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *Quarterly Journal of Economics*, 114 (1), pp. 83-116.

[23] Kalemli-Ozcan, S. (2002), "Does the Mortality Decline Promote Economic Growth?" *Journal of Economic Growth* 7, pp. 411-439.

[24] Lehr, C. S. (2009), "Evidence on the Demographic Transition," *Review of Economics and Statistics,* 91(4): pp. 871–887.

[25] Marshall, M. G. and Jaggers, K. (2008), "Polity IV project. Political Regime Characteristics and Transitions, 1800-2002," Integrated Network for Societal Conflict Research (INSCR), Program Center for International Development and Conflict Management (CIDCM), University of Maryland.

[26] Murphy, T. E. (2009), "Old Habits Die Hard (Sometimes): What Can Département Heterogeneity Tell Us About the French Fertility Decline?" *Technical report*, MIMEO.

[27] Murtin, F. (2009), "On the Demographic Transition," *working paper*. OECD.

[28] Norton, S. W. and Tomal, N. (2009). "Religion and Female Educational Attainment," *Journal of Money, Credit and Banking*, 41(5), pp. 961-986.

[29] Notestein, F. (1945), "Population- The Long View," in *Food for the World,* ed. Theodore W. Schultz. Chicago: University of Chicago Press.

[30] Nunn, N., and Puga, D. (2011), "Ruggedness: the blessing of bad geography in Africa," forthcoming, *Review of Economics and Statistics.*

[31] Putterman, L. (2006), Agricultural Transition Dataset, Brown University.

[32] Qian, N. (2009), "Quantity-Quality and the One Child Policy: The Only-Child Disadvantage in School Enrollment in Rural China," *NBER Working Paper* 14973. Cambridge, MA.

[33] Reher, D. S. (2004), "The Demographic Transition Revisited as a Global Process," *Population Space and Place*, 10, pp. 19-42.

[34] Rosenzweig, M. R., and Wolpin, K. I. (1980), "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment," *Econometrica,* 48 (1): 227-240.

[35] Schultz, T. P. (2008), "Population Policies, Fertility, Women's Human Capital, and Child Quality." In T. Paul Schultz, John Strauss (eds.), *Handbook of Development Economics*, vol. 4, pp. 3249-3303. Amsterdam: Elsevier.

[36] Spolaore, E. and Wacziarg, R. (2009). "The Diffusion of Development," *Quarterly Journal of Economics*, 124 (2), pp. 469-529.

8 Appendix

Table 8: Variables and data sources: cross-section analysis

Variable name and description	Source
Onset of the demographic transition	Reher (2004)
Executive constraints in 1900	Polity4, version 3 (2008)
Settler mortality rates	Acemoglu et al. (2001) and Albouy (2011)
Genetic distance to the UK, weighted	Spolaore and Wacziarg (2009)
Absolute value of latitude of country centroid	Nunn and Puga (2011); and Gallup et al.(2001)
Average distance to nearest ice-free coast (1000 km)	Nunn and Puga (2011)
Continental dummies	Nunn and Puga (2011)
% of land area in a tropical climate	Nunn and Puga (2011)
Population density in 1400	Nunn and Puga (2011)
Years passed since the Neolithic revolution	Putterman (2006)
Legal origins	Nunn and Puga (2011)
Shares of religion followers in 1900	Robert Barro's website

Table 9: Variables and data sources: bilateral analysis

Variable name and description	Source
Onset of the demographic transition	Reher (2004)
Genetic distance relative to UK, weighted	Spolaore and Wacziarg (2009)
Absolute value of latitude of country centroid	Nunn and Puga (2011); and Gallup et al.(2001)
Continental dummies	Nunn and Puga (2011)
Dummy for landlocked	Nunn and Puga (2011)
Dummy for island	CIA Factbook
Dummy for countries' contiguity	http://www.cepii.fr/anglaisgraph/bdd/distances.htm
Legal origins	Nunn and Puga (2011)
Colonial history	Nunn and Puga (2011)
Area in each Kopper climatic zone	Gallup et al.(2001)
Absolute value of longitude of country centroid	Nunn and Puga (2011); and Gallup et al.(2001)
Geodesic distance between countries	http://www.cepii.fr/anglaisgraph/bdd/distances.htm
Common official languages between pair of countries	http://www.cepii.fr/anglaisgraph/bdd/distances.htm
Shares of religion followers in 1900	Robert Barro's website
Transportation costs	http://www.importexportwizard.com/

Ivie

Guardia Civil, 22 - Esc. 2, 1º
46020 Valencia - Spain
Phone: +34 963 190 050
Fax: +34 963 190 055

Department of Economics
University of Alicante

Campus San Vicente del Raspeig
03071 Alicante - Spain
Phone: +34 965 903 563
Fax: +34 965 903 898

Website: www.ivie.es
E-mail: publicaciones@ivie.es