Modern and Ancient Cultural Capital. A Worldwide Cross-Sectional Analysis.

Guido Travaglini
Università di Roma "La Sapienza", Italy
Email: jay_of_may@yahoo.com
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Take a rest sometimes in your life and listen to the immense music of your past". Benhabib.

Abstract.

In this paper I attempt at answering to the following question: is modern culture affected by ancient cultural heritage? Are Archimedes and Qin Shi Huang, Cicero and Shakespeare, and the like, still intellectually alive? Do the Parthenon and the Temple of Heaven, and the like, significantly affect modern architects, artists, engineers and novelists? And if so, to what extent? To this end, by drawing from the genetics and memetics literature on cultural transmission and evolution, I empirically test for the existence of links between modern and ancient cultural capital stocks for a sample of over one hundred countries. By using some relevant international datasets, I proxy the former kind of stock with several education and printed-paper indicators and the latter with some distinctive features drawn from the UNESCO List of the World Heritage Cultural Properties. I run for each of the modern-culture indicators a cross-section regression to establish the magnitude and significance of these links, along with the effects of current demographic, social and economic variables. Due to the implied small-sample size, as well as to measurement error and endogeneity, coefficient bias associated to 'weak instrumenting' and to 'excess instrumenting' represents a serious issue, which is appropriately tackled by comparing some recently proposed econometric estimation methods. These are: two-step Empirical Likelihood (EL), two-step Generalized Method of Moments (GMM) and Bias-Corrected GMM (BGMM). The results obtained are in general similar, although the first outsmarts the other two by optimally selecting the instrument vector, and are definitely appealing, as there appears to be for most of the indicators and for the entire sample a timeless and significant thread connecting modern with ancient cultural capital, although in certain cases it is tied to elitarian means of learning and transmission.

Keywords: Education, Books and newspapers, Cross-Section, Empirical Likelihood, Generalized Method of Moments.
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Preliminary version. Comments and criticisms welcome.

1. Introduction.

The issue of cultural transmission and evolution has received growing attention in the last decades, especially thanks to the introduction of mathematical models in the field of memetics [Dawkins, 1976, 1982; Kendal and Laland, 2000] and of population genetics and epidemiology [Cavalli-Sforza and Feldman,1981; Lumsden and Wilson, 1981; Boyd and Richerson, 1985; Hofbauer and Sigmund, 1988]. In spite of different definitions of culture across specialists and of different methodologies used, the issue preserves high intellectual appeal in attempting to establish the extent to which, whether by *memes* or by *genes*, ancient and modern cultural capital stock are linked. At the same time, a large body of literature has developed by analyzing the relationship between modern cultural capital and economic growth [Becker, 1964; Lucas, 1988; Sala-i-Martin, 1997; Barro, 1999, 2000; Barro and Sala-i-Martin, 1999] or wage rates [Mincer,1974; Mincer and Polachek, 1974; Card, 1999; Card and Krueger, 1992; Heckman et al., 2003], or for its own determinants [Becker, 1964; Acemoglu, 1997; Brunello et al., 2000; Brunello and Checchi, 2003]. However, to date, only few economists have tackled the topic of growth in a long-term historical perspective or by making use of ancient cultural capital [Kremer, 1993; De Long and Shleifer, 1993; Casson, 1993; Gray, 1996; Cozzi, 1998; Faria and León-Ledesma, 2003].

In the present paper, I attempt to link together the experiences of these two bodies of literature in order to find, by means of econometric testing, the size and significance of cultural transmission and evolution across centuries and even millennia,. The goal can be achieved, however, only once a generally acceptable and measurable definition of culture is provided.

Although largely intuitive, in fact, the definition of culture in the present context is by no means given for granted. Cavalli-Sforza and Feldman [1981] define culture as: “Those aspects of thought, speech, action, and artifacts which can be learned and transmitted”. Because general and encompassing, this definition may be split into two mutually-exclusive categories: ‘High culture’ and ‘Low culture’ [Allott, 1999]. The former is: “The intellectual and artistic activity and the works produced by it - usually of high expertise and aesthetic value - that are passed on to future generations by means of education and training, and the resulting enlightenment and excellence of taste”[1]. High culture is identifiable with invisible accumulated capital, of recent or ancient quality and vintage which takes the visible form of scientific, technological or artistic capital, viz. the national cultural heritage. Low culture is instead defined as the totality of customs, tastes, behavior patterns, vocational arts and crafts, social arrangements and institutions of a given nation or ethnicity, and in part corresponds to the concept of ‘social capital’ [Putnam, 1993], but definitely does not enter cultural capital.

Because of their different natures, these two forms of culture also bear different time characteristics. In fact, within a (very) long-run perspective, low culture is subject to frequent and fundamental changes, whereas high culture is usually destined to remain unabated overtime, while both affect one another sometimes significantly and other times mildly. Cultural heritage is in fact a capital stock and thus a low-frequency phenomenon which provides the foundations of national identity in spite of multiethnical diversity, which usually positively affects it by fostering competition and improvement in mentifacts and artifacts. Low culture, instead, is a high-frequency phenomenon which may be affected by cultural heritage depending on the extent to which its intrinsic values (expertise and aesthetics) are embedded in the society, usually as a function of education. In a typical peaceful society they cohabit, but low culture in several cases may swamp high culture, especially when forcefully imposed or in the presence of a decadent society.[2]. Only high culture by definition has the capability of fully embedding the quality values of national cultural heritages and to pass them on the future generations, even in the not unfrequent case of dramatic socio-political and economic changes. By consequence, the word culture used in this paper is referred to as ‘High culture’, and may be defined as either ‘modern’ or ‘ancient cultural capital stock’ [Bourdieu, 1986].

While there is general agreement on the definition and measurement of modern cultural capital stock, nothing similarly accepted exists for its ancient counterpart. The former is proxied by standard education indicators, known as ‘human capital’ [Becker, 1964; Lucas, 1988; Barro, 1999, 2000; Barro and Sala-i-Martin, 1999], that are available from different data sets [Barro and Lee, 1996, 2001; Kiriacou, 1991; Cohen and Soto, 2001; UIS, 2004;] although quite often marred by measurement error[3]. To complete on the classic definition of culture mentioned above [Cavalli-Sforza and Feldman, 1981; Bourdieu, 1986] I add to these learning indicators a complementary set of cultural-transmission vehicles, represented by the different classes of books and newspapers titles (henceforth defined as 'printed-paper culture')[4]. Proxies for ancient cultural capital, instead, are to date unavailable and most likely very difficult to concoct because of poor data and no received uniformity in selection criteria[5]. However, a proxy that best defines it can be retrieved from the UNESCO List of the World Heritage Cultural Properties (WHCP) [Faria and León-Ledesma, 2003], whereby a number of quantitative indicators may be extracted, ranging from the number of sites to their mean age down to more specific characteristics of religious and political nature.

Given thus the availability of homogenous data striding the two cultural capital stocks, it is quite straightforward to carry econometric testing for the causality effects, and their significance, running from ancient cultural capital over modern cultural capital. The testing is conducted by means of three different Instrumental-Variables Estimation (IVE) techniques of a cross-section regression of each indicator of modern capital against a vector of exogenous variables represented by the indicators of ancient capital plus dummies, with the instruments being a vector of several current demographic, social and economic variables retrieved from official sources (UNDP, WHO, UIS, and others). The IVEs respectively are: Empirical Likelihood (EL), two-step Generalized Method of Moments (GMM) and Bias-Corrected GMM (BGMM).

The paper is subdivided as follows. Section 2 introduces the data and provides some preliminary descriptive statistics on the data set used. Section 3 describes the estimation methods adopted and may be comfortably skipped by the non-technical reader, while Section 4 provides and discusses the empirical results. Section 5 concludes.

2. Data and descriptive statistics.

2.1. The data.

The available data encompassing ancient and modern cultural capital stocks are divided into four categories: 1) modern-culture indicators, 2) ancient-culture indicators, 3) binary dummies, 4) demographic, social and economic indicators. The first set of indicators constitutes the endogenous variables undergoing the cross-section regression, the second and third sets of indicators sum up to the vector of the exogenous variables, while the last set includes the instruments. Sect. 3 describes formally the implied econometric setting, and the Appendix provides details on the complete list of the data and their sources.

1) As far as modern cultural capital is concerned, many indicators are available as proxy candidates, all stemming from updated world databases. I have identified a total of eighteen, subdivided into two main categories: educational and printed-paper indicators, by and large respectively associated to learning and transmission culture. The Appendix provides details and data sources.

Out of the educational indicators, I have selected seven: the population shares of post-secondary school enrolment and completion, the average years of school, the combined education index, gross enrolment ratios in tertiary education, years of school life expectancy and the literacy rate. Most of the indicators, however, are flawed by country data non-availabity, so that missing data is quite frequent and the workable number of observations hovers on average around 90. Moreover, if available, some data are not recent (several of them cover the period 1994-97), although many are updated to the years 2000 and beyond. In order to maximize the number of observations per indicator and preserve series continuity, the older date is adopted if the newer is unavailable.

Of the educational indicators, the first three pertain to the educational-attainment Barro-Lee dataset (henceforth BL) [1996, 2001] and the others to the UNDP [UNDP, 2004] and UNESCO Institute of Statistics (UIS) datasets [UIS, 2004]. The BL indicators are the country population shares of post-secondary schooling enrolment and completion as well as the average years of school, all referred to populations aged 25 and over. The UNDP indicator used is the combined education index, while the UIS indicators include gross enrolment ratios in tertiary education, school life expectancy and the adult literacy rate. While conflicting or overlapping, the selected indicators may supply – upon careful interpretation – the necessary information embedding the cultural heritage of a country. This is the reason why a more detailed explanation of their features is necessary at this juncture.

In fact, worth of notice for definitional purposes are some of these indicators. The adult literacy rate is defined as "The percentage of population aged 15 and over who can both read and write with understanding a short simple statement in his/her everyday life" [UIS, 2004], and is a very general proxy for modern cultural capital, yet viable because of the assumption that also lower-educated people may have (some) perception of their own cultural heritage. School life expectancy is less general as it encompasses the average length of years of schooling with no maximal age bound, while the tertiary-school gross enrolment ratio is expected to represent, in the absence of larger data availability on academic attendance, the workhorse of modern cultural capital. Finally, the UNDP combined educational index, by encompassing all school levels and including the adult literacy rate, attempts at supplying the broadest concept of human capital available to date.

The printed-paper indicators pertain all to the UIS dataset which includes total newspapers (number of titles of dailies and nondailies) and total book production (number of titles, therein including school textbooks) subdivided into nine Universal Decimal Classification (UDC) classes: generalities, philosophy and psychology, religion and theology, social sciences, philology, pure and applied sciences, arts and recreation, literature, geography and history. These book classes include also school textbooks and, from the intuitive viewpoint, they are all expected to embody ancient cultural heritage in one way or the other. In particular, those with a longstanding tradition, like philosophy, religion, arts and recreation, and literature, are expected to embody it in a significant way. On the other hand, other book classes and newspapers, being of very recent diffusion within and among countries, are expected to be weakly related to ancient cultural heritage[6].

2) As for ancient cultural capital, the WHCP list supplies precious qualitative and quantitative information usable to construct appropriate proxies that may retain its major features of intellectual and artistic dynamics. Even if incomplete and subject to continuous updating, and in spite of some subjectively unexplainable exclusions (e.g. Bhubaneswar in India and Rangoon in Myanmar) and inclusions (e.g. the Varberg Radio Station in Sweden), the WHCP list consists, as of July 2005, of 628 sites distributed across 116 countries of which I exclude three (Afghanistan, Iraq and the Democratic People's Republic of Korea) because of missing data or data unreliability of most if not all of the modern-culture indicators. We are thus left with a data base of 608 sites distributed across 113 countries of the five continents. Incidentally, the city of Jerusalem is included in Israel and the Holy See in Italy. In addition, the site of Auschwitz is removed from Poland[7].

From the WHCP list, which supplies for each country the number and a cursory description of the sites, I have contructed a total of five quantity indicators addressed at proxying ancient cultural capital stock: the total number of sites, their average age, the ratio (percent share) of sites older than 250 years, a historical dummy ratio and the ratio of 'Temples and Castles'. The number of sites offers a clue on the amount of cultural wealth accumulated by each country in the past, and also – at least form the probabilistic viewpoint – on its degree of technical expertise and aesthetics, according to the competitive principle whereby the larger the size of its input human capital stock (e.g. the number of artists, engineers and technicians employed) in an open society the higher the mean value of the output. By this reasoning, the number of sites is taken to represent the quality level of high culture expressed by the country.

The average site age[8] provides information on the time span covered to materialize the site construction process, thereby helping identify 'ancient' as opposed to 'young' cultures, without bearing any specific relationship with expertise and aesthetic values. Time is in fact a necessary yet not sufficient condition for cultural improvement in the long run, especially if the country has undergone destructive events like systematic warfare or frequent social and political turmoils, thereby negatively affecting its human capital stock. In quite a few cases, however, the amount and quality of cultural heritage may at least partially outweigh such consequences[9].

The ratio of sites exceeding 250 years is a subtle yet arbitrary concept that sets on a quarter millennium ago the commencement of the ‘Modern Era’ marked by the expansion of trade, colonization and conquest by the Western nations of the four corners of the world and initiation of the industrialization process still underway nowadays. Because of such dramatic changes on the features of cultural capital accumulation on both sides, the ratio is expected to expresses, albeit loosely, the returns to site production which may be considered decreasing (increasing) when the average age is high (low) and the ratio equals or is very close to (well below) unity. In essence, the ratio measures the overtime continuity of the quality level of sites by relating distant-past cultural capital stock with more recent additions, thereby revealing an improvement or deterioration in technical expertise and aesthetics[10].

Subsequently, I add a ratio denominated ‘Pre-post overhaul’, which may seem unpalatable for some scholars but appealing from the qualitative viewpoint. A cultural ‘overhaul’ is defined as a permanent shock, or series of shocks, that the religious and/or the socio-political setting of a country may have historically undergone by means of peaceful change(s) or violent upheaval(s). For each country, I establish the approximate date of the overhaul(s), if applicable (e.g. fall of the Roman Empire, Islamic conquest, colonization) and then check the amount of its sites that have been erected or manufactured prior to and after that date. The former amount divided by the latter yields the ratio, which is equal to zero for countries that have never experienced overhauls [11].

Finally, I consider the share of ‘Temples and Castles’, which reflects the amount of cultural wealth accumulated in the country by the traditional income-rich ruling classes (aristocrats and clerics) as opposed to the works and artifacts belonging to middle- and low-income classes (bourgeoisie and populace) [De Long and Shleifer, 1993][12]. Essentially, this variable intends to test for whether the impact on high modern culture more significantly stems from the former than from the latter.

3) I add to the regressor list a set of binary dummies, based on the official or largely prevailing religion practiced in each country. The dummy is unity for either of the four most diffused religions in the world (Islam, Christian, Catholic, Buddhist and Confucian) and zero elsewise. Christian includes Protestantism and Orthodoxy, while all other religions (Animist, Hindu, Other and Mixed) constitute the complementary dummy and must thus be excluded[13].

The rationale for using these dummies is based on cross-country historical evidence of the strong relationship between cultural heritage and religion via the very frequent agreements that have tied together the ruling classes (aristocrats and clerics). Moreover, by extending the intuition of Barro and McCleary [2003], the fact that both modern education and printed paper production are frequently tied to religion, either directly or indirectly, cannot be dismissed. In other words, it may be reasonably assumed that religions in general, due to their traditionally populistic stance, avail themselves with powerful means of seduction represented by ‘Temples and Castles’ and of coercion - especially with modern Islam and Catholicism - by influencing and often by directing modern culture, both in the educational and in the printed-paper forms. Econometric testing of these assumptions is conducted in Sect. 4 by checking for the sign and statistical significance of religious dummies in explaining the endogenous variables[14].

4) The world data base for demographic, social and economic indicators is to date very large and supplied by many authors and international institutions of which, in particular, the Penn World Tables, the United Nations, the World Bank and other specialized agencies. For the present purpose a limited amount of variables is required, specifically those mostly correlated to modern-culture indicators, in the spirit of the cited studies that deal with the relationship between education and growth and/or wages. All of the data reported are the most recent available as possible depending on the source (see Appendix).

The variables used (20 in total) are the following: real GDP percapita level and annual growth rate, total country population and annual growth rate, trade openness, fertility and urbanization rates, human development index, three indexes of freedom, civil liberties and political rights, average life expectancy, and the following percent ratios: Public Expenditure on Tertiary Education/Total Public Expenditure on Education, Public Expenditure on Total Education/GDP (or GNP), Total Public Expenditure/GDP (or GNP), average primary, secondary and tertiary school pupils/teacher, females/males gross tertiary school enrolment ratios (known as the ‘gender ratio’), internet users/total population, population aged 0-19/total population. I have added also the percent of endangered sites from the WHCP list.

The rationale for using these variables, as mentioned above, is justified on the following grounds, largely adopted by the recent literature on growth and education [Barro, 1999, 2000; Comi and Lucifora, 2000; Brunello and Checchi, 2003; Baldacci et al., 2004; Chen and Dahlam, 2004]. The ratio of educational government spending represents the effort of institutions to foster and disseminate education addressed at human capital formation [Schultz, 1961; Barro and Sala-i-Martin, 1999], while real GDP percapita is a proxy of the family income input in the education function, reflecting the 'parental role' of investment in youth education, especially in countries where education is not totally cost-free (e.g. textbooks, tuition fees and accomodation expenses) and/or private schooling is supplied in abundance [Mincer, 1974; Mincer and Polachek, 1974; Becker, 1981; Cremer et al., 1992; Brauninger and Vidal, 1999; Brunello et al., 2000]. Fertility measures the impact of incoming generations on extant schooling infrastructures [Barro, 1999, 2000], while the pupil-teacher ratio represents a school-quality indicator, and is interpreted as a substitute to parental education [Card and Krueger, 1992; Brunello and Checchi, 2003].

Moreover, introduction of the indexes of freedom, civil liberties and political rights involves the hypothesis that poor governance [Putnam, 1993] has an adverse effect on cultural dissemination and, more specifically, on public spending [Gupta et al., 2002; Baldacci et al., 2003], while urbanization and gender ratio are important factors of cultural dissemination as they widen the share of population potentially involved in learning and transmitting culture [Galor and Weil, 1996; Treiman, 2002], so much as trade openness and internet [Chen and Dahlam, 2004], either directly or via economic growth [Barro, 2000]. Also a comparatively good health and long life expectancy should positively affect human capital [Dahlin, 2003; Baldacci et al, 2004]. The share of endangered sites, finally, is regarded as an index of cure and maintenance of the local cultural heritage.

2.2. Descriptive statistics.

Precious as it may be due to its illustrative features, descriptive statistics offers only a general and generic overview for the understanding of cross-country or time-series phenomena. Hypothesis testing and statistical inferencing can be pursued only by the econometrics science. It is in this spirit that Tables 1 to 4 are subsequently exhibited and interpreted, letting Sect. 4 supply and explain the chore problem of the present paper.

Table 1 displays some relevant descriptive statistics regarding the variables used in the present context. There I report the number of sites for each country, the average age, the share of sites exceeding 250 years of age and some select modern-culture indicators, namely, three educational indicators plus total books and newspapers.

Figure 1 displays on a logarithmic scale the scatterplots of the relationship between the number of sites and the select modern-culture indicators reported in Table 1. While the squares depicted indicate the countries, the diamonds line illustrates the 'best fit' among each couple of variables for the entire country sample[15]. Simple eyeballig reveals a positive relationship across all indicators, which is particularly marked for two educational indicators (average years of schooling and combined education index) and for both total printed-paper indicators. The results are indeed appealing, as they evidence *prima facie* a connection between ancient and modern cultural capital stocks, and thus lend support to the hypothesis of overtime cultural transmission and evolution advanced by the genetics and the memetics literature. In fact most of the indicators are significantly correlated with the number of sites[16]

Table 2 goes a bit further by exhibiting the nine UDC classes that compose total book titles. Some countries of Table 1 are absent because of no data reporting. Several Islamic countries (most notably Iran, Oman, Algeria and Egypt) and quite a few Catholic countries (especially Brazil, Croatia, Italy and Poland) exhibit high reading rates of religious books, while social sciences, pure and applied sciences and literature constitute almost everywhere the majority of the books read. Social sciences share similar reading rates for most part of the sample with many Islamic countries in the trailing positions, while pure and applied sciences are particularly appreciated in the ex-communist countries and in Scandinavia as well as in some energy-exporting Islamic countries, but shunned in several Catholic countries like Italy, Brazil, the Philippines and Chile. Literature exhibits a very mixed pattern, yet quite a few Islamic countries occupy the lowest ranks. Apart from that, there appears to be no strict relationship between this reading class and the country amount of cultural heritage, a feature shared also – in general - by the the disciplines which are more directly related to antiquity: philosophy and psychology, arts and recreation, and geography plus history[17]. Notable exceptions, amongst others, are Mexico, Brazil and Argentina on the first discipline; Oman, Andorra and the Republic of Korea on the second; Bahrain, France, Tunisia and Italy on the third.

Table 3 to a certain extent summarizes Tables 1 and 2 by providing, together with real GDP percapita, some select educational and printed-paper indicators classified on the basis of the official or largely prevailing religion where, for explanatory purposes, I have split Christianity into its components: Protestantism and Orthodoxy. Interestingly, Islamic countries on average appear to fare worse than the others (excluding 'Other religions' which is represented mainly by Sub-Sahelian countries and Southern Asia) in terms of incomes and educational standards, while are much in line with world averages for the printed-paper indicators, except for religion and theology, social sciences and literature.

Tables 4 to 5 exhibit the country rankings of the ratios of select educational and printed-paper indicators with respect to the number of cultural sites. The purpose of this reported evidence stands in the need of search for the countries which are most 'virtuous' at teaching and transmitting the quality values of their own cultural heritage, whichever its size. As to the educational indicators, the following countries stand out in Table 4 in at least two of them: Australia, Azerbaijan, Estonia, Iceland, Latvia, Luxembourg, Kenya, Mongolia and Uruguay. All of them share one single site only, and may be viewed as virtuous. At the lowest ranks stand instead many cultural-heritage rich countries, like China, France, Germany, Greece, India, Italy, Mexico, Spain and the United Kingdom. As to books and newspapers, to which I add 'humanities' (the sum of all book classes from philosophy and psychology downwards), from Table 5 the following countries occupy the top ranks in at least two of them: Canada, Denmark, Japan, the Republic of Korea, Switzerland, the United Kingdom and the United States.

An interesting picture emerges from careful reading of these two tables: while the schooling ratios exhibit a negative relationship with size, the books ratios exhibit a positive one. As proven by the Spearman rank correlation coefficients[18], I conclude that schooling, which is usually governmental and/or religious, despises size and thus quality such that an abundant (scarce) ancient cultural wealth conduces to lower (higher) education. Probably this evidence is due to the widely received, yet so far unproven, dictum that public education masters disregard the amount and quality of their own high-culture traditions. The opposite occurs with book reading, which significantly appreciates them.

Tables 6 to 7 exhibit the country rankings of select educational and printed-paper indicators with respect to the average age of sites. The purpose here is to find evidence on the relationship existing between modern cultural indicators and the vintage of their ancient counterpart. The value judgement implied is obviously crude and gross as compared to the finesse required to value the sites quality, namely, the expertise and aesthetics therein embedded. While educational ratios exhibit a mixed pattern, books and newspapers ratios indicate that reading is significantly correlated to age, as evidenced by Table 7, where many top ranks are occupied by many cultural-heritage rich countries, most notably Germany, Italy, Japan, the Russian Federation and the United Kingdom.

3. Estimation methods.

3.1. Two-Stage Least Squares and Generalized Method of Moments.

With all the data selected at hand, I now describe the estimation methods adopted for running, one at a time, the linear cross-section regressions of the eighteen modern cultural-capital indicators against the regressors and with the instruments described in Sect. 2. The implied small-sample size, coupled with measurement error and regressor endogeneity may cause severe coefficient inconsistency associated to 'weak instrumenting' and to 'excess instrumenting' [Staiger and Stock, 1997; Andrews, 1991, 1999; Donald and Newey, 2001; Hahn and Hausman, 2002, 2003; Hahn et al., 2001, 2002; Stock and Wright, 2000; Stock et al., 2002; Chao and Swanson, 2004] so that biased estimates may result from using the traditional Two-Stage-Least-Squares (2SLS) and the two-step Generalized Method of Moments (GMM) [Hansen, 1982; Hansen and Singleton, 1982; Hansen and West, 2002]. For this reason, along with GMM, I introduce two well-known alternative methods: the two-step Empirical Likelihood (EL) [Owen, 1988, 2001; Qin and Lawless, 1994; Imbens, 1997; Donald et al., 2003; Guggenberger and Hahn, 2005] and the two-step Bias-Corrected GMM estimator (BGMM) [Donald et al., 2002], which is based upon the Bias-Corrected Two-Stages Least Squares (B2SLS) estimator [Donald and Newey, 2001]. In Sect. 4, EL, GMM and BGMM cross-section estimates will be analyzed and compared in terms of coefficient consistency and efficiency.

Let *N* be the number of countries for which data are available, and $y = (y_1, y_2, ... y_N)$ the *Nx1* vector of any of the modern-culture indicators, $X = (x_1, x_2, ... x_N)$ the *NxK* matrix of ancient-culture indicators plus the religious dummies, and $Z = (z_1, z_2, ... z_N)$ the *NxL* (*L >K*) matrix of the demographic and socio-economic variables.

A typical linear structural cross-section model of each of the modern-culture indicators may be represented as follows:

(3.1) $y_i = X_i'\beta + e_i$; *i*=1,…*N*

where β is a *Kx1* vector of coefficients, e_i is a *Nx1* vector of *I.I.D.* disturbances, and $E(X_i'e_i) = 0$, $E(e_i) = 0$, $E(e_i^2) = \sigma_{e_i}^2$, $E(\sigma_{e_i}^2) = \sigma_e^2$, which respectively imply no endogeneity bias, zero mean and given variance of the disturbance, and no heteroskedasticity. In addition, for η_i and ν_i being *Nx1* vectors of *I.I.D.* disturbances such that $y_i = y_i^* + \eta_i$ and $X_i = X_i^* + \nu_i$, where y_i^* and X_i^* are the respective 'true' observations, $E(y_i'\eta_i) = 0$ and/or $E(X_i'\eta_i) = 0$, namely, no expected measurement error on both the left and the right hand side of the equation is assumed [Portela et al., 2004]. If all of the stated 'well-behavedness' conditions apply, Ordinary Least-Squares (OLS) estimation is consistent and efficient. However, if any of the following occurs, namely $X_i'e_i \neq 0$, $y_i'\eta_i \neq 0$ or $X_i'\nu_i \neq 0$, IVE is required to correct for estimation bias, while heteroskedasticity calls for specific correction methods, e.g. the White [1980] or the Aitken [1935] estimators.

In turn, IVE requires instruments 'validity', that is, the orthogonality conditions $E(Z_i'e_i) = 0$. In applied work, however, orthogonality may not hold for several or many of the instruments chosen. Moreover, while meeting this requirement, instruments may be 'weak' by exhibiting low correlation with the regressors. Two well-known IVEs, the Two-Stages Least Squares (2SLS) and the two-step Generalized Method of Moments (GMM) are addressed at performing this task, by minimizing a criterion function based on sample counterparts of the population orthogonality conditions and on a specific weight matrix. To describe both IVEs, some notation is necessary at the onset.

For some compact coefficient space B of real numbers, let the 'true' population estimator be $\beta_0 \in \mathrm{B}$, and denote $g_i(\beta_0) \equiv g(X, \beta_0) = Z_i'e_i$ a *LxN* matrix of the 'long-run' unconditional moments with the assumed orthogonality property $E\left(g_i(\beta_0)\right) = 0$, (*i*=1,…*N*). A *LxL* weight matrix, known as the long-run covariance or second-moments matrix [Hansen and West, 2002] may thus be constructed as follows

$$W_N = N^{-1}\sum_{i=1}^{N} g_i(\beta_0) g_i(\beta_0)'$$

with typical element $z_{i,m}'e_i e_i'z_{i,n}$;$m = 1, ... L; n = 1, ... L$, $m = n$ for the diagonals and $m \neq n$ for the off-diagonals. For $N \to \infty$, the 'regularity conditions' are: $N^{-1}\sum_{i=1}^{N} g_i(\beta_0) \equiv \overline{g}(\beta_0) = E\left(g_i(\beta_0)\right)$, which constitute the *L*-sized vector of population moment averages, and $N^{-1/2}\sum_{i=1}^{N} g_i(\beta_0) \to N.I.D.(0, W_N{}^{-1})$, which represents their asymptotics. Linearity in the coefficients, to preserve the simplicity involved in the present context, is assumed throughout.

The first partial derivatives of the 'true' long-run moments, denoted as $E\left(\partial g_i(\beta_0)/\partial(\beta)\right)$, form an *LxK* matrix $G = -Z'X$ of rank *K*, with typical element $\sum_{i=1}^{N} z_i' x_i$. By making use of $\overline{g}(\beta_0)$ and W_N, a quadratic scalar criterion function can be constructed such that:

(3.2) $J_N = \overline{g}(\beta) W_N \overline{g}(\beta)'$

from which, after letting $Z'e$ be the stacked version of $Z_i' e_i$, the *K* first-order conditions (FOCs) may be derived:

(3.3) $G' W_N Z' e = 0$

to solve by minimization for the coefficient of interest $\beta_0 = (G' W_N G)^{-1} G' W_N Z' y$.

The same setup may be adopted to solve for the IVEs in an empirically applied context, where the actual sample moments replace the long-run moments and consistency of the estimated coefficient with β_0 is expected as $N \to \infty$. By letting $g_i(\beta) \equiv g(X, \beta)$ be the moment functions based on actual data and $\overline{g}(\beta) \equiv N^{-1}\sum_{i=1}^{N} g_i(\beta)$ be their sample means evaluated at $\beta \in \mathrm{B}$, the 2SLS estimator is expressed as

(3.4) $\beta_{2SLS} = \arg\min_{\beta \in B} \left(\overline{g}(\beta) W \overline{g}(\beta)'\right)$

where $\overline{g}(\beta) W \overline{g}(\beta)'$ is the sample counterpart of eq. 3.2 and the *LxL* nonsingular weight matrix *W* is $(Z'Z)^{-1}$. Similarly, given $\overline{g}(\hat{\beta}) \equiv N^{-1}\sum_{i=1}^{N} g_i(\hat{\beta})$ the sample moment means evaluated at $\hat{\beta}$, the GMM estimator is expressed as

(3.5) $\beta_{GMM} = \arg\min_{\hat{\beta} \in B} \left(\overline{g}(\hat{\beta}) W(\hat{\beta}) \overline{g}(\hat{\beta})'\right)$

so that, for $\hat{\beta}$ a preliminary estimator (usually $\hat{\beta}_{2SLS}$), $\overline{g}(\hat{\beta}) W \overline{g}(\hat{\beta})'$ is the sample counterpart of eq. 3.2, where

$$W(\hat{\beta}) = \left(N^{-1}\sum_{i=1}^{N} g_i(\hat{\beta}) g_i(\hat{\beta})'\right)^{-1}$$

defined as the optimal GMM weight matrix if $\hat{\beta}$ is a consistent estimate of β_0 and, furthermore, if the orthogonality conditions $E\left(g_i(\hat{\beta})\right) = 0$ are satisfied. The 2SLS estimation procedure and the GMM use sample moments derived from the first-stage estimated disturbance vector of the structural model (eq. 3.1), and the two models coincide when this vector is characterized by homoskedasticity and serially independent disturbances. In such case, the two weight matrices *W* and $W(\hat{\beta})$ coincide and, for N sufficiently large, both β_{2SLS} and β_{GMM} are the unique solutions to the minimand thereby being consistent estimates of β_0. In a cross-sectional context, heteroskedasticity is expected to prevail because both the mean and the variance of the dependent variable tend to be large the larger the independent variable(s). Therefore, a cross-sectional IVE model must account for this occurrence and GMM fares better than 2SLS in terms of efficiency if the preliminary estimator is a consistent estimate of β_0.

In general, however, this consistency is not granted in standard 2SLS, because of several reasons related to the choice of the instrument vector and to the available number of observations *N*. Hence, a biased estimator of $\hat{\beta}$ may be a quite frequent and undesirable occurrence. To describe it, let

(3.6) $X_i' = Z_i'\Pi + v_i'$

be the reduced-form auxiliary model tying all of the regressors of eq. (3.1) to the predetermined instruments Z_i, where Π is a *KxL* matrix of coefficients and $E(Z_i'e_i) = 0$, that is, the instruments are 'valid'. In addition, the disturbance is *I.I.D.* with $E(v_i) = 0$, $E(v_i^2) = \sigma_{v_i}^2$, $E(\sigma_{v_i}^2) = \sigma_v^2$. Finally, $rank(\Pi) \leq K$ depending on the arbitrarily selected minimum correlation coefficient below which the regressors are considered weakly correlated to the instruments, whereby some of them may be excluded in each of the *K* reduced-form equations[19]. Substituting eqs. (3.2) into (3.1) yields:

$$y_i = Z_i'\delta + \varepsilon_i$$

where the *KxL*-sized vector $\delta = \pi_{kl}\beta$, with π_{kl} a typical element of Π (*l=1,..L*; *k=1,…K*), is a linear combination of the coefficients of eqs (3.1) and (3.2), and similarly for $\varepsilon_i = e_i + v_i'\delta$.

The sample analog of the moments partial first derivatives is denoted as $\partial g_i(\hat{\beta}) / \partial(\beta)$, which form the *LxK* Jacobian matrix $G_i = -N^{-1}Z'X = N^{-1}\sum_{i=1}^{N} z_i'x_i$. For $\hat{e}_i = y_i - \hat{X}_i'\beta$ and $\hat{X}_i' = Z_i'\hat{\Pi}$, where $\hat{\Pi}$ is the estimated reduced-form coefficient matrix of eq. 3.6, and for $Z'\hat{e}$ the stacked version of $Z_i'\hat{e}_i$, the sample counterpart of eq. 3.3 constitutes the sample *K*-sized vector of FOCs, namely

(3.7) $G_i'WZ'\hat{e} = 0$

which, solved for β, yields the 2SLS estimator

$$\hat{\beta}_{2SLS} = (G_i'WG)^{-1}G_i'WZ'y$$

whose asymptotic bias is

(3.8) $\sqrt{N}(\hat{\beta} - \beta_0) = (N^{-1}G_i'WG)^{-1}(N^{-1/2}G_i'WZ'\hat{e}_i)$.

Let $\hat{\Pi} = WG$ and $H = N^{-1}\hat{\Pi}'W^{-1}\hat{\Pi}$ be the covariance of the estimated endogenous regerssors of eq. 3.1. A stochastic higher-order expansion of eq. 3.8, after a few arrangements [Bekker, 1994; Bound et al., 1995; Hahn et al., 2001, 2002; Hahn and Hausman, 2003; Donald and Newey, 2001], produces the following normality properties of the asymptotic bias, in case of heteroskedasticity correction [White, 1980] in terms of mean and variance:

(3.9) $\sqrt{N}(\hat{\beta}_{2SLS} - \beta_0) \xrightarrow{d} N.I.D.\left(N^{-1/2}H^{-1}L\sigma_{ve}, (G_i'WG - \kappa X'X)^{-1}\right)$

where σ_{ve} is the square-rooted covariance of the disturbances of the structural and of the reduced form. In other words, the 2SLS bias never approaches zero as either or all of the following circumstances occur: a too large number of instruments *L* relative to the number of observations N ('excess instrumenting') , a large covariance of the disturbances ('model inefficiency' due to bad choice of regressors and/or of instruments) and $\hat{\Pi} \rightarrow 0$ ('weak instrumenting') [Hahn et al., 2001, 2002; Stock et al., 2002; Chao and Swanson, 2005]. The bias vanishes if its causes are removed, and in general if *N* grows at a faster rate than *L*, such that $L^2 / N \rightarrow 0$ as $N \rightarrow \infty$, under the proviso that the instruments used be valid. If not, the bias persists [Hahn and Hausman, 2003].

The Bias-Corrected Two-Stage least Squares (B2SLS) estimator [Donald and Newey, 2001; Chao and Swanson, 2005], assuming validity, is:

(3.10) $\hat{\beta}_{B2SLS} = [G_i'WG - \kappa X'X)]^{-1}[G_i'WZ'y - \kappa X'y]$

for $\kappa = N^{-1}(L-2)$. If $\kappa = 0$, eq. 3.10 reduces to $\hat{\beta}_{2SLS}$.

The heteroskedasticity-corrected asymptotics of $\hat{\beta}_{B2SLS}$, which may be compared with those of eq. 3.9 , are

(3.11) $\sqrt{N}(\hat{\beta}_{B2SLS} - \beta_0) \xrightarrow{d} N.I.D.\left(N^{-1/2}H^{-1}L^{1/2}(\sigma_{ve} + \sigma_e\sigma_v),(G_i'WG)^{-1}\right)$

such that the B2SLS asymptotic bias vanishes at the rate $L/N \rightarrow 0$ as $N \rightarrow \infty$, In such case, the B2SLS estimator is expected to converge to the true coefficient at a faster rate than its 2SLS counterpart[20], and therefore to provide a more consistent preliminary estimator $\hat{\beta}$ for the two-step GMM procedure.

The two-step GMM estimation of the coefficient vector β of eq. 3.1 essentially follows the same path as above, as it uses sample moments to determine both the Jacobian and the weight matrix. The latter is optimal if the orthogonality conditions are satisfied and if the preliminary estimator is consistent so that, for what shown above, $\hat{\beta}_{B2SLS}$ is the best bias-minimizing candidate. The GMM criterion function is

(3.12) $J(\hat{\beta}) = N\overline{g}(\hat{\beta})W(\hat{\beta})\overline{g}(\hat{\beta})'$

and ist first derivative with respect to the estimator is

$$\partial J(\hat{\beta}) / \partial \hat{\beta} = 0$$

from which the following FOCs are derived

(3.13) $G_i'W(\hat{\beta})\overline{g}(\hat{\beta}) = 0$

and solved for $\hat{\beta}$ to yield the optimal estimator

(3.14) $\hat{\beta}_{GMM} = (G_i'W(\hat{\beta})G)^{-1}G_i'W(\hat{\beta})Z'y$

whose variance is denoted as

(3.15) $\hat{\Sigma} = (G_i'W(\hat{\beta})G)^{-1}$

which is the minimum possible variance compared to any other estimator (e.g. 2SLS) that does not use $W(\hat{\beta})$ as the weight matrix. Hence the estimator of eq. 3.14 is efficient, namely $\hat{\beta}_{GMM} \xrightarrow{p} \beta_0$, and $N.I.D.(\beta_0, \hat{\Sigma})$ [Chamberlain, 1987].

Given that the orthogonality conditions for the instrument vector Z_i exhibit the property of $E\left(g_i(\hat{\beta})\right)=0$, a statistical check for this requirement in applied work is conducted by means of the '*J* -statistic' [Hansen, 1982; Hansen and Singleton, 1982]. The criterion function of eq. 3.12 is a scalar whose expected value is zero. Therefore, for $L_1 < L$ a subset of the *L*-sized instrument vector, under the null hypothesis of $L_1 = K$ (perfect identification of the subset) $J(\hat{\beta})$ is asymptotically distributed as a $\chi^2_{L_1-K}$ statistic. The statistic provides a test for the 'overidentifying restrictions', because nonrejection of the null, within a given significance level, implies that the preselected subset of L_1 instruments satisfy the orthogonality conditions as they are truly predetermined. Contrarywise, additional information would be necessary in favor of an alternative or even of the entire set.

The GMM estimator in the presence of autocorrelation and heteroskedasticity is thus shown to be, for *N* sufficiently large, asymptotically consistent and more efficient than 2SLS. Moreover, it disposes of the consistency problems associated to instrument selection since minimization of eq. 3.12, with the weight matrix appropriately treated [Newey and West, 1987, 1994], bypasses weak instrumenting [Hayashi and Sims, 1983; Bound et al, 1995; Hayashi, 2000], excess intrumenting [Koenker and Machado, 1999; West et al., 2001; Hansen and West, 2002] and invalid instrumenting [Hahn and Hausman, 2003]. Hence, virtually, any *L*-sized vector of the instruments is considered optimal insofar as the orthogonality conditions are significantly proven to hold by means of the *J*-statistic test, and the larger is *L* for $N \to \infty$ the greater the gains in asymptotic efficiency of the estimator [West et al., 2001].

However, even if the preliminary estimator is consistent, in a small-sample setting with heteroskedasticity (as is the usual case of cross sections), estimation bias may be a very serious issue in the presence of weak instrumenting [Staiger and Stock, 1997; Stock and Wright, 2000; Donald and Newey, 2001] and/or of excess instrumenting relative to the number of observations [Hansen et al., 1988; Nelson and Starz, 1990; Hall et al., 1996; Gallant and Tauchen, 1996; Andrews, 1991, 1999; West et al., 2001; Donald et al., 2002]. In such setting, the sample moment averages are in fact shown by Montecarlo evidence to be negatively signed and asymmetric [Altonji and Segal, 1996]. Moreover, in cross-section models, the bias is proven to be proportional to the number of instruments [Newey and Smith, 2004; Okui, 2004]. It follows that, for $\beta_{GMM} \xrightarrow{p} \beta_0$ to hold as $N \to \infty$, the sample moments and their first derivatives must share the same distributional properties as their population counterparts. Figure 2 illustrates, by Montecarlo simulations based on 1,000 replications of artificial series of different length (50, 75,100 and 200 observations), the magnitude of the bias-variance tradeoff emerging from an increasing number of instruments[21]. As these are made to linearly grow for each selected sample size, the squared bias decreases and the variance rises, and their ratio rises the larger is the instrument set, albeit less intensely the larger is the sample size.

3.2. Asymptotic bias in the Generalized Method of Moments and Empirical Likelihood.

To theoretically explain the nature of the asymptotic bias in the GMM estimator, the following notation is required. Eq. 3.12 may be rewitten as $-\hat{\lambda}G_i{}'=0$, with the auxiliary coefficient $\hat{\lambda}=W(\hat{\beta}_{GMM})\overline{g}(\hat{\beta}_{GMM})$, where $\hat{\beta}_{GMM}$ replaces $\hat{\beta}$ to indicate explicit reference to the estimator. After some manipulation: $-\hat{\lambda}S(\hat{\beta}_{GMM})-\overline{g}(\hat{\beta}_{GMM})=0$. First-order Taylor expansion of $-\hat{\lambda}G_i{}'=0$ and of the last equation around the long-run values, β_0 and 0, provides the asymptotics of $\hat{\beta}_{GMM}$ and $\hat{\lambda}$. In fact, given that the long-run counterparts of $\overline{g}(\hat{\beta}_{GMM})$, $W(\hat{\beta}_{GMM})$ and G_i respectively are $\overline{g}(\beta_0)$, W_N and $G \equiv E(G_i)$, the two-equation system describing the dynamics of $\hat{\beta}_{GMM}$ and $\hat{\lambda}$ is the following:

$$\begin{bmatrix} 0 \\ -\overline{g}(\beta_0) \end{bmatrix} + \mathrm{M}\begin{bmatrix} \hat{\beta}_{GMM} - \beta_0 \\ \hat{\lambda} \end{bmatrix} = 0; \quad \mathrm{M} = -\begin{bmatrix} 0 & G' \\ G & W_N \end{bmatrix}$$

which, upon inversion to solve for $\hat{\beta}_{GMM} - \beta_0$ and $\hat{\lambda}$, yields:

$$\begin{bmatrix} \hat{\beta}_{GMM} - \beta_0 \\ \hat{\lambda} \end{bmatrix} = -M^{-1}\begin{bmatrix} 0 \\ -\overline{g}(\beta_0) \end{bmatrix}; \quad \mathrm{M}^{-1} = -\begin{bmatrix} -\Sigma & \Theta \\ \Theta' & \mathrm{P} \end{bmatrix}$$

where for M nonsingular, $\Sigma = (G'{W_N}^{-1}G)^{-1}$, $\mathrm{P} = {W_N}^{-1} - {W_N}^{-1}G\Sigma G'{W_N}^{-1}$ and $\Theta = \Sigma G'{W_N}^{-1}$. The first two are variance terms, the last is a covariance. In addition, $\mathrm{P} = {W_N}^{-1}$ if there is perfect collinearity among endogenous regressors and instruments, and $\mathrm{P} = I_L$ with exact identification (*L*=*K*) when ${W_N}^{-1} = I_L$. Since $\overline{g}(\hat{\beta}_{GMM})$ and $\hat{\lambda}$ are both $Op(N^{-1/2})$, by virtue of the Central Limit Theorem and of the Weak Law of Large Numbers, the asymptotics of $\hat{\beta}_{GMM}$ and $\hat{\lambda}$ are the following:

(3.16) $\sqrt{N}(\hat{\beta}_{GMM} - \beta_0) \xrightarrow{d} N.I.D.(0, diag(\Sigma)), \sqrt{N}\hat{\lambda} \xrightarrow{d} N.I.D.(0, diag(\mathrm{P}))$

namely, both $\hat{\beta}_{GMM}$ and $\hat{\lambda}$ are asymptotically normal.

The higher order bias of $\hat{\beta}_{GMM}$, in the presence of heteroskedasticity and conditional moments, follows from the stochastic expansion up to $Op(N^{-1/2})$ [Rothemberg,1984; Newey and Smith, 2004] of the expression:

$$\hat{\beta}_{GMM} - \beta_0 = -M^{-1}\overline{g}(\beta_0)$$

which, after letting $\hat{M} = \partial\overline{g}(\beta_{GMM}) / \partial\beta_{GMM}$ and $\hat{U} = -M^{-1}\overline{g}(\beta_0)$, yields the following approximation formula:

$$\hat{\beta}_{GMM} - \beta_0 = \hat{U} - M^{-1}(\hat{M} - M)(\hat{\beta}_{GMM} - \beta_0)$$

where $\hat{U} = Op(N^{-1/2})$ and the second term is $Op(N^{-1})$. Therefore:

$$\sqrt{N}(\hat{\beta}_{GMM} - \beta_0) = \hat{U} - M^{-1}(\hat{M} - M)\hat{U}$$

where:

$$-M^{-1}E(\hat{M}\hat{U}) = N^{-1}[-\Sigma E(G_i'Pg_i) + \Theta E(G_i\Theta g_i) + \Theta E(g_i g_i'Pg_i)].$$

The approximate asymptotic bias of $\hat{\beta}_{GMM}$ may thus be expressed as the sum of three components, two of which heavily depend on the number of instruments used. The first bias component depends on the sample estimate of the Jacobian G_i, the second on the sample estimate of the weight matrix $W(\hat{\beta})$, and the third on the moment vector, which is the product of G_i and $W(\hat{\beta})$, as well as on the conditional moments.

Out of these components, the major source of asymptotic bias is represented by the first, denoted as $B_G = -\Sigma N^{-1}E(G_iPg_i)$. This expression may be developed as:

$N^{-1}\Sigma E(X'ZPZ'\hat{e}) = -N^{-1}\Sigma E(\hat{e}'XZ'PZ)$

where the latter equation equals $-N^{-1}\Sigma\hat{e}'X \cdot tr[(Z'Z)P]$ so that, finally:

(3.17) $B_G = N^{-1}\Sigma(\hat{e}'\hat{e})^{-1}\hat{e}'X(L-2)$

which implies that this form of bias, defined as the long-run covariance of moments with their first derivatives or as the bias in the Jacobian [Newey and Smith, 2004], is proportional to the ratio between the number of instruments *L* (minus two) and the number of observations. Moreover, it is affected by the covariance of the endogenous regressors with the first-step residuals, the component $\hat{e}'X$ in eq. (3.17). This bias will be partly reduced if, for given *N*, the disturbance vector $\hat{e}$ is associated to $\hat{\beta}_{B2SLS}$.

The second form of asymptotic bias is denoted as $B_W = N^{-1}\Theta E(g_i g_i' P g_i)$. It arises from sample estimation of the weight matrix, that is, from the second-moment moment matrix $g_i g_i'$, and can be very severe if the moments g_i are far from normality [Altonji and Segal, 1996]. The bias vanishes if the residuals used to construct g_i are all normal (conditionally symmetric), which in turn requires a consistent estimate of W_N, namely $W(\hat{\beta}) \xrightarrow{p} W_N$ in the first-step estimation, hence absence of excess or weak instrumenting in the 2SLS procedure. This expression, as with B_G, may be developed as follows:

$B_W = N^{-1}\Theta Z'\mu_3 E(Z'PZ) = N^{-1}\Theta Z'\mu_3 tr(Z'Z)P$

where the latter equation equals

(3.18) $B_W = N^{-1}\Theta Z'\mu_3(L-2)$

for $\mu_3 = e_i^2 / \sigma_i^2$.

This bias, in essence, grows with the number of instruments and zeroes out for perfect symmetry ($\mu_3 = 0$). Reduction of this bias may be achieved either by suitably intervening on the latter by appropriately choosing the conditional disturbance $\hat{e}_i$ or a subset of conditional moments characterized by or at least approaching normality, as suggested by some authors [Donald et al., 2002].

The third form of asymptotic bias is denoted as

(3.19) $B_I = N^{-1}\Theta E(G_i \Theta g_i)$

which does not grow with number of moments but is affected, as the above, by endogeneity. This bias is the asymptotic bias for a GMM estimator where $G_i' W_N^{-1} g_i$ is the optimal (asymptotic variance minimizing) linear combination which uses the 'true' optimal instruments [Hansen, 1982; Newey and Smith, 2004].

A fourth form of bias should be added if the first-step estimator $\hat{\beta}$ is reputed inefficient. The assumption to depart from is that $W_N = g_i g_i' + \sum_{k=1}^{K} \bar{W}_{\beta_k}$, where $\bar{W}_{\beta_k} = E(\partial W_N / \partial \beta_k)$. Derivation of W_N with respect to β_k yields a *K*-sized sequence of *LxL* matrices whose typical diagonal element is $\bar{W}_{\beta_k} = 2(\beta_k x_k' z_l z_l' x_k - x_k' z_l y)$, $k = 1,\ldots K; l = 1,\ldots L$. Summation over *K* of each such matrix yields $\sum_{k=1}^{K} \bar{W}_{\beta_k}$. Let the covariance matrix associated to $\hat{\beta}$ be denoted as $\Theta_W \neq \Theta$. Then, after several arrangements [Newey and Smith, 2004], the bias is defined as

(3.20) $B_B = -\Theta N^{-1} E \sum_{k=1}^{K} (\partial W / \partial \beta_k)(\Theta_W - \Theta)$.

Needless to say, the bias vanishes if $\Theta_W = \Theta$, i.e. if $\hat{\beta}$ is asymptotically efficient. However, this may not be the usual case as efficiency implies a large *L* at the expense of bias in $\hat{\beta}$, so that reduction of this form of bias implies careful instrumenting although, in principle, the B2SLS estimator approximates the efficient $\hat{\beta}$.

The mean squared error (MSE) of the GMM estimator includes the squared biases described above and a variance $V(L) = \hat{Z}' W_N^{-1} \hat{Z} - G' W_N^{-1} G$, where $Z' \sigma_v^2$. This term shrinks as *L* grows giving rise to the well-known 'bias-variance tradeoff', on which the Montecarlo experiments shown in Figure 2.

With the bias forms so far described, a bias-corrected GMM estimator is obviously preferable to $\hat{\beta}_{GMM}$. To obtain it, Newey and Smith [2004] suggest simply subtracting the four biases from $\hat{\beta}_{GMM}$, and at the same time, exhibit the reduced-bias advantages of alternative IVEs, such as the Continuous Updating Estimator (CUE) [Hansen et al., 1996], the Empirical Likelihood (EL) and the Generalized Empirical Likelihood (GEL) [Smith, 1997, 2001] of which, under specific circumstances, the first two are a special case [Newey and Smith, 2004]. An alternative and perhaps equally efficient way to obtain it is to compute the following

(3.21) $\hat{\beta}_{BGMM} = (G_i' W(\hat{\beta}_{B2SLS}) G)^{-1} G_i' W(\hat{\beta}_{B2SLS}) Z' y$

where $\hat{\beta}_{B2SLS}$ is defined in eq. (3.10) [22].

Of the other bias-reducing methods, EL - different from two-step GMM and CUE - is a nonparametric Maximum-Likelihood estimation method which uses weighted sample moment conditions, not just their sample averages. The weights are derived from the probability p_i (*i*=1,…*N*) that each of the *L* moment conditions $g_i(\beta)$ be close enough to zero. The EL estimator is the unique solution to a saddlepoint problem represented by an empirical log-likelihood function subject to given constraints. The function is expressed as [Qin and Lawless, 1994]:

(3.22) $\sum_{i=1}^{N} \log(p_i)$

while the constraints are the following:

(3.23) $p_i \geq 0$, $\sum_{i=1}^{N} p_i = 1$, $\sum_{i=1}^{N} p_i g_i(\beta) = 0$.

such that, for each probability p_i, $E(p_i) = 1/N$, *i=1,…N*. Combining eqs. (3.22) and (3.23) yields the following Lagrangean to be maximized [Qin and Lawless, 1994]

$$\mathbf{L} = \sum_{i=1}^{N} \log(p_i) + \gamma(1 - \sum_{i=1}^{N} p_i) - N\lambda' \sum_{i=1}^{N} p_i g_i(\beta)$$

where γ and λ' respectively are a scalar and an *L*-sized vector of Lagrangean multipliers pertaining to the compact coefficient space Λ of real numbers. Derivation of **L** with respect to p_i yields, after some manipulation, the optimal EL probabilities

$$p_i^* = N^{-1}\log[1+\lambda' g_i(\beta)]^{-1}$$

which substituted back into eq. 3.21 produce the following empirical log-likelihood function

$$-N^{-1}\sum_{i=1}^{N}\log[1+\lambda' g_i(\beta)]$$

whose FOCs, comparable with eqs. 3.7 and 3.13, are:

3.24.1) $N^{-1}\sum_{i=1}^{N}[1+\hat{\lambda}_{EL}' g_i(\hat{\beta}_{EL})]^{-1} g_i(\hat{\beta}_{EL}) = 0$

with respect to λ, and

3.24.2) $N^{-1}\sum_{i=1}^{N}\left\{[1+\hat{\lambda}_{EL}' g_i(\hat{\beta}_{EL})]^{-1}\left(\partial g_i(\hat{\beta}_{EL})/\partial\beta\right)\right\}'\hat{\lambda}_{EL} = 0$

with respect to β, where $\hat{\lambda}_{EL}$ and $\hat{\beta}_{EL}$ are the numerical solutions to the FOCs[23]. In particular, as far as the present context is concerned, the EL estimator of β is:

(3.25) $\beta_{EL} = \arg\min_{\beta\in B}\max_{\lambda\in\Lambda}\left(N^{-1}\sum_{i=1}^{N}\log[1+\lambda' g_i(\beta)]\right)$

definitely the unique solution to a saddlepoint problem.

A formula for the EL estimator that compares with eqs. (3.10) and (3.14) is given by the following:

(3.26) $\hat{\beta}_{EL} = (G_i^*{}' W^*(\hat{\beta}) G_i^*)^{-1} G_i^*{}' W^*(\hat{\beta}) Z_i^* y$

where, for the optimal instrument set $Z_i^* = Z_i/[1+\hat{\lambda}_{EL}' g_i(\hat{\beta}_{EL})]$, the optimal Jacobian and the optimal weight matrices respectively are:

$$G_i^* = -X' Z_i^*$$

$$W^*(\hat{\beta}) = \left\{\left(g_i(\hat{\beta}_{EL})/[1+\hat{\lambda}_{EL}' g_i(\hat{\beta}_{EL})]\right)'\left(g_i(\hat{\beta}_{EL})/[1+\hat{\lambda}_{EL}' g_i(\hat{\beta}_{EL})]\right)\right\}^{-1}.$$

The asymptotic variance matrix and the *J*-statistic may be easily obtained along the same lines as those of the GMM estimator. In particular, the former mey be written as

(3.27) $\sqrt{N}(\hat{\beta}_{EL}-\beta_0)\xrightarrow{d} N.I.D.\left(0, G_i^*{}' W^*(\hat{\beta}) G_i^*)^{-1}\right)$

which compares with eq. (3.16).

A typical test of the conditional moment restrictions of eq. (3.23) is supplied by the Empirical Log-likelihood Ratio Test (ELRT) [Owen, 1988, 2001; Qin and Lawless, 1994], which is the difference of the log-likelihood for the empirical distribution, with $E(p_i) = 1/N$ for each *i*.th observation and the restricted distribution of eq. (3.22). Formally:

(3.28) $\text{ELRT} = 2\left(N\log(N) - \sum_{i=1}^{N}\log(p_i)\right) = 2\sum_{i=1}^{N}\log N^{-1}\left(1+\hat{\lambda}_{EL}{}'g_i(\hat{\beta}_{EL})\right)$

such that, for given *K*, ELRT $\xrightarrow{d} \chi^2_{L-K}$.

As a consequence of optimality, the solution to the saddlepoint problem via the FOCs, the EL estimation method – in comparison with GMM and BGMM - straightforwardly elimates three sources of bias: B_G, because it uses the optimal Jacobian matrix, a characteristic shared also by CUE [Donald and Newey, 2001]; B_B, because it involves single-step estimation in the one-step case [Newey and Smith, 2004] and a consistent initial estimator in the two-step case [Guggenberger and Hahn, 2005]; B_W , because it uses the optimal weight matrix. The sole and inescapable form of bias that EL cannot eliminate is B_I , which is the same as that emerging for any other estimator which uses W_N^{-1} as the optimal weight matrix. Finally, EL estimation is shown to be more efficient than GMM when the moment conditions are thin-tailed [Newey and Smith, 2004], although two-step EL may be characterized by fat tails [Guggenberger and Hahn, 2005][24].

A final word is due on the pseudo-logarithm (henceforth pseudolog) function [Owen, 2001] which, for the variable y_i and for given *N*, is the following:

(3.29) $\log_*(y_i) = \log(N^{-1}) - 1.5 + 2Ny_i - .5(Ny_i)^2$

where $\log_*(y_i)$ is a special transformation of $\log(y_i)$ adopted to accommodate for values of y_i lying in the neighborhood of zero, i.e. when $y_i \leq N^{-1}$. If instead $y_i \geq N^{-1}$, $\log(y_i)$ is retained.

4. The empirical results.

4.1. Equation setup: regressors and instruments.

Because of the need to log transform all series, some of these must undergo the above-shown pseudolog transformation [Owen, 2001] whenever some of their original values are unity, as with the number of sites, or zero as with the pre-post overhaul ratio, the ratio of sites exceeding 250 years, and the ‘Temples and Castles’ ratio. Preserving the classical log transformation would produce a zero in the first case and a non available (NA) datum in the second case, thereby heavily distorting coefficient estimation and reducing the sample size, respectively[25].

All of the percent rates and ratios (*r*) are treated as the log-ratio transformation (LRT) specified as *log*(1+*r*/100). Of all of the selected modern-capital indicators, the average years of schooling and the combined education index are originally expressed in levels, as well as total books and newspapers of the regressor list, plus real GDP per capita, total country population, trade openness, human development index, the indexes of freedom, civil liberties and political rights, and average life expectancy of the instrument list. All of these variables undergo log-level transformation, while all of the remaining variables undergo LRT, including the nine UDC book-title classes which I have transformed into ratio terms with respect to the total book titles, as they are exhibited in Table 2. This transformation is necessary for two reasons: avoiding the stock-flow criticism advanced by some authors on the nature of human capital (see fn. 6) and supplying interesting information on the the structural composition of book reading by classes, as already shown in Tables 2,3,5 and 7.

To avoid collinearity among regressors, the ‘Temples and Castles’ ratio is moved to the instrument list, which thus reaches a total of 21 variables and reduces the number of regressors to eight, excluding the constant term for both[26]. This is quite an unfortunate occurrence with regard to the assumed relevant role that this variable may exercise on modern culture (see Sect. 2) but technically unavoidable. A quick check on the orthogonality degree of the regressors (‘exogeneity’) has proven that some are endogenous or are, together with the endogenous variable, affected by measurement error[27], whereby the IVE approach is fully justified in all of the cross-section equations.

All of the cross-section regressions run for the eighteen selected modern-capital indicators exhibit a fixed format in terms of number of regressors. No potential regressor drawn from the instrument list described in Sect. 2 is added or substitutes for the fixed regressors, as used by selection methods like the extreme-bounds and the general-to-simple reduction techniques [Levine and Renelt, 1992; Sala-i-Martin, 1997; Temple, 2000, 2001; Hoover and Perez, 2004; Hendry and Krolzig, 2004]. A search procedure for such plausible candidates within the entire instrument list has been performed by sensitivity analysis of the fixed regressor coefficients and has proven that the fixed regressors are robust to any augmentation. This analysis has been performed via the following steps: *i*) GMM estimation of each cross-section equation with the fixed-regressor list; *ii*) selection of the potential regressors out of the instrument list via two alternative (yet similar) methods: the rankings of their signal-to-noise ratio with respect to the endogenous variable and the rankings of their partial correlation coefficient with the endogenous variable[28]; *iii*) GMM estimation of each cross-section equation with the fixed regressors augmented by the the top-ranking potential regressors found by either method; *iv*) elimination of the additional potential regressors with low *t*-statistic significance (*p*-value higher than 5%) and sequential re-estimation until only the significant ones are left; *v*) sensitivity analysis of the coefficients of the fixed-regressor list obtained from step *(i)* with respect to those obtained from step *(iv)* by checking the distribution of the former within the confidence bands (plus or minus two standard errors) of the latter [Sala-i-Martin, 1997; Hoover and Perez, 2004].

The results of the sensitivity analysis are not reported here, but suffice here to state that in most cross-sections either method used (signal-to-noise and correlation rankings) conduces to robustness of the fixed regressors with respect to augmentation of other potential regressors, whose role in explaining the dependent variable of each cross-section is by consequence reputed as statistically irrelevant.

No particular small-sample instrument selection criterion of those most reknown in the recent literature for 2SLS [Donald et al., 2003] and GMM [Andrews, 1999] has been adopted in the runs exhibited in Table 5. Admittedly, I have attempted two alternative instrument-selection criterion based on the ranking of the moment conditions that satisfy the orthogonality requirement ('valid' intrumenting) [Okui, 2004] and on small-sample normality requirements [D'Agostino and Stephens, 1986][29]. However, the method – which is still void of theoretical underpinnings - was subsequently dismissed because, by removing a substantial source of bias derived from excess and weak instrumenting in both the Jacobian and the weight matrix (B_G and B_W respectively), many coefficients exhibited excess inefficiency as compared to the three other estimators and could not be safely relied upon for inferencing.

4.2. Results and their interpretation.

Table 8 exhibits the cross-section results of the eighteen modern-capital indicators by means of the three alternative estimation methods proposed and introduced in Sect. 3. These are: EL, GMM and BGMM, which are being compared to test for coefficient consistency and efficiency and are respectively expected, as from the discussion in Sect. 3, to be unbiased and efficient, highly biased and efficient, and mildly biased and inefficient. The instrument set used is the same for all equations and totals 22, including the constant term. The number of available observations attached to each endogenous-variable estimation refers to number of available observations minus the 22 degrees of fredom of the instrument set. Apart from the estimated coefficients and their absolute *t*-statistic values, the table sequentially reports the *J*-statistic and its *p*-value (for a total of L-K=13 restrictions), the Root Mean Squared Error (RMSE), the Durbin-Watson coefficient for residual first-order autocorrelation, and also the Empirical Log-likelihood Ratio Test (ELRT) described in eq. (3.28) with its corresponding *p*-value (13 restrictions).

In one third of the cross sections, EL is more efficient than the other methods when measured by the size of RMSE, and much more efficient when measured by single-coefficient *t*-statistic values. In fact, for more than 20 of the reported coefficients in the entire table, as may be easily viewed, the EL *t*-statistic passes at least the 5% *p*-value test while the GMM and BGMM counterparts fail. These results, which are in line with the Montecarlo evidence exhibited above (Sect. 3, fn. 24), are at odds with what maintained by Newey and Smith [2004], because in all cross-section equations the EL moment conditions exhibit fatter tails [Guggenberger and Hahn, 2005] than those of the other two estimators.

All in all, the EL method may be viewed as the most robust interpretive tool of the hypothesis being tested in the present paper, unless the size of its RMSE were sizably lower (80% or below) than that of the other two methods, a rare occurrence which regards only the literacy rate, literature and newspapers. In such cases, although respectively highly biased and highly inefficient, the GMM and BGMM results should be taken seriously especially if their coefficient *t*-statistics are markedly different from those estimated by the EL method. As revealed by its *p*-values, the ELRT statistic indicates that in the vast majority of the cross-section regressions the moment conditions satisfy the orthogonality requirement stated in Sect. 3, that is, the selected instruments are optimal and valid. Only the complete educational attainment and the newspapers equations fail the test within a 5% significance level.

As for the educational indexes, *coeteris paribus* the number of cultural sites - which is taken as a proxy for the quality of cultural heritage (Sect. 2) – exhibits a positive and at least 5% significant *t*-statistic of the coefficient for the following four: average years of school, combined education index, gross tertiary enrolment ratio and school life expectancy. Educational attainments for populations of 25 years of age and over, and the literacy rate are instead apparently unaffected. Whether because of reported measurement error on the first two [Portela et al., 2004] or because of the very nature of the latter (as previously advanced in Sect. 2), these results may be loosely interpreted as implying that older generations, by being on average less educated than the young, place less emphasis on the technical expertise and aesthetics embedded in their own cultural heritage. This conclusion is reinforced by the fact that the share of sites exceeding 250 years carries a significantly negative coefficient, and their average age appears mostly irrelevant, which attaches to these educational classes the despicable opinion that 'ancient equals decrepit'. The precise opposite occurs with gross tertiary school enrolment and school life expectancy, which are indicators that definitionally imply younger and more educated people, more prone to cultural assimilation and more able to express value judgements related to the quality of their sites. The combined education index, by encompassing all of the mentioned educational indexes, stands in between these two extrema. The dummy 'Pre-post overhaul' is significantly positive in all but one case indicating that people, irrespective of their age or educational level, are fully conscious of their current institutional and/or religious setting as opposed to the previously dominant one (if any).

Religious dummies play a relevant role at explaining, along with ancient cultural capital, the current educational standards. Because of their historical intermesh, as shown in Sect. 2, the following results come as no surprise. Islam plays no significant role whatsoever in the indicators, exclusion made for gross tertiary school enrolment and school life expectancy, maybe because of the recent diffusion of the 'madrassa effect' on the younger generations. The dummy of Buddhism and Confucianism is somewhat more pervasive, as it significantly affects these two indicators and also average years of school, most likely because the countries involved have recently carried out extensive public education programs (e.g. Korea and China). The other two religions considered, Christianity and Catholicism, are robust determinants of modern culture at any age and educational level, obviously due to their longstanding traditions in those fields.

As for printed-paper modern cultural indicators, the ancient cultural capital stock and the dummies bear different effects depending on the book classes considered, while seemingly affecting in a positive way total books titles and, partly, also newspaper titles. This evidence substantiates the finding of Sect.2 whereby Spearman rank correlation coefficients significantly point to a positive relationship between the book ratios of Table 5 and the number of sites (see fn. 19).

Total book reading is very diffused interculturally and is positively affected by both the number and the average age of sites, indicating that quality and antiquity are similarly embedded in this form of modern culture. This effect is however outweighed by the negative coefficient exhibited by the share of sites exceeding 250 years, possibly because more recent rather than more ancient authorships are on average preferred worldwide. The dummies included are all significant and positively signed, also the one regarding the 'pre-post overhaul'. Quite the same occurs with newspaper reading for which the share of sites effect is unexpectedly absent (maybe because swamped by other effects) and only the Islam and Christianity dummies are significant. However, because the GMM reports a sizably lower RMSE, its results although biased as compared to EL are more efficient, and thus may be taken seriously insofar as they essentially skim off the dummy 'pre-post overhaul' and restore the role of Buddhism and Confucianism while downplaying that of Islam.

A cursory glance at the single UDC book classes reveals an interesting pattern: *coeteris paribus*, the number of sites positively affects in a significant way the reading of philosophy and psichology, arts and recreation, and geography and history. These disciplines appear thus to significantly incorporate the expertise and aesthetic values of their national cultural heritage, but only the first is deeply rooted in the past while the other two are definitely 'younger'. In fact, the average age of sites positively affects philosophy and psychology reading (a paltry mean value of 3% out of all book titles read, as from Table 3), whereby one may conclude that Aristotle and Plato are well and alive so much as their thinking and scholarly stature. This is not so for the other two disciplines, for which Pollock and Picasso are prefered to Phidias and Titian, the British explorers Stanley and Livingstone are more reknown than Hanno and Ibn Battutah, and Lyndon B. Johnson is more famous than Qin Shi Huang. In addition and quite unfortunately, both these disciplines (which tally together an average of 13% of all book titles read) appear to exhibit a vanishing relevance in countries with a longstanding artistic and historic tradition, since the coefficient of the share of sites older than 250 years is significantly negative. Finally, while the 'pre-post overhaul' dummy bears no significance in all three, the religious dummies play an interesting role by evidencing the intercultural relevance of philosophy and psychology, and a similar irrelevance for geography and history, while arts and recreation stand somewhere in between with Islam and Catholicism distinctively caring less about their development and dissemination.

A quite unexpected evidence (by common intuitive standards) is the insignificant role played by the number of sites on books of religion and theology and of literature. Religious books (read on average by than 7% of total book titles) appear to be, across all religious beliefs, absolutely unlinked with the national cultural heritage in any way. Therefore, neither its aesthetics nor its vintage nor even past overhaul(s), very often mastered by these same religions in the past centuries, happen to affect current religious printed-paper propaganda. Moreover, such books fare very poorly in the Christian and Catholic countries whose dummies are significantly negative, revealing a marked overproduction with respect to the reading capacity of the public. This is no wonder, however, because in these countries recent statistical evidence puts religious attendance to unprecedented historical lows due to higher education and percapita incomes. In a nutshell, religious book production worldover is historically ungrounded and void of ancient cultural values, which are being assimilated by the younger generations into alternative and richer forms of modern human capital accumulation in the Christian and Catholic countries and barely accepted in the other.

Also literature books (whose world reading share over total books averages 20%) shun expertise and aesthetics of their ancient cultural capital and are negatively related to the length of their historical time span. In essence, Stephen King is prefered to William Shakespeare, Quasimodo to Dante, and Tagore to Omar Khayyam, although a large ancient cultural capital sizably spurs current production, as evidenced by the positive coefficient of the share of sites exceeding 250 years. Therefore, modern literary production is abundant in countries with a longstanding and established tradition, but does not stick to quality output and generally dislikes themes related to or drawn from the ancient past. The religious dummies do not affect such readings in a significant way, except perhaps for the downweighting effect of Buddhism and Confucianism, not confirmed however by the GMM estimate whose RMSE is low as compared to that of the EL and would in this case provide a more reliable figure.

A final word on the last four book classes: generalities, social sciences, philology, and pure and applied sciences. Because of its very nature, a mix of low and high culture where the former on average prevails, generalities is quite obviously unaffected by the number of sites but places significant relevance on their average age, meaning that some recognition of the distant past is perceived by the readers of this discipline. This may be a partial proof of the scarce relevance experienced by ancient cultural capital in low culture, as advanced in Sect. 2 (see fn. 2). As a substitute for high culture in poorly-educated countries, generalities is shown to be mostly appreciated in the Islamic world as evidenced by its coefficient and by its reading audience as shown in Table 3. In a similar vein, it is highly likely that also the coefficient of generalities would exhibit the same pattern for Orthodox countries.

Social sciences as well as pure and applied sciences (which total together a mean value of 45% of total book titles read) are quite obviously unlinked to any ancient cultural heritage indicator, except for the average age of sites for the former because of its political and sociological contents. Barring this exception, the evidence provided is not unexpected, as both disciplines are comparatively very young with respect to all the others listed, especially the latter. In practice, while past institutional arrangements still bear some clout with today’s study of political affairs and codifications, past scientific achievements and discoveries do not matter in modern pure and applied sciences. In essence, Cicero is still alive and Archimedes is dead, although the latter is reknowingly incorporated into modern interpretations of his distinguished scientific experience. Interesting as it may be, none of the religious dummies significantly affects either of the two as an upshot of what may be defined as ‘scientific democracy’ or perhaps as ‘religious opportunism’.

Philology is a rather restricted field of reading that accounts for an average of no more than 5% of total books read, and to a larger extent than its parent discipline, literature, shuns expertise and aesthetics of ancient cultures while still delving into their past, perhaps because of the still relevant role played by language and linguistic traditions that constitute an important part of national cultural identities. The Christianity dummy bears a significantly negative coefficient, which may be interpreted as a proof of anedoctal evidence that the related countries, while open to the influx of foreign languages in spoken terms, possibly regard this discipline as characterized by excess book production.

5. Conclusions.

By making use in this paper of several indicators drawn from the UNESCO List of the World Heritage Cultural Properties (WHCP), from education and printed-paper datasets, and from other demographic and socio-economic sources I have demonstrated that cultural learning and transmission over centuries and even millennia is an empirical reality that strides most of the countries worldover. Their ancient cultural capital, whether by virtue of technical expertise and aesthetics developed overtime or simply because of its antiquity, significantly affects most forms of modern cultural capital. In fact only books of religion and theology, and of pure and applied sciences are - for different reasons - absolutely unaffected.

In particular, when ancient cultural capital is measured as the number of sites of the WHCP list to proxy technical expertise and aesthetics, i.e. its quality level, cultural learning and transmission is shown to be an elitarian phenomenon confined to specific educational and book-reading classes as may have been, *mutatis mutandis*, also in the distant past. Hence the tedophores of qualitatively valuable high culture are nowadays - and most likely since immemorial - the more educated people and especially the young, who appear to be more prone to cultural assimilation and, complementarily, the people engaged in reading philosophy and psychology, arts and recreation, and literature. In other words, the value judgement on technical expertise and aesthetics of the cultural heritage is monopolized by a rather restricted elite of students and readers.

There is additional evidence that cultural learning is a peculiar phenomenon, as in many countries a little amount of ancient heritage fosters high interest in education, and the reverse with a large amount. This is not true, however, with cultural transmission since book reading heavily relies on abundant quality heritage. Antiquity, as measured by the time span covered by the culture, still preserves its appeal at all latitudes independent of the size of the cultural capital accumulated, but requires a crude and gross value judgement of the cultural heritage solely based on its average age. All in all, however, the immense music of the past is well alive and in tune, and keeps on touching the intellectual chords of people worldover.

Appendix.

Sources of complete list of cultural, demographic and economic indicators.

Heston et al. [2002] (PWT6.1).
Barro-Lee (BL) [1996, 2001].
International Telecommunication Union (ITU, 2002-2003).
Heritage Foundation (HF, 2005).
Freedom House (FH, 2005).
United Nations Development Program (UNDP), Human Development Report 2004.
Sala-i-Martin (SM) [1997].
CIA Factbook (CIA, 2005).
United Nations (UN), Population Statistics, 2003.
World Health Organization (WHO, 2003).
UNESCO List of World Heritage Cultural Properties (WHCP, 2005).
UNESCO Institute for Statistics (UIS, Global-Statistics electronic tables, 2005*): AP (Access and Participation), RE (Resources), LA (Literacy and Attainment), BP (Book and newspapers production).

A. *Ancient-culture indicators*:

1) Total number of sites (WHCP).
2) Average age of sites (WHCP).
3) Ratio of sites with age equal to or exceeding 250 years (WHCP).
4) Ratio of sites denominated 'Temples and castles' to total sites (WHCP).
5) Ratio of pre-post overhaul sites.
6) Religious dummies, (SM, CIA).

B. *Modern-culture indicators*:

1) Post-secondary total educational attainment of the share of population aged 25 and over (BL).
2) Post-secondary complete educational attainment of the share of population aged 25 and over (BL).
3) Average years of school (BL).
4) Combined education index (UNDP).
5) Gross tertiary school enrolment ratio, both sexes (AP).
6) School life expectancy (expected number of years of formal schooling, approximation method) (AP).
7) Adult (population aged 15 and over) literacy rate (LA, 2000-2004, Aug. 2005 Assessment).
8) Book production: total number of book titles by Universal Decimal Classification Consortium (UDCC) classes (BP, Table IV.5, 1995-1999).
9) Daily and nondaily newspapers: total number of titles (BP, Table IV.8, 1995-1999).

C. *Demographic and economic indicators*:

1) Real GDP percapita level, chain index (PWT6.1).
2) Annual growth rate of real GDP percapita, chain index (PWT6.1).
3) Total country population (PWT6.1).
4) Annual growth rate of total country population (PWT6.1).
5) Trade openness (PWT6.1).
6) Fertility rate (WHO).
7) Urbanization rate (UN).
8) Human development index (UNDP).
9) Index of freedom, 2005 score (HF).

10) Indexes of civil liberties and political rights (FH).
101 Average life expectancy (WHO).
12) Public Expenditure on Tertiary Education/Total Public Expenditure on Education (RE).
13) Public Expenditure on Total Education/GDP (or GNP) (RE).
14) Total Public Expenditure/GDP (or GNP) (PWT6.1).
15) Primary, secondary and tertiary school pupil-teacher ratio (AP).
16) Gender ratio (Females/Males gross tertiary school enrolment ratios) (AP).
17) Internet users/total population (ITU).
18) Population aged 0-19/total population (UNDP).

* Unless otherwise indicated, the years of data availability – depending on the reporting country – are 2002-2003, 2003-2004.

Data sources and links:

UNESCO (http://unesco.org, http://whc.unesco.org, http://uis.unesco.org).
PWT6.1 (http://pwt.econ.upenn.edu).
WHO (http://www.who.int).
BL (http://www.nber.org/pub/barro.lee)
HF (http://www.heritage.org/research)
FH (http://www.freedomhouse.org)
UNDP (http://hdr.undp.org/statistics)
UDCC (http://www.udcc.org)
CIA (http://www.odci.gov/cia/publications/factbook/geos)

The UDC classes adopted by UNESCO are ten. Two of them, applied and pure sciences, are stacked into one for simplicity purposes. The resulting nine classes broadly include each of the following:
1) *Generalities*: fundamentals of knowledge and culture, computer science, information and general reference;
2) *Religion and Theology*: history of religions, religious activities and practice, theology;
3) *Philosophy and Psychology*: philosophy (logics, ethics and aesthetics), psychology, psychophysiology;
4) *Social Sciences*: demography, statistics, sociology, politics, social welfare, law, economics, education;
5) *Philology*: history of literature and literacy criticism;
6) *Pure and Applied Sciences*: mathematics, physics, astrophysics, chemistry, engineering and technology, geology, medical sciences, zoology, botany, biology;
7) *Arts and Recreation*: architecture, painting, photography, music, graphics, recreation, entertainment, sports;
8) *Literature:* linguistics and languages, literature(poetry, fiction, literary criticism);
9) *Geography and History*: geography, exploration, history of individual places and of the world (ancient and modern), science of history.

Table 1.

Main characteristics of cultural sites and select modern-capital indicators.

(1) Number of sites; (2) Average age; (3) Ratio of sites aged 250 years or more; (4) Literacy ratio; (5) School life expectancy; (6) Tertiary gross enrolment ratio; (7) Combined education index; (8) Total book titles; (9) Total daily and nondaily newspaper titles.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Albania	2	1650	1.00	0.99	11	15.1	0.8	381	NA
2	Algeria	6	1483	1.00	0.69	11	15.11	0.69	670	106
3	Andorra	1	1000	1.00	1.00	16	NA	NA	173	4
4	Argentina	4	5450	1.00	0.97	11	56.31	0.92	11991	NA
5	Armenia	3	1000	1.00	0.99	20	26.66	0.92	516	91
6	Australia	1	120	0.00	1.00	15	74.35	0.99	NA	145
7	Austria	8	1918	0.88	1.00	10	48.27	0.96	8056	136
8	Azerbaijan	1	2600	1.00	0.99	8	24.05	0.88	444	344
9	Bahrain	1	4300	1.00	0.81	11	44.18	NA	92	NA
10	Bangladesh	2	900	1.00	0.41	14	6.26	0.39	NA	NA
11	Belarus	2	500	1.00	1.00	19	60.27	0.92	6073	620
12	Belgium	9	1630	0.78	1.00	7	59.82	0.99	13913	NA
13	Benin	1	375	1.00	0.40	7	3.63	0.41	9	15
14	Bolivia	5	690	1.00	0.87	14	39.07	0.80	NA	39
15	Botswana	1	10000	1.00	0.79	12	4.38	0.74	158	NA
16	Brazil	10	2787	0.60	0.85	15	18.22	0.83	21689	2245
17	Bulgaria	7	1500	1.00	0.88	12	37.68	0.90	4971	579
18	Cambodia	1	1200	1.00	0.69	9	2.40	0.66	NA	NA
19	Canada	5	1630	0.80	0.99	16	57.70	0.98	22941	NA
20	Chile	4	575	0.76	0.96	14	42.41	0.90	1443	62
21	China	23	2272	0.95	0.91	10	12.72	0.80	100951	2007
22	Colombia	4	1112	1.00	0.92	11	24.18	0.85	5302	29
23	Croatia	5	1546	1.00	0.98	13	36.42	0.88	2309	243
24	Cuba	6	340	0.67	0.97	13	27.36	NA	952	33
25	Cyprus	3	4833	1.00	0.97	13	25.56	0.87	931	46
26	Czech Republic	12	560	0.92	1.00	15	33.66	0.89	12551	815
27	Denmark	3	791	1.00	1.00	17	62.57	0.98	14455	43
28	Dominican Rep.	1	500	1.00	0.84	NA	NA	0.79	NA	17
29	Ecuador	2	475	1.00	0.92	NA	NA	0.86	996	76
30	Egypt	6	2583	1.00	0.56	12	38.29	0.62	1410	61
31	El Salvador	1	2000	1.00	0.80	11	16.66	0.73	NA	NA
32	Estonia	1	800	1.00	1.00	16	63.93	0.94	3265	109
33	Ethiopia	6	834633	1.00	0.42	5	1.72	0.34	444	80
34	Finland	5	852	0.40	1.00	18	85.66	0.99	13173	204
35	France	27	1330	0.95	1.00	15	53.58	0.97	39083	329
36	Gambia	1	1500	1.00	0.37	NA	NA	0.39	NA	5
37	Georgia	3	1433	1.00	1.00	11	36.49	0.89	697	157
38	Germany	29	722	0.79	1.00	16	26.51	0.97	71515	431
39	Ghana	2	462	1.00	0.54	7	3.35	0.61	7	NA
40	Greece	14	2357	1.00	0.97	15	68.32	0.92	4067	221
41	Guatemala	2	1185	1.00	0.69	NA	NA	0.62	NA	NA
42	Haiti	1	180	0.00	0.49	NA	NA	0.50	NA	NA

43	Honduras	1	1500	1.00	0.80	NA	14.26	0.70	NA	NA
44	Hungary	7	2178	1.00	0.99	15	44.09	0.93	10352	200
45	Iceland	1	1100	1.00	1.00	18	54.56	0.96	1796	25
46	India	21	1404	0.90	0.61	9	11.44	0.56	14085	43828
47	Indonesia	3	334133	1.00	0.88	11	15.24	0.79	4018	1142
48	Iran	6	1890	1.00	0.80	11	20.31	0.75	14783	955
49	Ireland	2	8200	1.00	1.00	17	49.89	0.96	NA	67
50	Israel	7	1790	0.78	0.95	16	57.65	0.91	1969	NA
51	Italy	40	1640	0.98	0.99	15	53.14	0.94	32365	NA
52	Japan	10	766	0.90	1.00	15	49.17	0.93	56221	116
53	Jordan	3	1966	1.00	0.91	13	31.03	0.78	511	25
54	Kazakhstan	2	2552	1.00	1.00	13	38.36	0.92	1223	NA
55	Kenya	1	200	0.00	0.84	9	2.90	0.71	300	14
56	Laos Peo. Dem. Rep.	2	600	0.50	0.69	9	5.53	0.51	88	NA
57	Latvia	1	800	1.00	1.00	15	68.54	0.93	2178	227
58	Lebanon	5	2500	1.00	0.86	13	44.67	0.83	289	17
59	Libya	5	4440	1.00	0.80	16	58.07	0.83	NA	NA
60	Lithuania	3	6933	1.00	1.00	15	64.45	0.93	4097	361
61	Luxembourg	1	600	1.00	1.00	14	11.51	0.90	681	15
62	Madagascar	1	500	1.00	0.71	6	2.17	0.59	108	NA
63	Mali	3	1120	1.00	0.19	4	2.46	0.36	33	NA
64	Malta	3	4066	1.00	0.93	14	24.44	0.88	237	15
65	Mauritania	1	2000	1.00	0.41	7	3.2	0.41	NA	NA
66	Mexico	22	851	0.91	0.91	12	21.48	0.84	6952	337
67	Mongolia	1	1500	1.00	0.98	10	34.65	0.61	285	32
68	Morocco	8	995	0.88	0.51	9	10.3	0.49	918	530
69	Mozambique	1	450	1.00	0.47	5	0.57	0.36	NA	52
70	Nepal	2	1875	1.00	0.49	10	5.37	0.47	NA	NA
71	Netherlands	7	347	0.57	1.00	16	56.97	0.99	34067	84
72	Nicaragua	1	475	1.00	0.64	NA	NA	0.66	NA	NA
73	Nigeria	2	625	0.50	0.65	NA	NA	0.57	1314	NA
74	Norway	5	3624	1.00	1.00	17	74.07	0.98	4985	151
75	Oman	3	3300	1.00	0.74	10	7.48	0.66	12	NA
76	Pakistan	6	3085	1.00	0.43	NA	NA	0.43	NA	912
77	Panama	2	417	1.00	0.92	12	33.56	0.86	NA	NA
78	Paraguay	1	350	1.00	0.97	12	18.55	0.83	152	NA
79	Peru	6	1415	1.00	0.85	14	31.79	0.86	1942	NA
80	Philippines	3	895	0.67	0.93	12	31.06	0.91	1380	89
81	Poland	10	608	0.90	1.00	15	59.51	0.94	19192	66
82	Portugal	12	2830	1.00	0.92	16	53.06	0.93	8331	585
83	Rep. of Korea	7	1115	0.86	0.98	16	84.73	0.95	30487	4824
84	Romania	6	819	1.00	0.98	12	30.42	0.88	7874	465
85	Russian Fed.	14	1488	0.95	1.00	13	69.79	0.92	36237	10521
86	Senegal	2	450	1.00	0.37	6	3.75	0.36	NA	144
87	Serbia & Montenegro	4	728	1.00	0.93	13	36.03	NA	NA	NA
88	Slovakia	4	736	1.00	1.00	14	32.11	0.91	3153	451
89	South Africa	3	1166916	1.00	0.82	13	14.99	0.87	5418	277
90	Spain	34	31455	0.94	0.98	16	58.9	0.97	59174	98
91	Sri Lanka	6	1668	1.00	0.96	NA	NA	0.84	4655	48
92	St. Kitts & Nevis	1	400	1.00	0.9	16	NA	NA	NA	NA
93	Sudan	1	2900	1.00	0.59	5	NA	0.49	NA	16
94	Suriname	1	390	1.00	0.95	12	12.24	0.89	47	11

95	Sweden	11	1791	0.82	1.00	19	76.15	0.99	12547	161
96	Switzerland	4	1162	1.00	1.00	16	44.37	0.94	18273	201
97	Syrian Ar. Rep.	4	4250	1.00	0.83	9	5.71	0.70	598	65
98	Thailand	3	3816	1.00	0.93	12	36.67	0.84	8142	354
99	Togo	1	250	0.00	0.57	10	3.73	0.58	5	53
100	Tunisia	7	1890	1.00	0.73	13	23.22	0.71	720	36
101	Turkey	7	2625	1.00	0.85	11	24.76	0.77	9313	1230
102	Turkmenistan	2	3000	1.00	NA	NA	NA	0.92	450	24
103	Uganda	1	200	0.00	0.69	11	3.24	0.59	288	12
104	Ukraine	2	850	1.00	1.00	13	57.98	0.92	6282	2667
105	United Kingdom	21	1050	0.76	1.00	22	63.57	0.99	110965	575
106	Un. Rep. of Tanzania	2	650	1.00	0.77	5	0.7	0.61	172	NA
107	United States	8	843	0.62	1.00	16	81.35	0.98	68175	NA
108	Uruguay	1	325	1.00	0.98	15	37.13	0.92	674	NA
109	Uzbekistan	4	1475	1.00	0.89	11	9.38	0.84	1003	354
110	Venezuela	2	270	0.50	0.93	11	27.07	0.83	3851	NA
111	Viet Nam	3	900	1.00	0.93	11	10.02	0.84	5581	NA
112	Yemen	3	1766	1.00	0.46	8	11.15	0.47	NA	NA
113	Zimbabwe	3	3816	1.00	0.93	9	4.32	0.80	232	NA

Table 2*.

Shares of total book titles by UDC classes**.

(1) Generalities; (2) Religion and Theology; (3) Philosophy and Psychology; (4) Social Sciences; (5) Philology; (6) Pure and Applied Sciences; (7) Arts and Recreation; (8) Literature; (9) Geography and History.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Albania	0.03	0.01	0.00	0.07	0.09	0.53	0.05	0.17	0.05
2	Algeria	0.06	0.17	0.03	0.14	0.05	0.34	0.04	0.11	0.05
3	Andorra	0.03	0.01	NA	0.26	0.02	NA	0.27	0.16	0.16
4	Argentina	0.03	0.05	0.08	0.29	0.01	0.14	0.07	0.27	0.06
5	Armenia	0.04	0.05	0.04	0.25	0.02	0.10	0.05	0.36	0.07
7	Austria	0.03	0.04	0.04	0.35	0.03	0.17	0.12	0.15	0.09
8	Azerbaijan	0.02	0.02	0.01	0.24	0.02	0.10	0.03	0.44	0.11
9	Bahrain	0.03	0.11	NA	0.16	0.01	NA	0.04	0.13	0.42
11	Belarus	0.03	0.02	0.03	0.32	0.04	0.28	0.03	0.20	0.03
12	Belgium	0.02	0.05	0.02	0.20	0.03	0.22	0.10	0.27	0.09
13	Benin	0.00	0.22	0.00	0.00	0.00	0.11	0.00	0.56	0.11
15	Botswana	0.05	NA	0.00	0.79	0.01	0.13	0.00	0.00	0.02
16	Brazil	0.05	0.18	0.10	0.26	0.03	0.13	0.03	0.16	0.05
17	Bulgaria	0.03	0.04	0.05	0.21	0.03	0.19	0.04	0.36	0.05
19	Canada	0.03	0.03	0.02	0.36	0.03	0.21	0.06	0.19	0.08
20	Chile	0.00	0.08	0.03	0.27	0.02	0.11	0.03	0.37	0.09
21	China	0.03	0.00	0.01	0.55	0.03	0.19	0.05	0.10	0.04
22	Colombia	0.12	0.04	0.05	0.35	0.02	0.18	0.04	0.17	0.03
23	Croatia	0.03	0.09	0.04	0.28	0.00	0.22	0.05	0.24	0.05
24	Cuba	0.08	0.01	0.01	0.27	0.02	0.12	0.04	0.40	0.07
25	Cyprus	0.02	0.03	0.01	0.41	0.09	0.19	0.10	0.09	0.06
26	Czech Republic	0.03	0.03	0.03	0.19	0.03	0.24	0.06	0.30	0.09
27	Denmark	0.02	0.03	0.04	0.20	0.02	0.30	0.06	0.23	0.09

30	Egypt	0.07	0.14	0.01	0.09	0.15	0.26	0.03	0.18	0.06
32	Estonia	0.04	0.03	0.03	0.22	0.00	0.24	0.06	0.33	0.05
33	Ethiopia	0.09	0.14	NA	0.46	0.02	0.19	0.02	0.04	0.05
34	Finland	0.02	0.02	0.02	0.23	0.03	0.34	0.06	0.16	0.12
35	France	0.13	0.03	NA	0.23	0.01	NA	0.03	0.31	0.19
37	Georgia	0.68	0.02	0.02	0.12	0.02	0.03	0.01	0.09	0.00
38	Germany	0.09	0.05	0.05	0.23	0.04	0.19	0.08	0.13	0.14
39	Ghana	0.00	0.00	0.00	0.43	0.29	0.29	0.00	0.00	0.00
40	Greece	0.03	0.05	0.03	0.15	0.04	0.14	0.07	0.39	0.11
44	Hungary	0.03	0.06	0.04	0.11	0.06	0.24	0.05	0.32	0.10
45	Iceland	0.02	0.03	0.02	0.27	0.08	0.18	0.08	0.25	0.08
46	India	0.03	0.08	0.03	0.24	0.02	0.09	0.04	0.38	0.09
47	Indonesia	0.06	0.11	0.02	0.20	0.07	0.31	0.03	0.12	0.04
48	Iran	0.04	0.30	0.05	0.09	0.10	0.29	0.05	0.02	0.06
50	Israel	0.02	0.07	0.04	0.22	0.03	0.20	0.02	0.32	0.08
51	Italy	0.02	0.07	0.06	0.20	0.02	0.14	0.10	0.24	0.14
52	Japan	0.02	0.02	0.03	0.23	0.02	0.24	0.18	0.21	0.05
53	Jordan	0.05	0.12	0.02	0.24	0.03	0.16	0.04	0.23	0.12
54	Kazakhstan	0.04	0.02	0.01	0.47	0.03	0.21	0.01	0.14	0.06
55	Kenya	0.01	0.25	0.01	0.24	0.14	0.20	0.04	0.04	0.05
56	Laos Peo. Dem. Rep.	0.00	0.02	0.00	0.47	0.07	0.17	0.02	0.17	0.08
57	Latvia	0.05	0.05	0.06	0.29	0.07	0.20	0.04	0.18	0.06
58	Lebanon	0.63	0.00	0.02	0.14	0.02	0.07	0.00	0.09	0.02
60	Lithuania	0.07	0.04	0.03	0.19	0.08	0.20	0.05	0.28	0.05
61	Luxembourg	0.09	0.02	0.02	0.36	0.00	0.10	0.17	0.10	0.13
62	Madagascar	0.06	0.24	0.00	0.33	0.00	0.21	0.05	0.07	0.03
63	Mali	0.70	0.00	0.00	0.00	0.00	0.15	0.00	0.15	0.00
64	Malta	0.02	0.17	0.01	0.27	0.04	NA	0.05	0.19	0.22
66	Mexico	0.07	0.07	0.10	0.30	0.05	0.22	0.07	0.07	0.06
67	Mongolia	0.09	0.02	0.04	0.13	0.02	0.13	0.03	0.47	0.07
68	Morocco	0.04	0.05	0.01	0.39	0.01	0.16	0.12	0.15	0.07
71	Netherlands	0.00	0.02	0.02	0.06	0.01	0.07	0.08	0.09	0.04
73	Nigeria	0.01	0.15	0.03	0.40	0.07	0.15	0.04	0.10	0.04
74	Norway	0.03	0.05	0.03	0.16	0.01	0.14	0.06	0.43	0.08
75	Oman	0.00	0.42	0.08	0.00	0.00	0.08	0.42	0.00	0.00
78	Paraguay	0.07	0.03	0.01	0.47	0.04	0.12	0.01	0.18	0.07
79	Peru	0.02	0.04	0.01	0.44	0.10	0.14	0.03	0.14	0.06
80	Philippines	0.05	0.03	0.01	0.46	0.06	0.12	0.06	0.16	0.05
81	Poland	0.04	0.07	0.03	0.20	0.04	0.25	0.05	0.22	0.10
82	Portugal	0.04	0.04	0.02	0.27	0.00	0.12	0.03	0.42	0.06
83	Rep. of Korea	0.01	0.05	0.02	0.10	0.05	0.13	0.21	0.14	0.02
84	Romania	0.12	0.05	0.03	0.12	0.00	0.30	0.02	0.31	0.05
85	Russian Fed.	0.09	0.03	0.04	0.24	0.03	0.27	0.02	0.23	0.04
88	Slovakia	0.02	0.08	0.04	0.22	0.03	0.30	0.04	0.23	0.05
89	South Africa	0.03	0.10	0.01	0.23	0.10	0.25	0.03	0.23	0.04
90	Spain	0.02	0.03	0.04	0.18	0.03	0.20	0.09	0.31	0.09
91	Sri Lanka	0.09	0.11	0.08	0.30	0.04	0.09	0.02	0.24	0.03
94	Suriname	0.38	0.34	0.02	0.13	0.04	NA	NA	0.02	0.02
95	Sweden	0.03	0.03	0.03	0.20	0.03	0.30	0.07	0.24	0.08
96	Switzerland	0.02	0.06	0.05	0.27	0.02	0.31	0.10	0.13	0.05
97	Syrian Ar. Rep.	0.24	0.10	0.04	0.13	0.02	0.15	0.04	0.19	0.08
98	Thailand	0.06	0.03	0.02	0.30	0.03	0.37	0.05	0.08	0.05
99	Togo	0.00	0.20	0.00	0.20	0.20	0.20	0.00	0.00	0.20
100	Tunisia	0.03	0.02	0.03	0.19	0.01	0.06	0.03	0.47	0.15
101	Turkey	0.02	0.07	0.04	0.28	0.02	0.13	0.03	0.32	0.09
102	Turkmenistan	0.00	0.02	0.01	0.33	0.05	0.24	0.04	0.27	0.04
104	Ukraine	0.03	0.03	0.02	0.47	0.02	0.21	0.02	0.16	0.04

105	United Kingdom	0.02	0.05	0.03	0.22	0.04	0.23	0.09	0.20	0.11
106	Un. Rep. of Tanzania	0.00	0.10	0.01	0.26	0.01	0.27	0.02	0.27	0.05
107	United States	0.04	0.06	0.03	0.21	0.01	0.21	0.06	0.19	0.10
108	Uruguay	0.02	0.01	0.03	0.29	0.01	0.23	0.04	0.27	0.10
109	Uzbekistan	0.01	0.02	0.01	0.37	0.04	0.20	0.01	0.28	0.07
110	Venezuela	0.04	0.05	0.04	0.28	0.01	0.25	0.08	0.18	0.06
113	Zimbabwe	0.03	0.06	0.00	0.46	0.06	0.22	0.03	0.10	0.03

*87 fully or partly reporting countries. Countries absent from the list reported NA data for all columns.
**The country numbers are those of Table 1.

Table 3.

Select percapita income, educational and printed-paper indicators by religious groups*

		Islam	Protestant	Orthodox	Catholic	Buddist & Confucian	Other	World average
1	Real GDP percapita in $**	3687	14000	5235	7093	3261	4295	6397
2	Average years > 25	4.55	9.99	8.30	6.84	6.27	5.06	6.71
3	Gross tertiary enrolment	20.55	56.79	46.16	35.36	26.81	13.10	32.53
4	School life expectancy	10.30	15.69	13.67	13.63	11.33	10.07	12.48
5	Combined educ. index	0.64	0.93	0.86	0.86	0.75	0.69	0.79
6	Literacy rate	0.68	0.97	0.93	0.92	0.86	0.72	0.84
7	Generalities	0.12	0.05	0.12	0.04	0.04	0.02	0.07
8	Religion & Theology	0.10	0.07	0.05	0.06	0.04	0.10	0.07
9	Philosophy & Psychology	0.02	0.03	0.03	0.04	0.03	0.01	0.03
10	Social Sciences	0.19	0.25	0.26	0.28	0.27	0.29	0.26
11	Philology	0.04	0.04	0.03	0.03	0.04	0.07	0.04
12	Pure & applied sciences	0.20	0.22	0.20	0.18	0.19	0.19	0.20
13	Arts & recreation	0.06	0.08	0.03	0.06	0.08	0.03	0.06
14	Literature	0.19	0.20	0.23	0.24	0.21	0.16	0.21
15	Geography & History	0.09	0.08	0.05	0.09	0.05	0.06	0.07
16	Daily & Nondaily news.†	245	337	429	186	109	143	234

* Christianity is subdivided into Protestantism and Orthodoxy.
** Heston et al. [2002].
† Daily and nondaily newspapers in circulation, per 1,000 inhabitants.

Table 4*.

Ratios of select educational indicators with number of sites by country rank.

(1) Tertiary gross enrolment ratio/number of sites; (2) Combined education index/number of sites;
(3) Literacy ratio/number of sites.

		(1)			(2)			(3)
1	Australia	74.4	1	Australia	0.99	1	Australia	1.00
2	Latvia	68.5	2	Iceland	0.96	2	Iceland	1.00
3	Estonia	63.9	3	Estonia	0.94	3	Luxembourg	1.00
4	Iceland	54.6	4	Latvia	0.93	4	Estonia	1.00
5	Bahrain	44.2	5	Uruguay	0.92	5	Latvia	1.00
6	Uruguay	37.1	6	Luxembourg	0.90	6	Andorra	1.00
7	Mongolia	34.7	7	Suriname	0.89	7	Azerbaijan	0.99
8	Belarus	30.1	8	Azerbaijan	0.88	8	Mongolia	0.98

9	Ukraine	29.0	9	Paraguay	0.83	9	Uruguay	0.98
10	Ireland	24.9	10	Dominican Rep.	0.79	10	Paraguay	0.97
11	Azerbaijan	24.1	11	Botswana	0.74	11	Suriname	0.95
12	Lithuania	21.5	12	EL Salvador	0.73	12	St. Kitts & Nevis	0.90
13	Denmark	20.9	13	Kenya	0.71	13	Kenya	0.84
14	Kazakhstan	19.2	14	Honduras	0.70	14	Dominican Rep.	0.84
15	Paraguay	18.6	15	Cambodia	0.66	15	Bahrain	0.81
16	Finland	17.1	16	Nicaragua	0.66	16	Honduras	0.80
17	Panama	16.8	17	Mongolia	0.61	17	EL Salvador	0.80
18	EL Salvador	16.7	18	Madagascar	0.59	18	Botswana	0.79
19	Norway	14.8	19	Uganda	0.59	19	Madagascar	0.71
20	Honduras	14.3	20	Togo	0.58	20	Cambodia	0.69
21	Argentina	14.1	21	Haiti	0.50	21	Uganda	0.69
22	Venezuela	13.5	22	Sudan	0.49	22	Nicaragua	0.64
23	Suriname	12.2	23	Ireland	0.48	23	Sudan	0.59
24	Thailand	12.2	24	Belarus	0.46	24	Togo	0.57
25	Georgia	12.2	25	Kazakhstan	0.46	25	Ireland	0.50
26	Rep. of Korea	12.1	26	Turkmenistan	0.46	26	Belarus	0.50
27	Libya	11.6	27	Ukraine	0.46	27	Ukraine	0.50
28	Canada	11.5	28	Ecuador	0.43	28	Kazakhstan	0.50
29	Luxembourg	11.5	29	Panama	0.43	29	Albania	0.49
30	Switzerland	11.1	30	Venezuela	0.42	30	Haiti	0.49
31	Chile	10.6	31	Benin	0.41	31	Mozambique	0.47
32	Philippines	10.4	32	Mauritania	0.41	32	Venezuela	0.47
33	Jordan	10.3	33	Albania	0.40	33	Ecuador	0.46
34	United States	10.2	34	Gambia	0.39	34	Panama	0.46
35	Serbia & Montenegro	9.0	35	Mozambique	0.36	35	Mauritania	0.41
36	Lebanon	8.9	36	Denmark	0.33	36	Benin	0.40
37	Armenia	8.9	37	Guatemala	0.31	37	Un. Rep. of Tanzania	0.39
38	Cyprus	8.5	38	Lithuania	0.31	38	Gambia	0.37
39	Israel	8.2	39	Armenia	0.31	39	Guatemala	0.35
40	Malta	8.1	40	Ghana	0.31	40	Laos Peo. Dem. Rep.	0.34
41	Netherlands	8.1	41	Un. Rep. of Tanzania	0.31	41	Denmark	0.33
42	Slovakia	8.0	42	Philippines	0.30	42	Georgia	0.33
43	Bolivia	7.8	43	Georgia	0.30	43	Lithuania	0.33
44	Albania	7.6	44	Malta	0.29	44	Armenia	0.33
45	Croatia	7.3	45	Cyprus	0.29	45	Nigeria	0.33
46	Sweden	6.9	46	South Africa	0.29	46	Cyprus	0.32
47	Belgium	6.6	47	Nigeria	0.29	47	Viet Nam	0.31
48	Egypt	6.4	48	Thailand	0.28	48	Zimbabwe	0.31
49	Hungary	6.3	49	Viet Nam	0.28	49	Malta	0.31
50	Colombia	6.0	50	Zimbabwe	0.27	50	Philippines	0.31
51	Austria	6.0	51	Indonesia	0.26	51	Thailand	0.31
52	Poland	6.0	52	Jordan	0.26	52	Jordan	0.30
53	Bulgaria	5.4	53	Laos Peo. Dem. Rep.	0.26	53	Indonesia	0.29
54	Peru	5.3	54	Nepal	0.24	54	South Africa	0.27
55	Indonesia	5.1	55	Switzerland	0.24	55	Ghana	0.27
56	Romania	5.1	56	Argentina	0.23	56	Switzerland	0.25
57	South Africa	5.0	57	Slovakia	0.23	57	Slovakia	0.25
58	Russian Fed.	5.0	58	Chile	0.23	58	Oman	0.25
59	Japan	4.9	59	Oman	0.22	59	Nepal	0.24
60	Greece	4.9	60	Colombia	0.21	60	Argentina	0.24
61	Cuba	4.6	61	Uzbekistan	0.21	61	Chile	0.24
62	Portugal	4.4	62	Finland	0.20	62	Serbia & Montenegro	0.23
63	Botswana	4.4	63	Canada	0.20	63	Colombia	0.23
64	Andorra	3.8	64	Norway	0.20	64	Uzbekistan	0.22
65	Togo	3.7	65	Bangladesh	0.20	65	Syrian Ar. Rep.	0.21

66	Yemen	3.7	66	Senegal	0.18	66	Bangladesh	0.21
67	Benin	3.6	67	Croatia	0.18	67	Finland	0.20
68	Turkey	3.5	68	Syrian Ar. Rep.	0.18	68	Norway	0.20
69	Iran	3.4	69	Lebanon	0.17	69	Canada	0.20
70	Viet Nam	3.3	70	Libya	0.17	70	Croatia	0.20
71	Tunisia	3.3	71	Bolivia	0.16	71	Senegal	0.19
72	Uganda	3.2	72	Yemen	0.16	72	Bolivia	0.17
73	Mauritania	3.2	73	Romania	0.15	73	Lebanon	0.17
74	Bangladesh	3.1	74	Peru	0.14	74	Romania	0.16
75	United Kingdom	3.0	75	Netherlands	0.14	75	Cuba	0.16
76	Kenya	2.9	76	Sri Lanka	0.14	76	Libya	0.16
77	Czech Republic	2.8	77	Rep. of Korea	0.14	77	Sri Lanka	0.16
78	Laos Peo. Dem. Rep.	2.8	78	Hungary	0.13	78	Yemen	0.15
79	Nepal	2.7	79	Israel	0.13	79	Netherlands	0.14
80	Algeria	2.5	80	Bulgaria	0.13	80	Hungary	0.14
81	Oman	2.5	81	Iran	0.13	81	Peru	0.14
82	Cambodia	2.4	82	United States	0.12	82	Rep. of Korea	0.14
83	Uzbekistan	2.3	83	Austria	0.12	83	Israel	0.14
84	Madagascar	2.2	84	Mali	0.12	84	Iran	0.13
85	France	2.0	85	Algeria	0.12	85	Bulgaria	0.13
86	Senegal	1.9	86	Belgium	0.11	86	Austria	0.12
87	Brazil	1.8	87	Turkey	0.11	87	United States	0.12
88	Spain	1.7	88	Egypt	0.10	88	Turkey	0.12
89	Ghana	1.7	89	Tunisia	0.10	89	Algeria	0.11
90	Zimbabwe	1.4	90	Poland	0.09	90	Belgium	0.11
91	Syrian Ar. Rep.	1.4	91	Japan	0.09	91	Tunisia	0.10
92	Italy	1.3	92	Sweden	0.09	92	Japan	0.10
93	Morocco	1.3	93	Brazil	0.08	93	Poland	0.10
94	Mexico	1.0	94	Portugal	0.08	94	Egypt	0.09
95	Germany	0.9	95	Czech Republic	0.07	95	Sweden	0.09
96	Mali	0.8	96	Pakistan	0.07	96	Brazil	0.09
97	Mozambique	0.6	97	Greece	0.07	97	Czech Republic	0.08
98	China	0.6	98	Russian Fed.	0.07	98	Portugal	0.08
99	India	0.5	99	Morocco	0.06	99	Pakistan	0.07
100	Un. Rep. of Tanzania	0.4	100	Ethiopia	0.06	100	Russian Fed.	0.07
101	Ethiopia	0.3	101	United Kingdom	0.05	101	Greece	0.07
102	Turkmenistan	NA	102	Mexico	0.04	102	Ethiopia	0.07
103	Sudan	NA	103	France	0.04	103	Morocco	0.06
104	St. Kitts & Nevis	NA	104	China	0.03	104	Mali	0.06
105	Sri Lanka	NA	105	Germany	0.03	105	United Kingdom	0.05
106	Pakistan	NA	106	Spain	0.03	106	Mexico	0.04
107	Nigeria	NA	107	India	0.03	107	China	0.04
108	Nicaragua	NA	108	Italy	0.02	108	France	0.04
109	Haiti	NA	109	St. Kitts & Nevis	NA	109	Germany	0.03
110	Guatemala	NA	110	Serbia & Montenegro	NA	110	India	0.03
111	Gambia	NA	111	Cuba	NA	111	Spain	0.03
112	Ecuador	NA	112	Bahrain	NA	112	Italy	0.02

* Numbers correspond to the rank position. 112 fully or partly reporting countries.

Table 5*.

Ratios of total books, humanities books and newspaper titles with number of sites by country rank.
(1) Book titles/number of sites; (2) Humanities titles/number of sites; (3) Newspaper titles/number of sites.

		(1)			(2)			(3)
1	United States	8522	1	United States	5188	1	India	2087
2	Japan	5622	2	Japan	4048	2	Ukraine	1334
3	United Kingdom	5284	3	United Kingdom	3696	3	Russian Fed.	752
4	Netherlands	4867	4	China	3412	4	Rep. of Korea	689
5	Denmark	4818	5	Canada	3374	5	Indonesia	381
6	Canada	4588	6	Denmark	3150	6	Azerbaijan	344
7	Switzerland	4568	7	Switzerland	2803	7	Belarus	310
8	China	4389	8	Rep. of Korea	2384	8	Latvia	227
9	Rep. of Korea	4355	9	Argentina	2325	9	Brazil	225
10	Estonia	3265	10	Ukraine	2300	10	United States	185
11	Ukraine	3141	11	Estonia	2251	11	Turkey	176
12	Belarus	3037	12	Belarus	2016	12	Iran	159
13	Argentina	2998	13	Germany	1662	13	Pakistan	152
14	Thailand	2714	14	Finland	1628	14	Australia	145
15	Finland	2635	15	Russian Fed.	1573	15	Lithuania	120
16	Russian Fed.	2588	16	Latvia	1525	16	Thailand	118
17	Germany	2466	17	Thailand	1472	17	Slovakia	113
18	Iran	2464	18	Netherlands	1438	18	Estonia	109
19	Latvia	2178	19	Iceland	1374	19	South Africa	92
20	Brazil	2169	20	Brazil	1367	20	Uzbekistan	89
21	Venezuela	1926	21	Spain	1286	21	China	87
22	Poland	1919	22	Venezuela	1267	22	Bulgaria	83
23	Viet Nam	1860	23	Poland	1239	23	Romania	78
24	South Africa	1806	24	South Africa	1145	24	Senegal	72
25	Iceland	1796	25	Belgium	1098	25	Czech Republic	68
26	Spain	1740	26	Turkey	1038	26	Morocco	66
27	Belgium	1546	27	Hungary	1001	27	Togo	53
28	Hungary	1479	28	Lithuania	938	28	Georgia	52
29	France	1448	29	Iran	900	29	Mozambique	52
30	Lithuania	1366	30	Colombia	876	30	Switzerland	50
31	Indonesia	1339	31	Norway	776	31	Portugal	49
32	Turkey	1330	32	Austria	774	32	Croatia	49
33	Colombia	1326	33	Czech Republic	732	33	Venezuela	43
34	Romania	1312	34	Sweden	731	34	Finland	41
35	Sweden	1141	35	Romania	700	35	Ecuador	38
36	Czech Republic	1046	36	Indonesia	630	36	Ireland	34
37	Austria	1007	37	Italy	619	37	Mongolia	32
38	Norway	997	38	Portugal	559	38	Armenia	30
39	Italy	809	39	Sri Lanka	547	39	Norway	30
40	Slovakia	788	40	Luxembourg	534	40	Philippines	30
41	Sri Lanka	776	41	India	533	41	Hungary	29
42	Bulgaria	710	42	Bulgaria	524	42	United Kingdom	27
43	Portugal	694	43	Uruguay	493	43	Argentina	27
44	Luxembourg	681	44	Slovakia	471	44	Iceland	25
45	Uruguay	674	45	Nigeria	449	45	Canada	21
46	India	671	46	Kazakhstan	444	46	Algeria	18
47	Nigeria	657	47	Azerbaijan	382	47	Austria	17
48	Kazakhstan	612	48	Philippines	369	48	Dominican Rep.	17
49	Ecuador	498	49	Croatia	304	49	Syrian Ar. Rep.	16
50	Croatia	462	50	Chile	293	50	Sudan	16

51	Philippines	460	51	Peru	256	51	Greece	16
52	Azerbaijan	444	52	Cyprus	235	52	Chile	16
53	Chile	361	53	Greece	226	53	Cyprus	15
54	Peru	324	54	Mongolia	217	54	Mexico	15
55	Mexico	316	55	Mexico	205	55	Benin	15
56	Cyprus	310	56	Israel	199	56	Luxembourg	15
57	Kenya	300	57	Uzbekistan	193	57	Germany	15
58	Greece	291	58	Turkmenistan	168	58	Sweden	15
59	Uganda	288	59	Kenya	156	59	Nepal	15
60	Mongolia	285	60	Armenia	139	60	Denmark	14
61	Israel	281	61	Botswana	129	61	Kenya	14
62	Uzbekistan	251	62	Cuba	126	62	Ethiopia	13
63	Egypt	235	63	Egypt	124	63	Nigeria	13
64	Georgia	232	64	Paraguay	119	64	France	12
65	Turkmenistan	225	65	Jordan	114	65	Netherlands	12
66	Albania	191	66	Tunisia	91	66	Turkmenistan	12
67	Andorra	173	67	Morocco	87	67	Uganda	12
68	Armenia	172	68	Albania	82	68	Japan	12
69	Jordan	170	69	Syrian Ar. Rep.	76	69	Suriname	11
70	Cuba	159	70	Malta	62	70	Egypt	10
71	Botswana	158	71	Georgia	60	71	Peru	10
72	Paraguay	152	72	Un. Rep. of Tanzania	54	72	Jordan	8
73	Syrian Ar. Rep.	150	73	Zimbabwe	53	73	Sri Lanka	8
74	Morocco	115	74	Madagascar	52	74	Bolivia	8
75	Algeria	112	75	Algeria	49	75	Colombia	7
76	Madagascar	108	76	Laos Peo. Dem. Rep.	36	76	Honduras	7
77	Tunisia	103	77	Lebanon	17	77	Poland	7
78	Bahrain	92	78	Benin	6	78	Cuba	6
79	Un. Rep. of Tanzania	86	79	Togo	3	79	Tunisia	5
80	Malta	79	80	Ghana	3	80	Gambia	5
81	Zimbabwe	77	81	Oman	2	81	Madagascar	5
82	Ethiopia	74	82	Mali	2	82	Malta	5
83	Lebanon	58	83	Panama	NA	83	Andorra	4
84	Suriname	47	84	Pakistan	NA	84	Bahrain	4
85	Laos Peo. Dem. Rep.	44	85	Nicaragua	NA	85	EL Salvador	4
86	Mali	11	86	Senegal	NA	86	Haiti	4
87	Benin	9	87	Serbia & Montenegro	NA	87	Uruguay	4
88	Togo	5	88	Nepal	NA	88	Guatemala	4
89	Oman	4	89	Mozambique	NA	89	Panama	4
90	Ghana	4	90	Mauritania	NA	90	Lebanon	3
91	Serbia & Montenegro	NA	91	Libya	NA	91	Belgium	3
92	St. Kitts & Nevis	NA	92	St. Kitts & Nevis	NA	92	Spain	3
93	Sudan	NA	93	Sudan	NA	93	Italy	2
94	Senegal	NA	94	Suriname	NA	94	Cambodia	2
95	Panama	NA	95	Ireland	NA	95	Ghana	2
96	Pakistan	NA	96	Honduras	NA	96	Mauritania	2
97	Nicaragua	NA	97	Haiti	NA	97	Oman	2
98	Nepal	NA	98	Guatemala	NA	98	Viet Nam	2
99	Mozambique	NA	99	Gambia	NA	99	Un. Rep. of Tanzania	2
100	Mauritania	NA	100	France	NA	100	Yemen	1
101	Libya	NA	101	Ethiopia	NA	101	Botswana	1
102	Ireland	NA	102	EL Salvador	NA	102	Mali	1
103	Honduras	NA	103	Uganda	NA	103	Israel	1
104	Haiti	NA	104	Ecuador	NA	104	Libya	1
105	Guatemala	NA	105	Dominican Rep.	NA	105	Zimbabwe	1

* Numbers correspond to the rank position. Countries absent from the list reported NA or exhibit data equal to 0.

Table 6*.

Ratios of select educational indicators with average age of sites by country rank.

(1) Tertiary gross enrolment ratio/average age of sites; (2) Combined education index/average age; (3) Literacy ratio/average age.

		(1)			(2)			(3)
1	Australia	0.62	1	Australia	0.83	1	Australia	0.83
2	Netherlands	0.16	2	Kenya	0.36	2	Kenya	0.42
3	Belarus	0.12	3	Venezuela	0.31	3	Uganda	0.34
4	Uruguay	0.11	4	Uganda	0.30	4	Venezuela	0.34
5	Finland	0.10	5	Netherlands	0.29	5	Uruguay	0.30
6	Venezuela	0.10	6	Uruguay	0.28	6	Netherlands	0.29
7	Poland	0.10	7	Haiti	0.28	7	Cuba	0.29
8	United States	0.10	8	Paraguay	0.24	8	Paraguay	0.28
9	Latvia	0.09	9	Togo	0.23	9	Haiti	0.27
10	Panama	0.08	10	Suriname	0.23	10	Suriname	0.24
11	Cuba	0.08	11	Panama	0.21	11	Togo	0.23
12	Estonia	0.08	12	Belarus	0.18	12	St. Kitts & Nevis	0.23
13	Denmark	0.08	13	Ecuador	0.18	13	Panama	0.22
14	Rep. of Korea	0.08	14	Czech Republic	0.16	14	Belarus	0.20
15	Chile	0.07	15	Dominican Rep.	0.16	15	Ecuador	0.19
16	Ukraine	0.07	16	Chile	0.16	16	Czech Republic	0.18
17	Japan	0.06	17	Poland	0.15	17	Dominican Rep.	0.17
18	United Kingdom	0.06	18	Luxembourg	0.15	18	Luxembourg	0.17
19	Czech Republic	0.06	19	Nicaragua	0.14	19	Chile	0.17
20	Bolivia	0.06	20	Germany	0.13	20	Poland	0.16
21	Paraguay	0.05	21	Ghana	0.13	21	Madagascar	0.14
22	Iceland	0.05	22	Denmark	0.12	22	Germany	0.14
23	Serbia & Montenegro	0.05	23	Slovakia	0.12	23	Slovakia	0.14
24	Russian Fed.	0.05	24	Japan	0.12	24	Nicaragua	0.13
25	Slovakia	0.04	25	Madagascar	0.12	25	Japan	0.13
26	Sweden	0.04	26	Estonia	0.12	26	Serbia & Montenegro	0.13
27	France	0.04	27	United States	0.12	27	Denmark	0.13
28	Switzerland	0.04	28	Latvia	0.12	28	Bolivia	0.13
29	Romania	0.04	29	Finland	0.12	29	Estonia	0.12
30	Germany	0.04	30	Bolivia	0.12	30	Latvia	0.12
31	Belgium	0.04	31	Benin	0.11	31	Romania	0.12
32	Canada	0.04	32	Ukraine	0.11	32	Un. Rep. of Tanzania	0.12
33	Philippines	0.03	33	Romania	0.11	33	United States	0.12
34	Italy	0.03	34	Philippines	0.10	34	Finland	0.12
35	Israel	0.03	35	Mexico	0.10	35	Ukraine	0.12
36	Suriname	0.03	36	United Kingdom	0.09	36	Ghana	0.12
37	Greece	0.03	37	Un. Rep. of Tanzania	0.09	37	Laos Peo. Dem. Rep.	0.11
38	Armenia	0.03	38	Viet Nam	0.09	38	Mexico	0.11
39	Georgia	0.03	39	Armenia	0.09	39	Benin	0.11
40	Mexico	0.03	40	Nigeria	0.09	40	Nigeria	0.10
41	Austria	0.03	41	Iceland	0.09	41	Viet Nam	0.10
42	Bulgaria	0.03	42	Rep. of Korea	0.09	42	Philippines	0.10
43	Croatia	0.02	43	Laos Peo. Dem. Rep.	0.09	43	Mozambique	0.10
44	Mongolia	0.02	44	Switzerland	0.08	44	Andorra	0.10
45	Peru	0.02	45	Mozambique	0.08	45	Armenia	0.10
46	Colombia	0.02	46	Senegal	0.08	46	United Kingdom	0.10
47	Norway	0.02	47	Colombia	0.08	47	Iceland	0.09
48	Hungary	0.02	48	France	0.07	48	Rep. of Korea	0.09
49	Luxembourg	0.02	49	Georgia	0.06	49	Switzerland	0.09

50	Portugal	0.02	50	Russian Fed.	0.06	50	Colombia	0.08
51	Lebanon	0.02	51	Peru	0.06	51	Senegal	0.08
52	Uganda	0.02	52	Belgium	0.06	52	France	0.08
53	Jordan	0.02	53	Canada	0.06	53	Georgia	0.07
54	Kazakhstan	0.02	54	Bulgaria	0.06	54	Russian Fed.	0.07
55	Togo	0.01	55	Italy	0.06	55	Mongolia	0.07
56	Egypt	0.01	56	Uzbekistan	0.06	56	Croatia	0.06
57	Kenya	0.01	57	Croatia	0.06	57	Belgium	0.06
58	Libya	0.01	58	Sweden	0.06	58	Canada	0.06
59	Tunisia	0.01	59	Cambodia	0.06	59	Uzbekistan	0.06
60	Viet Nam	0.01	60	Guatemala	0.05	60	Peru	0.06
61	Iran	0.01	61	Israel	0.05	61	Italy	0.06
62	Morocco	0.01	62	Sri Lanka	0.05	62	Albania	0.06
63	Argentina	0.01	63	Austria	0.05	63	Bulgaria	0.06
64	Bahrain	0.01	64	Morocco	0.05	64	Guatemala	0.06
65	Algeria	0.01	65	Albania	0.05	65	Cambodia	0.06
66	Benin	0.01	66	Honduras	0.05	66	Sri Lanka	0.06
67	Thailand	0.01	67	Algeria	0.05	67	Sweden	0.06
68	Honduras	0.01	68	Bangladesh	0.04	68	Honduras	0.05
69	Turkey	0.01	69	Hungary	0.04	69	Israel	0.05
70	Lithuania	0.01	70	Mongolia	0.04	70	Austria	0.05
71	Azerbaijan	0.01	71	India	0.04	71	Morocco	0.05
72	Laos Peo. Dem. Rep.	0.01	72	Iran	0.04	72	Algeria	0.05
73	Albania	0.01	73	Jordan	0.04	73	Jordan	0.05
74	Senegal	0.01	74	Greece	0.04	74	Bangladesh	0.05
75	EL Salvador	0.01	75	Tunisia	0.04	75	Hungary	0.05
76	India	0.01	76	EL Salvador	0.04	76	India	0.04
77	Ghana	0.01	77	Kazakhstan	0.04	77	Iran	0.04
78	Bangladesh	0.01	78	China	0.04	78	Greece	0.04
79	Brazil	0.01	79	Azerbaijan	0.03	79	China	0.04
80	Uzbekistan	0.01	80	Lebanon	0.03	80	EL Salvador	0.04
81	Yemen	0.01	81	Portugal	0.03	81	Kazakhstan	0.04
82	Ireland	0.01	82	Mali	0.03	82	Tunisia	0.04
83	Malta	0.01	83	Turkmenistan	0.03	83	Azerbaijan	0.04
84	China	0.01	84	Brazil	0.03	84	Lebanon	0.03
85	Cyprus	0.01	85	Turkey	0.03	85	Portugal	0.03
86	Madagascar	0.00	86	Norway	0.03	86	Turkey	0.03
87	Andorra	0.00	87	Yemen	0.03	87	Brazil	0.03
88	Nepal	0.00	88	Gambia	0.03	88	Norway	0.03
89	Oman	0.00	89	Nepal	0.03	89	Yemen	0.03
90	Mali	0.00	90	Egypt	0.02	90	Nepal	0.03
91	Cambodia	0.00	91	Thailand	0.02	91	Gambia	0.02
92	Spain	0.00	92	Malta	0.02	92	Zimbabwe	0.02
93	Mauritania	0.00	93	Zimbabwe	0.02	93	Thailand	0.02
94	Syrian Ar. Rep.	0.00	94	Mauritania	0.02	94	Malta	0.02
95	Mozambique	0.00	95	Oman	0.02	95	Oman	0.02
96	Zimbabwe	0.00	96	Libya	0.02	96	Egypt	0.02
97	Un. Rep. of Tanzania	0.00	97	Cyprus	0.02	97	Mauritania	0.02
98	Botswana	0.00	98	Sudan	0.02	98	Sudan	0.02
99	Indonesia	0.00	99	Argentina	0.02	99	Cyprus	0.02
100	South Africa	0.00	100	Syrian Ar. Rep.	0.02	100	Syrian Ar. Rep.	0.02
101	Ethiopia	0.00	101	Pakistan	0.01	101	Bahrain	0.02
102	Turkmenistan	NA	102	Lithuania	0.01	102	Libya	0.02
103	Sudan	NA	103	Ireland	0.01	103	Argentina	0.02
104	St. Kitts & Nevis	NA	104	Botswana	0.01	104	Mali	0.02
105	Sri Lanka	NA	105	Spain	0.00	105	Lithuania	0.01
106	Pakistan	NA	106	Indonesia	0.00	106	Pakistan	0.01

107	Nigeria	NA	107	South Africa	0.00	107	Ireland	0.01
108	Nicaragua	NA	108	Ethiopia	0.00	108	Botswana	0.01
109	Haiti	NA	109	St. Kitts & Nevis	NA	109	Spain	0.00
110	Guatemala	NA	110	Serbia & Montenegro	NA	110	Indonesia	0.00
111	Gambia	NA	111	Cuba	NA	111	South Africa	0.00
112	Ecuador	NA	112	Bahrain	NA	112	Ethiopia	0.00

*Numbers correspond to the rank position. 112 fully or partly reporting countries.

Table 7*.

Ratios of total books, humanities and newspapers with average age of sites by country rank.
(1) Book Titles/average age; (2) Humanities/average age; (3) Newspapers/average age.

		(1)			(2)			(3)
1	United Kingdom	105.68	1	United Kingdom	73.92	1	India	31.22
2	Germany	99.05	2	Germany	66.76	2	Russian Fed.	7.07
3	Netherlands	98.18	3	Japan	52.84	3	Rep. of Korea	4.33
4	United States	80.87	4	United States	49.23	4	Ukraine	3.14
5	Japan	73.40	5	China	34.54	5	United States	1.75
6	China	44.43	6	Netherlands	29.01	6	Czech Republic	1.46
7	Poland	31.57	7	Poland	20.38	7	Belarus	1.24
8	France	29.39	8	Czech Republic	15.68	8	Australia	1.21
9	Rep. of Korea	27.34	9	Italy	15.11	9	China	0.88
10	Russian Fed.	24.35	10	Rep. of Korea	14.97	10	Brazil	0.81
11	Czech Republic	22.41	11	Russian Fed.	14.80	11	Slovakia	0.61
12	Italy	19.73	12	Denmark	11.95	12	Germany	0.60
13	Denmark	18.27	13	Canada	10.35	13	Romania	0.57
14	Switzerland	15.73	14	Switzerland	9.65	14	United Kingdom	0.55
15	Finland	15.46	15	Finland	9.55	15	Morocco	0.53
16	Venezuela	14.26	16	Venezuela	9.38	16	Iran	0.51
17	Canada	14.07	17	Belarus	8.06	17	Turkey	0.47
18	Belarus	12.15	18	India	7.98	18	Mexico	0.40
19	India	10.03	19	Belgium	6.06	19	Bulgaria	0.39
20	Romania	9.61	20	Ukraine	5.41	20	Senegal	0.32
21	Belgium	8.54	21	Mexico	5.30	21	Venezuela	0.32
22	Mexico	8.17	22	Romania	5.13	22	Pakistan	0.30
23	Iran	7.82	23	Brazil	4.90	23	Latvia	0.28
24	Brazil	7.78	24	Sweden	4.49	24	France	0.25
25	Ukraine	7.39	25	Austria	3.23	25	Netherlands	0.24
26	Sweden	7.01	26	Hungary	3.22	26	Uzbekistan	0.24
27	Viet Nam	6.20	27	Colombia	3.15	27	Finland	0.24
28	Colombia	4.77	28	Iran	2.86	28	Togo	0.21
29	Hungary	4.75	29	Estonia	2.81	29	Portugal	0.21
30	Slovakia	4.28	30	Turkey	2.77	30	Switzerland	0.17
31	Austria	4.20	31	Slovakia	2.56	31	Ecuador	0.16
32	Estonia	4.08	32	Bulgaria	2.45	32	Croatia	0.16
33	Turkey	3.55	33	Portugal	2.37	33	Japan	0.15
34	Bulgaria	3.31	34	Cuba	2.22	34	Estonia	0.14
35	Portugal	2.94	35	Chile	2.04	35	Azerbaijan	0.13
36	Cuba	2.80	36	Sri Lanka	1.97	36	Mozambique	0.12
37	Sri Lanka	2.79	37	Latvia	1.91	37	Georgia	0.11
38	Latvia	2.72	38	Argentina	1.71	38	Poland	0.11
39	Chile	2.51	39	Uruguay	1.52	39	Chile	0.11
40	Argentina	2.20	40	Nigeria	1.44	40	Philippines	0.10

41	Thailand	2.13	41	Spain	1.39	41	Cuba	0.10
42	Nigeria	2.10	42	Greece	1.34	42	Greece	0.09
43	Ecuador	2.10	43	Iceland	1.25	43	Thailand	0.09
44	Uruguay	2.07	44	Philippines	1.24	44	Hungary	0.09
45	Spain	1.88	45	Thailand	1.16	45	Armenia	0.09
46	Greece	1.73	46	Peru	1.08	46	Sweden	0.09
47	Iceland	1.63	47	Norway	1.07	47	Algeria	0.07
48	Philippines	1.54	48	Croatia	0.98	48	Austria	0.07
49	Kenya	1.50	49	Luxembourg	0.89	49	Kenya	0.07
50	Croatia	1.49	50	Kenya	0.78	50	Canada	0.06
51	Uganda	1.44	51	Israel	0.78	51	Uganda	0.06
52	Norway	1.38	52	Morocco	0.70	52	Bolivia	0.06
53	Peru	1.37	53	Uzbekistan	0.52	53	Denmark	0.05
54	Luxembourg	1.14	54	Armenia	0.42	54	Italy	0.05
55	Israel	1.10	55	Lithuania	0.41	55	Lithuania	0.05
56	Morocco	0.92	56	Kazakhstan	0.35	56	Norway	0.04
57	Uzbekistan	0.68	57	Paraguay	0.34	57	Peru	0.04
58	Lithuania	0.59	58	Tunisia	0.34	58	Benin	0.04
59	Egypt	0.55	59	Egypt	0.29	59	Nigeria	0.04
60	Armenia	0.52	60	Algeria	0.20	60	Dominican Rep.	0.03
61	Georgia	0.49	61	Jordan	0.17	61	Sri Lanka	0.03
62	Kazakhstan	0.48	62	Un. Rep. of Tanzania	0.16	62	Suriname	0.03
63	Algeria	0.45	63	Azerbaijan	0.15	63	Colombia	0.03
64	Paraguay	0.43	64	Cyprus	0.15	64	Luxembourg	0.03
65	Tunisia	0.38	65	Mongolia	0.14	65	Egypt	0.02
66	Un. Rep. of Tanzania	0.26	66	Georgia	0.13	66	Iceland	0.02
67	Jordan	0.26	67	Laos Peo. Dem. Rep.	0.12	67	Haiti	0.02
68	Albania	0.23	68	Turkmenistan	0.11	68	Mongolia	0.02
69	Madagascar	0.22	69	Madagascar	0.10	69	Argentina	0.02
70	Cyprus	0.19	70	Albania	0.10	70	Tunisia	0.02
71	Mongolia	0.19	71	Syrian Ar. Rep.	0.07	71	Belgium	0.02
72	Andorra	0.17	72	Malta	0.05	72	Panama	0.02
73	Azerbaijan	0.17	73	Zimbabwe	0.04	73	Nepal	0.02
74	Turkmenistan	0.15	74	Lebanon	0.03	74	Syrian Ar. Rep.	0.02
75	Laos Peo. Dem. Rep.	0.15	75	Benin	0.02	75	Jordan	0.01
76	Syrian Ar. Rep.	0.14	76	Botswana	0.01	76	Uruguay	0.01
77	Suriname	0.12	77	Togo	0.01	77	Madagascar	0.01
78	Lebanon	0.12	78	Ghana	0.01	78	Cyprus	0.01
79	Zimbabwe	0.06	79	Indonesia	0.01	79	Ghana	0.01
80	Malta	0.06	80	Mali	0.00	80	Ireland	0.01
81	Mali	0.03	81	South Africa	0.00	81	Turkmenistan	0.01
82	Benin	0.02	82	Oman	0.00	82	Lebanon	0.01
83	Bahrain	0.02	83	Panama	NA	83	Guatemala	0.01
84	Togo	0.02	84	Pakistan	NA	84	Viet Nam	0.01
85	Botswana	0.02	85	Nicaragua	NA	85	Sudan	0.01
86	Ghana	0.02	86	Senegal	NA	86	Honduras	0.00
87	Indonesia	0.01	87	Serbia & Montenegro	NA	87	Un. Rep. of Tanzania	0.00
88	South Africa	0.00	88	Nepal	NA	88	Andorra	0.00

*Numbers correspond to the rank position. The countries not shown exhibit either NA or 0.00.

Figure 1.

Scatterplot of number of cultural sites and select modern-capital indexes. Logarithmic scale.

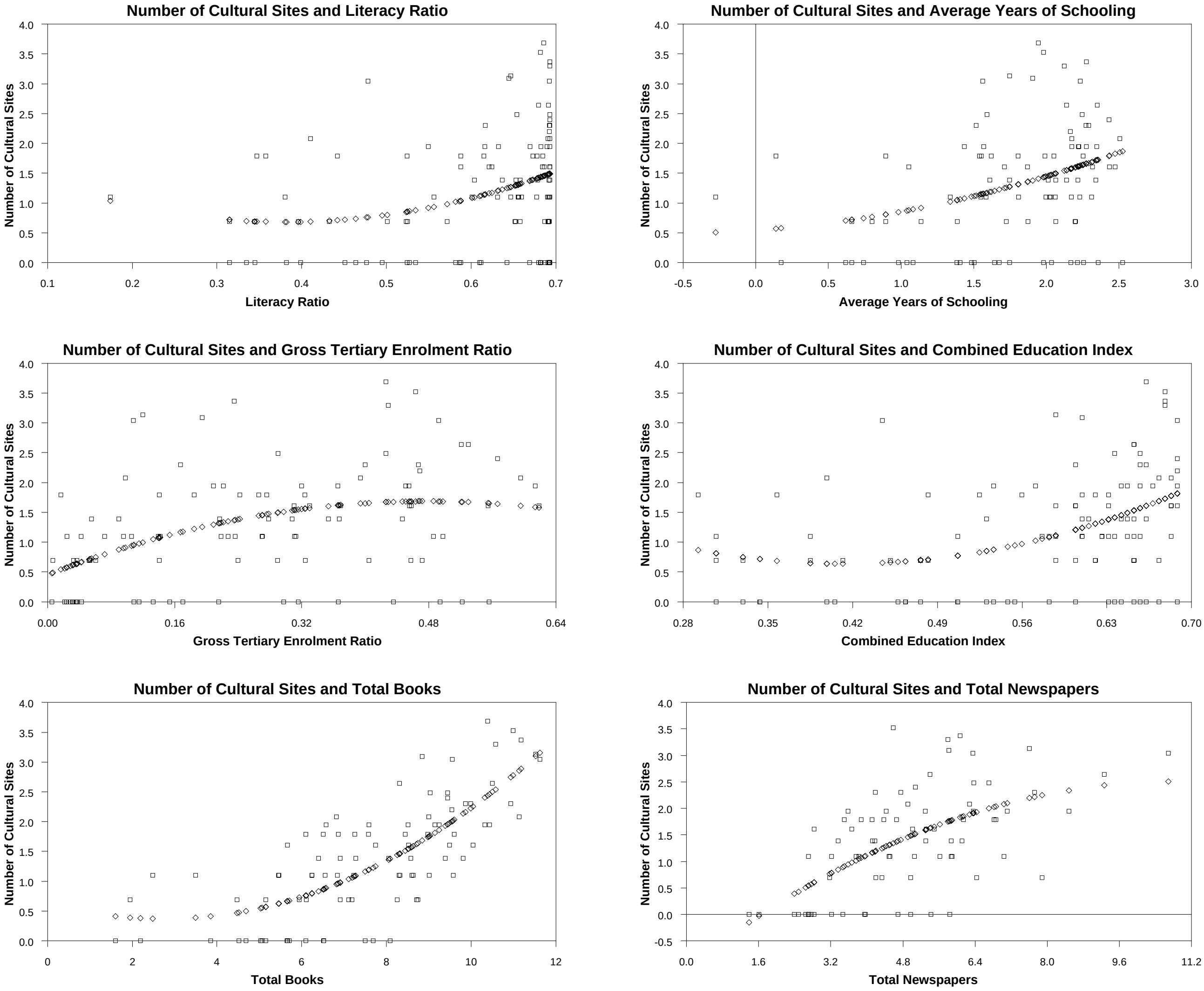

Figure 2.

Montecarlo simulation of squared bias, variance and their ratio. 1,000 replications of a stationary AR(1) 'true' model .

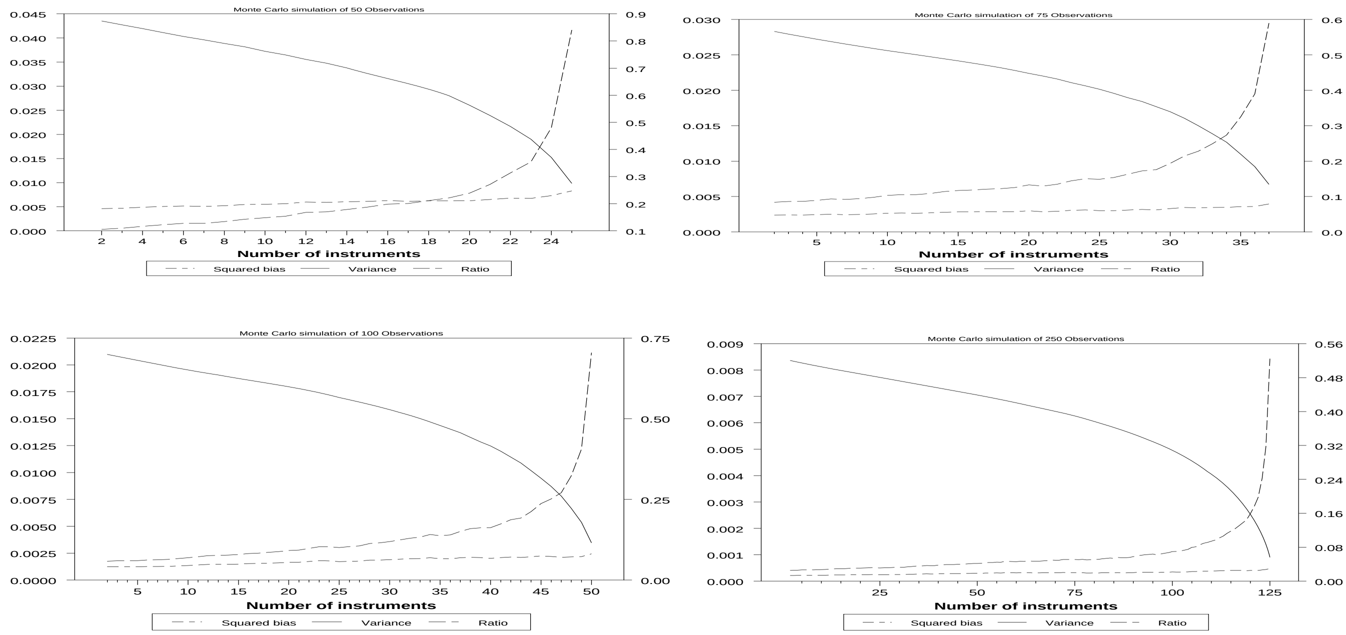

Table 8.

Cross-section regression results of all modern-culture indicators.

COMPLETE EDUCATIONAL ATTAINMENT*

Number of available observations: 74

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.0630	2.8210	0.0118	0.2132	-0.0158	0.2207
Number of sites	-0.0117	1.3332	-0.0011	0.0722	0.0024	0.1421
Share of sites > 250 years	-0.0625	2.2708	-0.0480	1.4518	-0.0365	0.9062
Average age of sites	0.0022	0.6907	0.0078	1.6011	0.0092	1.5532
Dummy Pre-post overhaul	0.0022	2.8057	0.0022	1.2217	0.0027	1.0770
Dummy Islam	0.0037	0.3613	-0.0023	0.1105	0.0007	0.0325
Dummy Christian	0.0942	9.6227	0.0967	5.5280	0.1009	5.0941
Dummy Catholic	0.0746	7.6875	0.0573	2.9932	0.0655	2.9730
Dummy Buddhist and Confucian	-0.0078	0.2251	0.0182	0.4885	0.0394	0.8847
J-statistic and p-value	0.0042	1.0000	15.8103	0.2595	12.7184	0.4698
RMSE	0.0476	0.0479	0.0501			
Durbin-Watson	2.1748	1.9496	1.8915			
ELRT and p-value	7.8954	0.7933				

TOTAL EDUCATIONAL ATTAINMENT*

Number of available observations: 74

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.0399	0.4358	0.1564	1.4758	0.1457	0.9776
Number of sites	0.0289	1.2817	0.0341	1.3800	0.0397	1.2872
Share of sites > 250 years	-0.1291	1.9839	-0.1638	2.5804	-0.1784	2.1936
Average age of sites	0.0093	1.3656	-0.0003	0.0326	-0.0000	0.0005
Dummy Pre-post overhaul	0.0040	1.3373	0.0075	2.0625	0.0101	1.7339
Dummy Islam	0.0291	0.9652	0.0110	0.2853	0.0181	0.3663
Dummy Christian	0.1613	5.7478	0.1513	4.2634	0.1634	3.3837
Dummy Catholic	0.1444	5.2873	0.1064	2.9779	0.1293	2.7156
Dummy Buddhist and Confucian	0.0400	1.0478	0.0348	0.5137	0.0545	0.5309
J-statistic and p-value	0.0037	1.0000	14.4216	0.3448	9.5736	0.7284
RMSE	0.0802	0.0909	0.1047			
Durbin-Watson	2.0581	2.0071	1.9985			
ELRT and p-value	2.7961	0.9968				

AVERAGE YEARS OF SCHOOL*

Number of available observations: 74

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.2510	0.7255	0.2891	0.3574	0.0643	0.0617
Number of sites	0.4224	1.9217	0.3956	1.4247	0.4299	1.0984
Share of sites > 250 years	-0.4373	2.4860	-0.3050	0.8726	-0.3287	0.6837
Average age of sites	0.1586	3.4457	0.1484	1.6307	0.1730	1.5874
Dummy Pre-post overhaul	0.0487	3.4278	0.0479	1.6585	0.0558	1.1776
Dummy Islam	-0.2258	1.4042	-0.1178	0.3679	-0.1587	0.4317
Dummy Christian	1.2191	9.4376	1.1970	5.4179	1.1839	4.1367
Dummy Catholic	0.8037	5.6614	0.6683	2.5076	0.7339	2.2116
Dummy Buddhist and Confucian	0.7833	2.5227	0.6173	1.0695	0.6616	0.8398
J-statistic and p-value	0.0033	1.0000	14.2813	0.3543	10.5776	0.6462
RMSE	0.6976	0.6769	0.7193			
Durbin-Watson	1.6220	1.6397	1.6430			
ELRT and p-value	4.5238	0.9720				

COMBINED EDUCATION INDEX

Number of available observations: 82

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.2845	1.8581	0.3346	2.4877	0.3576	2.0036
Number of sites	0.0726	1.7552	0.0566	1.1950	0.0536	0.8851
Share of sites > 250 years	-0.0940	1.7017	-0.1448	2.5693	-0.1512	2.1058
Average age of sites	0.0205	1.1540	0.0323	2.0464	0.0302	1.5642
Dummy Pre-post overhaul	0.0136	2.9513	0.0072	1.4496	0.0087	1.1995
Dummy Islam	0.0701	1.0884	-0.0092	0.1778	-0.0184	0.3081
Dummy Christian	0.3056	7.6569	0.2380	6.5809	0.2333	5.0553
Dummy Catholic	0.2686	4.4926	0.1642	3.7599	0.1646	3.1147
Dummy Buddhist and Confucian	0.1094	1.0715	0.0560	0.5032	0.0252	0.1799
J-statistic and p-value	0.0027	1.0000	14.0616	0.3695	11.2906	0.5865
RMSE	0.1301	0.1114	0.1138			
Durbin-Watson	1.7418	1.7464	1.7313			
ELRT and p-value	3.0744	0.9950				

GROSS TERTIARY SCHOOL ENROLMENT RATIO

Number of available observations: 75

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.0633	0.6530	-0.0634	0.4454	0.3093	0.6009
Number of sites	0.1611	4.0122	0.1660	3.2459	0.1215	0.8208
Share of sites > 250 years	-0.0300	0.5472	0.0049	0.0588	-0.1642	0.5662
Average age of sites	-0.0139	1.0582	0.0076	0.4729	-0.0121	0.2260
Dummy Pre-post overhaul	0.0161	3.1019	0.0127	1.5237	-0.0121	0.2819
Dummy Islam	0.1036	2.0194	0.0618	0.8991	0.1333	0.5671
Dummy Christian	0.5415	15.0823	0.5458	12.7564	0.4335	2.1207
Dummy Catholic	0.3583	7.5162	0.2412	3.6165	0.2189	1.1483
Dummy Buddhist and Confucian	0.4128	1.8360	0.4127	2.7287	0.0696	0.1489
J-statistic and p-value	0.0031	1.0000	12.5212	0.4854	6.6705	0.9183
RMSE	0.1685	0.1686	0.1790			
Durbin-Watson	1.9635	1.8484	1.9407			
ELRT and p-value	3.5315	0.9905				

SCHOOL LIFE EXPECTANCY

Number of available observations: 74

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	1.4262	3.9515	1.6118	3.6855	2.1105	1.9429
Number of sites	0.2548	1.7358	0.3824	2.0582	0.3267	1.1786
Share of sites > 250 years	0.0279	0.1712	-0.0024	0.0133	-0.2966	0.4715
Average age of sites	0.0270	0.6163	0.0323	0.6064	-0.0074	0.0639
Dummy Pre-post overhaul	0.0366	3.1671	0.0235	1.3548	-0.0115	0.1028
Dummy Islam	0.5366	3.2200	0.4436	2.3584	0.5653	1.0471
Dummy Christian	1.0494	8.7059	0.9550	6.4767	0.9668	2.0782
Dummy Catholic	0.9197	5.1272	0.5961	3.3483	0.7622	1.7847
Dummy Buddhist and Confucian	1.0837	4.6345	0.8706	2.5415	0.7517	0.8754
J-statistic and p-value	0.0028	1.0000	11.6523	0.5563	5.7759	0.9539
RMSE	0.4262	0.3796	0.3931			
Durbin-Watson	2.1547	1.9931	1.9509			
ELRT and p-value	2.6773	0.9974				

LITERACY RATE

Number of available observations: 82

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.2145	1.1729	0.3691	2.1425	0.3779	1.6541
Number of sites	0.0587	1.5907	0.0323	0.6253	0.0311	0.4420
Share of sites > 250 years	-0.0809	1.3725	-0.0781	1.1679	-0.0970	1.0416
Average age of sites	0.0261	1.5068	0.0282	1.5267	0.0289	1.2202
Dummy Pre-post overhaul	0.0153	3.8058	0.0060	1.0912	0.0071	0.8487
Dummy Islam	0.0757	0.8718	-0.0458	0.6850	-0.0397	0.4657
Dummy Christian	0.3514	3.7207	0.2032	4.0248	0.2014	3.0881
Dummy Catholic	0.3259	3.1567	0.1323	2.6228	0.1362	2.0129
Dummy Buddhist and Confucian	-0.0447	0.4948	0.0042	0.0321	-0.0339	0.2023
J-statistic and p-value	0.0032	1.0000	13.9215	0.3794	11.4034	0.5771
RMSE	0.1585	0.1160	0.1186			
Durbin-Watson	1.7518	1.8148	1.8325			
ELRT and p-value	3.5231	0.9906				

ALL BOOKS

Number of available observations: 67

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	2.0675	1.6252	2.9005	1.2286	-1.0753	0.2792
Number of sites	3.7461	4.2026	4.2973	2.8822	6.0505	2.7704
Share of sites > 250 years	-4.6720	5.8258	-4.7926	3.1935	-3.3372	1.4339
Average age of sites	0.7551	6.7777	0.7708	3.4260	0.9451	1.9463
Dummy Pre-post overhaul	0.1260	1.9713	0.0168	0.2402	0.0938	0.8000
Dummy Islam	2.9063	3.9480	2.7058	2.2961	4.0538	2.0577
Dummy Christian	4.9244	7.8256	4.4080	5.2376	5.5965	3.8079
Dummy Catholic	4.4066	6.1620	3.3209	3.3988	4.2870	2.3004
Dummy Buddhist and Confucian	6.1623	9.5741	5.4888	2.5515	7.5239	2.1163
J-statistic and p-value	0.0059	1.0000	21.6971	0.0602	9.7890	0.7111
RMSE	2.4593	2.3191	2.7823			
Durbin-Watson	2.0681	2.0602	2.0462			
ELRT and p-value	4.9444	0.9598				

GENERALITIES

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	-0.0824	2.2989	-0.0786	1.3263	-0.0434	0.5896
Number of sites	0.0372	1.2374	0.0094	0.5965	0.0063	0.3178
Share of sites > 250 years	0.0362	0.9968	0.0244	0.7644	0.0229	0.4881
Average age of sites	0.0097	2.9970	0.0091	1.2730	0.0052	0.6322
Dummy Pre-post overhaul	0.0020	1.3533	0.0001	0.0556	-0.0002	0.0836
Dummy Islam	0.0531	1.9654	0.0665	1.9512	0.0548	1.1937
Dummy Christian	0.0079	0.6665	0.0202	0.9419	0.0115	0.3750
Dummy Catholic	-0.0093	0.6043	0.0300	1.2009	0.0303	0.8724
Dummy Buddhist and Confucian	0.0041	0.0853	0.0476	1.0567	0.0406	0.5864
J-statistic and p-value	0.0041	1.0000	7.8515	0.8531	5.4511	0.9639
RMSE	0.0923	0.0911	0.0915			
Durbin-Watson	1.6448	1.7190	1.7385			
ELRT and p-value	3.5547	0.9902				

RELIGION AND THEOLOGY

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.0742	0.9940	0.0976	1.2841	0.1089	1.3604
Number of sites	-0.0136	0.5913	-0.0258	1.2741	-0.0268	1.2550
Share of sites > 250 years	-0.0281	1.1849	-0.0250	0.8104	-0.0261	0.8091
Average age of sites	0.0072	0.8138	0.0057	0.6167	0.0051	0.5343
Dummy Pre-post overhaul	-0.0007	0.2901	-0.0007	0.3697	-0.0011	0.5465
Dummy Islam	0.0083	0.2301	-0.0263	0.7369	-0.0325	0.8613
Dummy Christian	-0.0761	3.2606	-0.0797	3.6774	-0.0855	3.8149
Dummy Catholic	-0.0532	1.7197	-0.0701	2.3301	-0.0774	2.4870
Dummy Buddhist and Confucian	-0.0453	0.9141	-0.0926	1.6920	-0.1010	1.7314
J-statistic and p-value	0.0028	1.0000	8.6710	0.7973	8.0883	0.8378
RMSE	0.0598	0.0598	0.0611			
Durbin-Watson	2.3836	2.4106	2.4192			
ELRT and p-value	2.8404	0.9966				

PHILOSOPHY AND PSYCHOLOGY

Number of available observations: 64

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	-0.0251	2.5208	-0.0085	0.4464	-0.0280	0.6505
Number of sites	0.0181	2.7289	0.0211	2.2896	0.0169	1.2704
Share of sites > 250 years	0.0027	0.6279	0.0062	0.5844	0.0092	0.5440
Average age of sites	0.0032	2.2140	0.0010	0.3691	0.0036	0.6068
Dummy Pre-post overhaul	0.0008	1.4472	0.0007	1.3689	0.0007	0.5527
Dummy Islam	0.0223	4.3455	0.0193	1.9656	0.0139	0.7724
Dummy Christian	0.0252	6.9950	0.0208	4.0714	0.0274	2.2437
Dummy Catholic	0.0310	8.0528	0.0271	3.5425	0.0222	1.9145
Dummy Buddhist and Confucian	0.0202	3.6049	0.0239	1.7840	0.0232	0.7877
J-statistic and p-value	0.0048	1.0000	14.0574	0.3698	8.1051	0.8367
RMSE	0.0199	0.0193	0.0198			
Durbin-Watson	2.0887	2.0911	2.1437			
ELRT and p-value	6.1653	0.9075				

SOCIAL SCIENCES

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	-0.2632	2.4278	-0.0721	0.4408	-0.1331	0.3429
Number of sites	-0.0227	0.5551	-0.0459	0.8549	-0.0398	0.3586
Share of sites > 250 years	0.0382	0.6304	-0.0353	0.4795	-0.0531	0.3177
Average age of sites	0.0582	4.6929	0.0390	1.9729	0.0403	0.8912
Dummy Pre-post overhaul	-0.0033	1.1355	-0.0036	0.9946	-0.0030	0.2990
Dummy Islam	0.0547	0.8636	0.0558	0.6917	0.1207	0.7846
Dummy Christian	0.0055	0.1257	0.0075	0.1458	0.0548	0.5121
Dummy Catholic	0.0526	1.0500	0.0716	1.0286	0.1626	1.0810
Dummy Buddhist and Confucian	0.1469	1.4412	0.1857	1.4447	0.3314	1.0710
J-statistic and p-value	0.0038	1.0000	13.3442	0.4216	4.6314	0.9824
RMSE	0.1434	0.1235	0.1485			
Durbin-Watson	1.7962	1.8908	2.0792			
ELRT and p-value	3.1595	0.9943				

PHILOLOGY

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	-0.0141	0.4493	-0.0213	0.4043	-0.0292	0.2708
Number of sites	-0.0353	2.8528	-0.0163	1.4476	-0.0212	0.9435
Share of sites > 250 years	-0.0407	1.8746	-0.0094	0.4081	-0.0166	0.3657
Average age of sites	0.0142	3.6948	0.0120	2.1917	0.0137	1.1595
Dummy Pre-post overhaul	-0.0008	1.0645	-0.0011	0.9212	-0.0013	0.4927
Dummy Islam	0.0052	0.2783	-0.0193	0.7781	-0.0063	0.1427
Dummy Christian	-0.0406	3.0028	-0.0340	1.8817	-0.0236	0.8279
Dummy Catholic	-0.0081	0.5723	-0.0249	1.0632	-0.0285	0.6923
Dummy Buddhist and Confucian	0.0119	0.6121	-0.0114	0.3136	-0.0104	0.1297
J-statistic and p-value	0.0038	1.0000	10.7561	0.6312	4.2799	0.9878
RMSE	0.0498	0.0475	0.0495			
Durbin-Watson	2.0569	2.0972	2.1260			
ELRT and p-value	2.6513	0.9975				

PURE AND APPLIED SCIENCES

Number of available observations: 65

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.1224	1.8745	0.0636	0.8092	0.0319	0.3584
Number of sites	-0.0198	1.3376	-0.0187	1.2735	-0.0198	1.1079
Share of sites > 250 years	-0.0197	0.4878	0.0105	0.2388	0.0065	0.1247
Average age of sites	0.0105	1.2878	0.0138	1.5602	0.0174	1.8406
Dummy Pre-post overhaul	0.0005	0.2109	0.0019	0.7894	0.0024	0.7238
Dummy Islam	-0.0333	0.9959	-0.0589	1.6863	-0.0471	1.2947
Dummy Christian	0.0233	0.8232	0.0235	1.1021	0.0265	1.0407
Dummy Catholic	-0.0125	0.3909	0.0053	0.1732	0.0153	0.4712
Dummy Buddhist and Confucian	-0.0274	0.5212	-0.0267	0.4779	-0.0070	0.1213
J-statistic and p-value	0.0038	1.0000	10.2280	0.6752	10.3487	0.6652
RMSE	0.0631	0.0693	0.0728			
Durbin-Watson	1.8896	1.7804	1.8106			
ELRT and p-value	2.4210	0.9984				

ARTS AND RECREATION

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.1193	4.5223	0.1163	3.0160	0.1094	1.4966
Number of sites	0.0418	4.9257	0.0429	5.0053	0.0417	3.0356
Share of sites > 250 years	-0.0717	3.0805	-0.0686	3.3253	-0.0606	1.7161
Average age of sites	-0.0052	1.9475	-0.0063	1.4992	-0.0049	0.6076
Dummy Pre-post overhaul	0.0005	0.6045	0.0011	1.2601	0.0008	0.4285
Dummy Islam	0.0124	0.9426	0.0226	1.5505	0.0123	0.5478
Dummy Christian	0.0299	3.0500	0.0333	3.1204	0.0259	1.4068
Dummy Catholic	0.0216	1.3605	0.0338	2.1324	0.0177	0.6764
Dummy Buddhist and Confucian	0.0411	1.9259	0.0340	1.4266	0.0072	0.1673
J-statistic and p-value	0.0036	1.0000	11.1499	0.5983	6.5492	0.9239
RMSE	0.0355	0.0367	0.0352			
Durbin-Watson	2.0369	2.1838	2.1800			
ELRT and p-value	2.7639	0.9970				

LITERATURE

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.3907	3.6460	0.2805	1.8876	0.4951	1.8449
Number of sites	-0.0114	0.2939	-0.0143	0.3133	0.0047	0.0606
Share of sites > 250 years	0.1840	3.1632	0.1824	2.7606	0.2000	1.6420
Average age of sites	-0.0497	3.2853	-0.0328	1.8396	-0.0500	1.5297
Dummy Pre-post overhaul	0.0018	0.6173	-0.0016	0.4048	-0.0043	0.5668
Dummy Islam	-0.0704	1.0798	-0.0601	0.8488	-0.1545	1.2853
Dummy Christian	0.0369	0.9660	0.0427	0.9812	-0.0462	0.6404
Dummy Catholic	0.0531	1.3713	0.0349	0.6534	-0.0789	0.7360
Dummy Buddhist and Confucian	-0.1952	2.5845	-0.0594	0.6055	-0.1991	0.9785
J-statistic and p-value	0.0031	1.0000	15.1222	0.2998	4.6978	0.9813
RMSE	0.1361	0.1110	0.1431			
Durbin-Watson	2.0899	2.0513	1.9724			
ELRT and p-value	3.3129	0.9929				

GEOGRAPHY AND HISTORY

Number of available observations: 66

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.2059	6.0995	0.1722	3.7588	0.2488	3.2301
Number of sites	0.0407	5.9815	0.0419	3.6373	0.0377	1.8812
Share of sites > 250 years	-0.0527	3.9236	-0.0610	3.1808	-0.0849	2.8769
Average age of sites	-0.0130	3.1462	-0.0074	1.2225	-0.0131	1.2339
Dummy Pre-post overhaul	-0.0017	1.5443	-0.0011	1.0030	0.0008	0.4242
Dummy Islam	0.0221	1.3612	0.0217	1.0449	-0.0029	0.0870
Dummy Christian	-0.0004	0.0252	0.0031	0.3021	-0.0078	0.4170
Dummy Catholic	0.0024	0.1032	-0.0023	0.1271	-0.0157	0.5346
Dummy Buddhist and Confucian	-0.0238	0.9085	-0.0331	1.1377	-0.0819	1.5899
J-statistic and p-value	0.0043	1.0000	14.9852	0.3083	5.0095	0.9750
RMSE	0.0370	0.0338	0.0466			
Durbin-Watson	1.7404	1.7506	1.9875			
ELRT and p-value	2.9653	0.9958				

DAILY AND NONDAILY NEWSPAPERS

Number of available observations: 60

Estimation method	EL		GMM		BGMM	
Coefficients and t-statistics	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	0.0554	0.0695	1.2525	0.7568	3.3768	1.0452
Number of sites	3.3542	6.4472	3.1593	2.4262	4.2151	2.0585
Share of sites > 250 years	-0.0286	0.0695	0.1280	0.1401	1.0667	0.6597
Average age of sites	0.4912	4.8832	0.3332	1.6748	0.0478	0.1217
Dummy Pre-post overhaul	0.1085	2.8433	0.0092	0.1505	-0.0396	0.4329
Dummy Islam	1.3358	2.7132	1.1293	1.4340	0.2467	0.1576
Dummy Christian	1.8802	5.5878	1.7131	2.6559	0.9006	0.6197
Dummy Catholic	-0.5013	1.1156	0.1028	0.1491	-0.6760	0.5084
Dummy Buddhist and Confucian	2.7991	1.4620	2.8511	2.0286	2.9552	1.3104
J-statistic and p-value	0.0062	1.0000	25.9955	0.0170	13.8161	0.3869
RMSE	2.3537	1.8874	1.8517			
Durbin-Watson	1.6051	1.6632	1.5701			
ELRT and p-value	7.1854	0.8451				

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* Referred to populations aged 25 and over.

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Endnotes.

[1] The definition supplied is a combination of the Yahoo and of the Merriam-Webster online dictionaries currently available on the Web. For the sake of completeness, I would add, at the end of the quotation, the words: "and knowledge".

[2] Examples are the Christian Revolution in Western Europe, the Islamic Involution following the 'Granada Syndrome' occurred in many Arabic countries, and the colonization episodes of the Americas and Africa. Also the reverse happens: notable examples are the acquisition of the Greek culture by the Romans and by ancient Islam, and of the Indian and Chinese cultures by the Moghuls and the Mongols of the Khan dynasty, respectively. On average, high culture tends to absorb and even to feed in from low culture to a larger extent than the reverse. Typical examples are the evolutionary phenomena of arts and sciences in many societies, where low culture frequently provides a substantial part of the supply of human capital.

[3] Measurement error due to misreporting by national statistical agencies or to data construction methodologies [Portela et al., 2004] as well as differences in data collection criteria and lack of data are frequent phenomena facing the applied researcher. An example among the countless: cross-section differences in graduation rates or in school life expectancy, or in the percentage of repeaters, by no means imply that comparatively higher country rankings are associated to smarter or more-cultured students because of the high worldwide variance in educational selectivity criteria. However, see Brunello et al. [2000] and Brunello and Checchi [2003].

[4] From now onwards, for simplicity purposes, I define as 'learning' all forms of schooling and educational standards, and as 'transmission' all of the printed-paper means, even if books – as is the case in the present context – include school textbooks.

[5] Apart from the lack of some time-series and cross-section statistics, no uniform criterion may be used to compare ancient cultures among them and with modern cultures as well. For instance, even within similar or identical fields of artistic production, many ancient cultures have specialized in fine arts (e.g. painting and architecture), others in humanities (e.g. poetry and romance), others in performing arts (e.g. dance and theater), and so on. In addition, even in the case of countries sharing the identical class of artistic production, a quantity output indicator may severely run counter the universally-received coefficients of quality, i.e. of expertise and aesthetics contained in the definition of high culture. In practice: is culturally wealthier a country that has produced hundreds of Cubist paintings or one that has produced only a dozen of reputed Old Masters ? And similarly: is

more valuable the heritage of a country that has produced only temples and castles or that of a country that has specialized since immemorial in commercial and civilian buildings (e.g. bridges, irrigation systems, cultivation techniques) ?

[6] As pointed out by some authors (Barro [1999]; Chen and Dahlam [2004]), two of the reported educational indicators may not be strictly considered as human capital stocks. This applies to enrolment ratios, which are yearly flows, and to the literacy rate, which does not consider accumulated investments in education. These indicators are however retained in the present context for two reasons: their undisputable relevance at catching the extremal effects of ancient cultures over modern culture, and their disputable nature which requires additional proofs on the correctness of the criticism that are well beyond the scope of this paper. The same criticism formulated above may apply to the printed-paper indicators, whose only data in stock format supplied by the UIS are the number of volumes in libraries of institutions of tertiary education, only available for Europe and North America, and the number of volumes in national and public libraries, where the reporting countries are less than sixty and are not subdivided by UDC classes. Also these indicators expressed in flow terms are retained because of their valuable information in the present context, while the criticism is turned around by transforming them into ratio terms with respect to total book reading (Sect. 4).

[7]The UNESCO list does not include Palestine as an autonomous nation, and hence Jerusalem cannot be considered yet as a transboundary property. The same applies to the Holy See, which is granted a particular status for its citizens only for a very limited number of jurisdictional matters and by consequence must be fully considered as part of Italy. The extermination camp of Auschwitz does not pertain to the history of Poles but to that of Jews, and thus must be included in Israel, just as with Robben Island (South Africa), James Island (Gambia) and Island of Gorée (Senegal), associated with apartheid and slavery.

[8] The average site age is the sum of the age of each site divided by the number of sites. The age of each site is determined on the first-stage construction year or period supplied by the WHCP list. Therefore if the site – especially if ancient – has undergone partial/total destruction and further reconstructon/restoration, its age always refers to the date it was first erected.

[9] An example, among many, of the relationship between amount and age of culture is offered by the Greek civilization which after exporting culture to the four corners of the Ancient World, has suffered a longstanding artistic drawback during the Turkish rule. Another example is offered by Western Europe which, following the barbaric invasions and the imposition of papacy and Christianity, took almost fifteen centuries to fully achieve the Renassaince.

[10] The correlation coefficient between this ratio and average site age is 0.37, higher than the 5% critical value of nonrejection for the given sample size (which is .19), indicating that younger (older) cultures tend to exhibit lower (higher) ratios. However, quite a few ancient cultures (Austria, Belgium, Finland, Germany, Israel, Sweden and the United Kingdom) exhibit low ratios, indicating nondecreasing returns as compared, for instance, to China, France and Italy which have scarcely added cultural capital in the past quarter millennium.

[11] Peaceful and/or violent 'regime switches' are religious or political permanent takeovers, like those occurred to many European and to the totality of the American countries following the superimposition of Christianity upon extant socio-political customs and religious beliefs. Similarly for North-African and Middle-East countries following the introduction of Islam, and for Subsahelian African countries with the European slavery and colonial periods.

[12] The WHCP list specifies by brief description the nature of the sites, whereby three major categories can be distinguished: 'Temples and Castles', 'Historic Town Centers', and 'Other'. The first category includes elitarian works and artifacts of religious nature (sacred cities, devotional temples, holy shrines and graves, sacred rock carvings and drawings) and of governmental nature (castles, fortifications, royal palaces and gardens, statues and tombs). The third category includes non-elitarian works and artifacts of commercial nature, namely, cultural and agricultural landscapes, products of engineering and technology (ports, canals and waterways, bridges, railways, handicraft and industrial plants, mines) and traditional human settlements (villages and hamlets) characterized by vernacular architecture. The second category includes some classes of both (in fact those that can be hosted within a city borders) plus, by default, those archaeological landscapes that are not exclusively of religious or governmental nature. Since 'Temples and Castles' are very frequently found in historic towns, the first two categories are strictly intermingled. Therefore, to ensure nothing is lost, I computed the sum of the sites pertaining to the first category and 50% percent of the sum of the sites pertaining to the second, on the assumption that the remaining 50% is associated to commercial sites. The share is obtained by rounding the ratio between the sum and the total number of sites existing in the country. Its average, for the entire country set, is just around 60%.

[13] The dummies are derived from Sala-i-Martins's dataset [1997] if available for the country and from the CIA Factbook elsewise. 'Official or largely prevailing' is intended to be the religion whose share equals to or exceeds 85% of the population. Mixed refers instead to shares lower than that amount.

[14] Another candidate set of dummies, frequently used in the growth literature, is represented by continents. However, preliminary empirical runs have demonstrated their uselessness in the present context, chiefly because cultural transmission since immemorial is of transcontinental nature [Cavalli-Sforza and Feldman, 1981].

[15] The 'best fit' line is constructed with the fitted values originating from an Ordinary-Least-Squares regression of the logged number of sites against a constant and the logged select indicator, both in levels and squares.

[16] The gross enrolment ratio and the combined education index exhibit cross-correlation values of .25 and .24, respectively, while the total number of book titles and newspapers exhibit values of .66 and .25.

[17] The partial correlation coefficient between the number of sites and the three book classes respectively are: .35, .16, and .29, of which the first and the last are statistically significant at the 5% level, and the other somewhat less than 10%. In other words,

philosophy and psychology as well as geography and history are highly related to the amount of cultural heritage, while the other book class only weakly.

[18] The Spearman rank correlation coefficients are all positive and 5% significant for the educational indicators of Table 4, and are .27, .64 and .70 respectively. They are negative for the printed-paper indicators of Table 5, but significant only for the books ratios: -.38 and -.34 respectively. While all insignificant for the educational indicators of Table 5, conversely they are all significant for the printed-paper indicators of Table 7, and are -.52, -.46 and -.34, respectively.

[19] Several alternative criteria of instrument relevance are used in the literature, like the F-test statistic for the joint null hypothesis that all elements of Π are zero [Stock et al., 2002] or the forward/reverse estimator test [Hahn and Hausman, 2002, 2003].

[20] Some of the most recent literature adopts the so-called 'concentration coefficient' [Stock et al, 2002; Chao and Swanson, 2005] to better specify the asymptotic consistency properties of the 2SLS and B2SLS estimators vis-á-vis the L^2 / N and the *L/N* criteria.

[21] Given a simulated AR(1) process, the bias is the difference between the 'true' assumed coefficient value of unity for stationarity and the estimated coefficient value.

[22] No proof stands yet in the cited theoretical literature on this account, and is in any case beyond the scope of this paper.

[23] The EL model described does not allow for closed-form solutions to $\hat{\lambda}_{EL}$ and $\hat{\beta}_{EL}$, as they must be solved simultaneously. To achieve this goal, numeric solutions are customarily found by making use of nonlinear optimization iteration algorithms (e.g. Newton-Raphson). In the present case, starting 'guess' values of λ and β are fixed to zero and $\hat{\beta}_{GMM}$ (eq. 3.5), respectively, as in Guggenberger and Hahn [2005], under the generic assumption that $\hat{\beta}_{GMM}$ be a consistent first-step estimator.

[24] I have run a Montecarlo simulation based on 1,000 replications of heteroskedastic artificial series to test for efficiency of the two-step EL with respect to GMM and BGMM. The model is a regression with 10 regressors and 30 fixed instruments, which is very close to the experiments being run in Sect. 4, and the procedure is initialized with λ and β respectively fixed to zero and $\hat{\beta}_{GMM}$. The tests adopted are three: F-test for the null of nonzero coefficient vector, size of RMSE and sum of the absolute t-statistics (T-SUM) of the coefficient vector, an alternative measure to jointly test for its significance. F-tests of EL are in 40% (70%) of the cases smaller than hose reported for GMM (BGMM), RMSEs of EL are in 50% (70%) of the cases smaller than those of GMM (BGMM) and, finally, the T-SUM is in 90% (98%) of the cases larger than those of GMM (BGMM). BGMM definitely fares worst in terms of efficiency due to its bias correction, which is obvious. EL outperforms both, by supplying together with reduced bias a higher efficiency, especially with the T-SUM test. See, however, Guggenberger and Hahn [2005] for a more substantiated analysis that compares the small-sample efficiency properties of EL and 2SLS.

[25] I have proceeded to a slight although necessary modification of eq. 3.29 to avoid excess variance within the pseudologged and the logged values of the series of interest y_i. After pseudologging all entries of y_i, for *N*=113 the following constructions apply: *i*) if in y_i some data equal 1 so that their log is zero, the pseudolog becomes -6164.72; *ii*) if in y_i some data equal 0 so that their log is NA, the pseudolog becomes -6.22. Thereafter, the other pseudologged entries are divided by either *i*) or *ii*) so as to obtain normalized values and therefore smoother series than would be elsewise.

[26] The ratio, because of the nature of its construction, exhibits an untolerable .98 cross-correlation value with the number of sites. The other (logged) regressors are much less correlated one with the other, in all cases but two less than the critical threshold value of .19 (see fn. 11) and can be safely retained. Collinearity causes coefficient attenuation and exceedingly high coefficient standard errors, and is closely akin to model uncertainty [Temple, 2000; Hoover and Perez, 2004].

[27] The correlation coefficient between the OLS residuals of eq. (3.1) and the endogenous variable is on average, for all cross-section equations, close to .80, and this is a sufficient condition for instrumenting. The correlation coefficient between the first-stage residuals and the fixed regressors never exceeds .35 in absolute value and is on average higher for some dummies and for the average age of sites (evidencing some mild measurement error and/or endogeneity).

[28]This 'skimming' procedure is necessary to avoid unwanted multicollinearity deriving from use of the entire instrument list; which exhibits in the vast majority of cases high cross-correlation coefficients, well beyond the .19 critical value.

[29] The first strategy followed consists of ranking from the lowest to the highest the correlations of all available instruments with the first-stage residual, forming a minimal set of the *L=K* most orthogonal moment conditions, and then subsequently adding one by one the others so as to obtain a total of *L-K* sets, where each of them has one instrument more than the preceding. Of all these sets, the 'optimal' is the one with the highest *p*-value of its *J*-statistic. Donald et al. [2003] perform a similar strategy, but use 'discrete' instrument sets (see their Table VII). The second alternative strategy consists of ranking from the lowest to the highest the normality tests [D'Agostino and Stephens, 1986] applied to the moment conditions and then proceeding as above.