The first Great Divergence and the evolution of cross-country income inequality during the last millennium: the role of institutions and culture

Jakob B. Madsen[a] & Eric Yan[b]

[a] Department of Economics, Monash University, Caulfield East, Vic 3145, Australia

[b] Department of Economics, National Chengchi University, Taipei 116, Taiwan
Published online: 24 May 2013.

PLEASE SCROLL DOWN FOR ARTICLE

Routledge
Taylor & Francis Group

The first Great Divergence and the evolution of cross-country income inequality during the last millennium: the role of institutions and culture

Jakob B. Madsen[a],* and Eric Yan[b]

[a]*Department of Economics, Monash University, Caulfield East, Vic 3145, Australia*
[b]*Department of Economics, National Chengchi University, Taipei 116, Taiwan*

Using a millennium of data for 12 countries in the East and in the West, this article tests the extent to which contracting institutions, property right institutions and culture can explain economic development and the Great Divergence. It is tested whether these theories influence growth through science and technology or through human capital or channels that are independent of these two channels. It is found that culture, contracting institutions and property right institutions have all been relevant for growth and development.

Keywords: the Great Divergence; culture; institutions

JEL Classification: O1; P16

I. Introduction

The causes of the Great Divergence remain a mystery, and several growth theories have recently been proposed to explain it. Many theories are based on the models of Hansen and Prescott (2002) and Lucas (2002), in which technological progress eventually renders the manufacturing sector sufficiently profitable for the economy to take off. Unified theory of economic growth is another influential line of thought, which provides a three-stage interpretation of long-run economic growth in the Western world (Galor and Weil, 2000; Galor, 2011). At the more fundamental level, the most influential hypotheses of the Great Divergence have been the institutional hypothesis of North and Thomas (1973), which has been developed further by Williamson (1985) and the cultural/religious

hypothesis of Landes (1998), Weber (2002), Doepke and Zilibotti (2008) and Becker and Woessmann (2009).

Using a millennium of data for 12 countries, this article examines the influence of culture, property rights and contracting institutions on growth and development in the East, the Middle East and the West since the year 950 through the channels of human capital and science and technology (S&T). The cultural hypothesis suggests that economic development is associated with values such as time preferences, and work ethics and some other social values that are supportive for economic development because they affect people's attitude towards knowledge, independent thinking, work and savings. Property rights institutions refer to the legal protection of private parties from expropriation of private property by governments and elites (DeLong and Shleifer, 1993). Finally,

*Corresponding author. E-mail: jakob.madsen@monash.edu

contracting institutions refer to the efficiency of organizations in the enforcement of contracts between private parties (see Acemoglu and Johnson, 2005). Failure to enforce the contracts leads to economic inefficiencies.

The contribution of the article is twofold. First, it constructs data on contracting institutions, culture, per capita income, S&T, human capital and property rights institutions for 12 countries over thousand years and tests the approximate and the more fundamental causes of growth and the Great Divergence. Second, it examines the extent to which cultural, contracting institutions and property rights institutions can explain the income path and the Great Divergence through, or independently of, human capital and S&T, over the period from 950 to 1850. Instruments are used to deal with endogeneity.

II. Three Theories of Early Development and Divergence

Culture is a key determinant of the values, preferences and beliefs of individuals and societies and is advocated to have been an important factor behind the Industrial Revolution by Landes (1998), Weber (2002), Mokyr (2005) and Doepke and Zilibotti (2008). Landes (1998) concludes that 'if we learn anything from the history of economic development it is that culture makes all the difference' (1998, p. 516) and 'what counts is work, thrift, honesty, patience, tenacity' (1998, p. 523). Mokyr (2005, p. 61) argues that the European Enlightenment was associated with religious and political tolerance, human rights and freedom and natural law and justice; an open cultural climate that allowed for the pursuit of productivity improvements. The Industrial Enlightenment ensured that subsequent micro-inventions were created to support and improve on macro-inventions.

In *The Protestant Ethic and the Spirit of Capitalism*, first published in 1905, Weber (2002) puts forward the thesis that Protestantism, especially Calvinist ethics and ideas, influenced the development of capitalism by being supportive of the rational pursuit of economic gain. According to Weber (2002), protestant beliefs included hard work, thrift, saving and economic success, whereas Catholic and Muslim beliefs did not promote capitalism. Comparing economic development in the East and West, Weber argued that the difference in social attitudes and values in dominant religions contributed to the development of capitalism in the West and the absence of it in China.

Contracting institutions determine the type of contract that can be enforced between private agents. Good contracting institutions are associated with effective resource allocation, particularly transaction cost economizing (Williamson, 1985). Transaction costs are in turn about structural efficiency such as financial development, trade,

capitalistic development and division of labour. Trade improves economic growth through market expansion and international specialization. Financial development reduces contracting costs, which facilitates contracting relationships. Finally, vertical integration that is facilitated by centralization is also a way to minimize on transaction costs.

Property rights institutions regulate the relationship between ordinary citizens and politicians or the elite with access to political power and are, therefore, linked to the distribution of the political power in the society. Bad property right institutions fail to constrain those who are in charge of the state because the state is the ultimate arbiter of contracts (Acemoglu and Johnson, 2005). The incentive to innovate and invest is larger in the presence of secure property rights because the proceeds from the investment go to the entrepreneur. Conversely, in the absence of secure property rights, human capital may be used for rent-seeking instead of productive pursuits, thus further retarding economic growth.

III. Modelling Strategy

A two-step procedure is adopted here in which per capita income is influenced by institutions and culture indirectly through S&T and human capital and directly through channels independently of S&T and human capital for country i at time t as follows:

$$\ln y_{it} = \alpha_0 + \alpha_1 S\&T_{it} + \alpha_2 HC_{it} + \alpha_3 \ln Cul_{it} \\ + \alpha_4 \ln Con_{it} + \alpha_5 \ln Pro_{it} + CD + \varepsilon_{it} \tag{1}$$

where y is productivity or per capita income, $S\&T$ is science and technology, HC is human capital, Cul is culture, Con is contracting institutions, Pro is property right institutions, CD is fixed effect dummies and ε is a stochastic error term.

The variables $S\&T$ and HC are instrumented using culture and institutions as instruments:

$$S\&T_{it} = \beta_0 + \beta_1 \ln Cul_{it} + \beta_2 \ln Con_{it} \\ + \beta_3 \ln Pro_{it} + CD + \varepsilon_{1,it} \tag{2}$$

and

$$HC_{it} = \gamma_0 + \gamma_1 \ln Cul_{it} + \gamma_2 \ln Con_{it} \\ + \gamma_3 \ln Pro_{it} + CD + \varepsilon_{2,it} \tag{3}$$

Equations 2 and 3 are the primary regressions, and Equation 1 is the secondary regression.

This framework follows standard growth modelling in which productivity is predominantly driven by technological progress along the balanced growth path; however,

culture and institutions further enhance productivity to the extent that they improve the effectiveness of production at a given level of technology. The identifying restrictions in this framework are that productivity is determined predominantly by *Cul, Con* and *Pro* through the channels of *S&T* and *HC*. The advantage of this identifying approach is that, to some extent, it overcomes potential feedback effects from productivity to *S&T* and *HC*.

IV. Data

The model is estimated using data over the period 950 to 1850 for the following 12 countries: China, India, France, the UK, the Netherlands, Germany, Italy, Portugal, Spain, Japan, Russia and Turkey. The starting period of circa 950 is dictated by data availability; however, it appears that events that were important for the Great Divergence started to unfold around 1250 AD – the conditions in these countries appear to have been fairly stable during the period 950 to 1250 and may also have been so during the dark ages. The analysis ends in 1850 and, as such, does not focus on the transition from the post-Malthusian growth regime to the modern growth regime at the turn of the twentieth century or later because the economies were governed by a quite different growth regime in the twentieth century than earlier. Construction of the data and data sources are detailed in the accompanying working paper of Madsen and Yan (2013).

Scoring criteria for culture

The score of 2 is given for major positive events, 1 for normal positive events and 0.5 for positive minor events,

−2 for major negative events, −1 for normal negative events and 0.5 for minor negative events. The scores are then accumulated over time. Positive scores are given for events that render a society more secular and individuals think more independently and negative scores for reverse events such as religious triumph over secular power. Furthermore, according to cultural psychologists, a key aspect that distinguishes cultures is *individualism* versus *collectivism* (Heine, 2007). While individualism emphasizes personal freedom and achievement, collectivism emphasizes group interests and discourages behaviour that makes the individual stand out (Heine, 2007). Since a secular society encourages individual behaviour, while a nonsecular society emphasizes collective behaviour, we would expect secular societies to be more innovative and to invest more in human capital than nonsecular societies. An individualistic and, thus, secular society would try to control its own fate and not appeal to supernatural powers, while nonsecular societies believe that they cannot do much to influence their fate.

Figure 1 shows the evolution of culture over time across the world. To simplify the graphical exposition, the following three groups are considered: the East (China and India), West (France, the UK, the Netherlands, Germany and Italy) and a middle group (Portugal, Spain, Japan, Russia and Turkey). The figure shows the unweighted average accumulated score for each country in the group. The country groupings are defined in terms of their income paths although the groups do, somewhat, cluster geographically. Some may object to the grouping of Japan in the Middle group since, geographically, it belongs to the East. However, Huntington (1996) argues that Japan's cultural development has been quite independent of that of China and India. Note that the grouping used here is only for
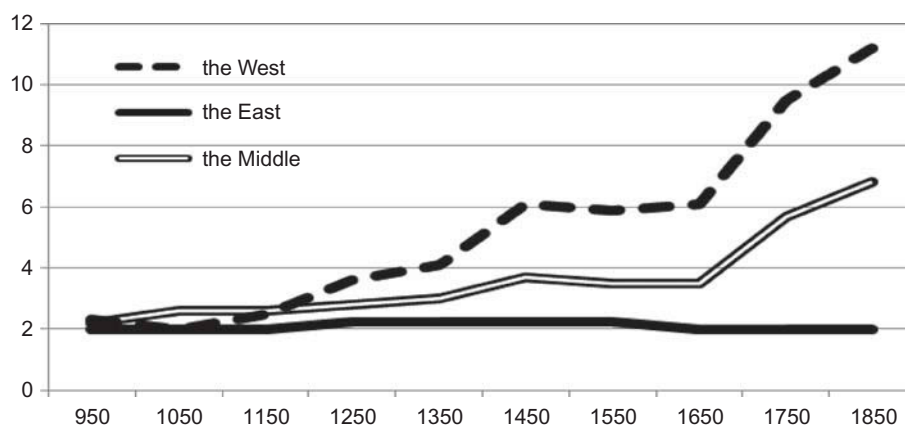

Fig. 1. Accumulated score for culture
Note: The graph is unweighted average accumulated scores for countries in the East (China and India), West (France, the UK, the Netherlands, Germany and Italy) and the Middle (Portugal, Spain, Japan, Russia and Turkey).

expositional purposes as only individual countries are used in the empirical analysis.

The figure shows that after an uneventful two centuries the West takes off from the twelfth century while the East stays put for almost the whole millennium. Culturally the West experienced much more cultural progression due to the weakening of religious power since the eleventh century. The split of the church in the eleventh century gradually weakened the Pope's control over the European societies. With rising secular power, the secular ideas, originally banned by the church, began to develop and the public started to relax the strict constraints on life imposed by Christianity at that time. A milestone in this process was the Renaissance, which was a major cultural event in Europe that promoted independent thinking and was the prime mover in the development of a strong scientific and liberal culture (Pirenne, 1963, pp. 377–78).

The Middle group experienced only modest improvements up to the seventeenth century. The Ottoman Empire was influential for the secular increase in the Middle group. Ottoman Turkey had benefitted economically from religious conflicts in Europe through making use of its geographic advantage in the fifteenth century. Not until the seventeenth century did another wave of changes reach the Middle group heavily influenced by the expansion of the Western economic frontier, which led to religious reform in Russia in the eighteenth century and changing zeitgeist in Japan and Turkey in the nineteenth century (Langer, 1972, p. 479).

Scoring criteria for property rights institutions

The data on property rights institutions for the UK, France, Turkey, the Netherlands, Portugal, Spain, Germany and Italy are from Acemoglu *et al*. (2005), and we follow their method to construct data for Japan, China, Russia and India. Constraints on the executive are coded according to the criteria of Polity IV: The scores 1, 3, 5 and 7 are given, where the score of 1 is given if there are no regular limitations on the executive's actions and the score of 7 is given if 'accountability groups have effective authority equal to or greater than the executive in most activity' (Polity IV).

The scores are displayed in Fig. 2. Throughout the thousand years covered by the graphs Japan and China were ruled by Confucian elites and India was ruled by Hindu elites who failed to protect the property rights of regular citizens. These elites enjoyed absolute power and were not subject to any constraints. Landes (2006) posits that the Chinese state continually interfered with private enterprises and this interference came in many forms: expropriation, prohibiting and inhibiting others, manipulating prices and forbidding all overseas trade. In contrast, property rights institutions improved substantially in the West during the first four centuries covered in the figure.

The Middle group started up with almost as good property rights institutions as the West; however, no significant improvement occurred until the eighteenth century, triggered by events such as the chartering of corporate rights to the nobility in Russia in 1785 (Langer, 1972, p. 517), abolition of serfdom in Russia in 1803 (Langer, 1972, p. 749), the introduction of a new constitution in Japan in 1889 (Langer, 1972, p. 921) and the reformation in Ottoman Turkey in 1839 (Langer, 1972, pp. 772 and 774).

Scoring criteria for contracting institutions

The coding criteria follow the coding criteria used for culture in which the score of 2 is given for major positive events, 1 is given for normal positive events and 0.5 is given for minor positive events. Negative scores of 2, 1 and 0.5 are given for events that are in reverse of positive events. Positive events include events such as (1) promotion of parliamentarianism, which, in contrast to monarchy rule, economizes transaction costs as well as increases the bourgeoisie's investment incentives; (2) a political
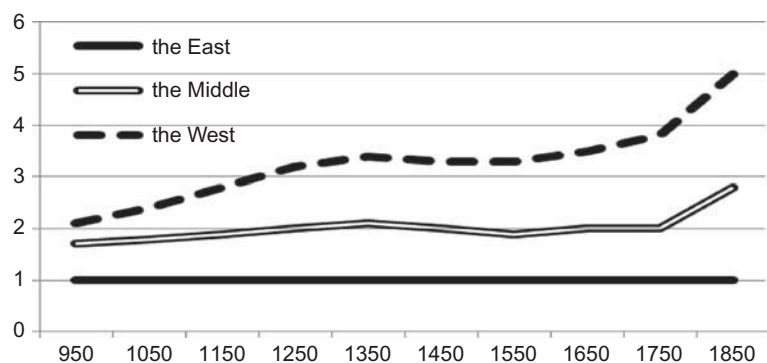

Fig. 2.   Accumulated scoring for constraints on executives
Note: See the notes to Fig. 1.

reform that strengthens the legal institutions; (3) development of rule that vertically integrates an economy's organizations; (4) formation and improvements of legal institutions that reduce transaction costs; and (5) capitalistic development such as financial development, territorial unification, promotion of international trade or other ways of overseas expansion.

Figure 3 shows the evolution of contracting institutions over time. The score starts from index 2 in year 950 to ensure that all scores are positive throughout the whole period. The Middle group experienced significant advances in its contracting institutions during most of the considered period. The founding of the Ottoman Empire in the thirteenth century increased the organizational efficiency in Turkey (Langer, 1972). The decline in the seventeenth century was predominantly by the Japanese isolation policy in which the Japanese were forbidden to leave the country from 1636 to 1854 when the law was abolished (Langer, 1972, p. 586; Pacey, 1990, p. 153).

The West witnessed a vast improvement in their contracting institutions throughout the whole period. The first ascent, starting in the eleventh century, was brought about by increasing trade, followed by a series of financial developments that started in the fifteenth century such as the foundations of the Bank of St George, Genoa, in 1407 (Davies, 1996, p. 548), and legalization of charging interest on loans in Florence in 1403 (Davies, 1996, pp. 219–20). This trend continued over the next centuries; partly fuelled by increasing trade and colonization that increased organizational complexity and enlarged the feasible set of transaction cost savings; and partly fuelled by events such as the French revolution in 1789 and the introduction of parliamentary rule in the Netherlands and Germany in the nineteenth century (Langer, 1972, pp. 674, 723–26).

In the East, contracting institutions deteriorated over centuries to 1800, predominantly due to the introduction of closed door policies in China. Overseas trade was deliberately curtailed by the government and ocean-going ships prohibited, and even coastal trade was severely restricted in the period 1368 to 1567 (Deng, 1999). After that, there were nonconsecutive periods of closed door policies in the periods 1662 to 1669 and 1757 to 1842 (Langer, 1972, pp. 576–79). The Cornwallis Code enacted in 1773 in India as an improved and more efficient administrative framework ensured a subsequent recovery in the East (Langer, 1972, p. 574).

Scoring criteria for science and technology

S&T is measured as the number of significant innovations over time for each country and is obtained from the detailed chronologies of significant innovations classified in Pacey (1990) and Murray (2003) and added together and accumulated over time missing. Without discrimination, a score of one is given for any significant scientific achievement or technological discovery as detailed in the working paper version of the paper (Madsen and Yan, 2013).

Figure 4 shows the development of S&T in the three country groups. The data are normalized by population assuming that the likelihood of innovating is proportional to the population size. The innovations in Fig. 4 are dominated by advances in book production, ship-building techniques, textile making and nonhuman energy production and mechanics. China's shipping technology reached its peak in the early fifteenth century; however, the massive decline in Chinese international trade starting in the fifteenth century discouraged further innovations in ship building (Pacey, 1990, pp. 54–5). At the same time European ship-building technology gained momentum and Europeans quickly became dominant within ship-building technology, particularly Spain and Portugal (Pacey, 1990, p. 66).
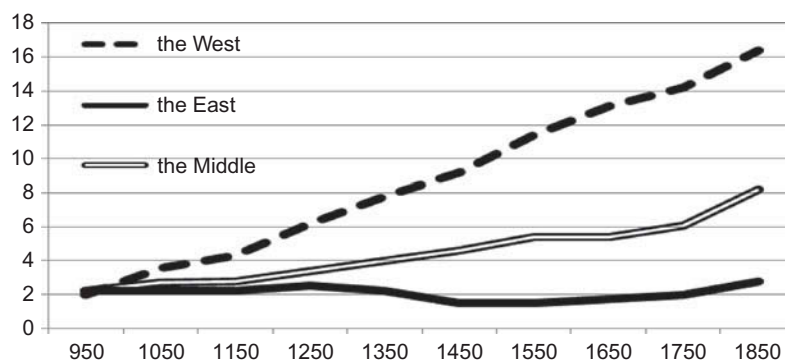

Fig. 3.   Accumulated scoring contracting institutions
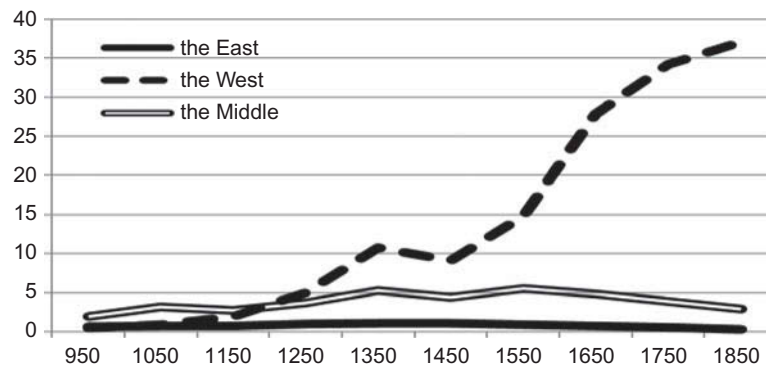*Note*: See the notes to Fig. 1.

Fig. 4. Accumulated per capita achievements in S&T
Note: See the notes to Fig. 1.

Regarding textile manufacturing, India was the world leader in textile technologies before the second millennium in areas such as the spinning wheel, cotton cultivation and processing (Pacey, 1990, p. 23). Subsequently, China caught up to the Indian technology and went on to develop the water-driven spinning machine by 1300 (Pacey, 1990, pp. 26–30). Finally, Europe took over as the dominant textile producer in the eighteenth century (Pacey, 1990, p. 119).

The most important factors of industrial development are nonhuman energy and mechanics such as the water mill, the steam engine and clock-making. The water mill was first used in the Middle East, and then its use spread to Europe, China and India (Pacey, 1990, p. 10). After the sixteenth century, almost all nonhuman energy technologies and mechanics were invented and used by Europeans.

In terms of scientific achievements earlier on in time, India, China and Italy were relatively more advanced than other countries. According to Murray (2003, pp. 163–204), scientific developments in India and China stagnated after the fifteenth century. The combination of only a few innovations post 950 and the large and increasing populations resulted in no significant increase in the accumulated per capita S&T in China and India. Europe, in contrast, saw vast developments in the field of science after 1450.

The size and the growth in population explain the poor scoring performance of the East compared to the West. The East made key innovations; however, in per capita terms their performance was unimpressive. For example, accumulative S&T score in the thirteenth century was 13 and 6 for China and India, thus exceeding those of France (5), the Netherlands (3), the UK (4) and Germany (3). However, population size was much bigger in the East than in the West in the thirteenth century: China (100.5), India (85.5), France (13.3), the Netherlands (0.7), the UK (4.3) and Germany (7.5), where the numbers in parentheses are the population size in millions.

Human capital

Human capital is measured as the number of universities multiplied by the number of students enrolled in each university in 1850 – approximately the first year at which data on student enrolment become available.

The development of intellectual capital density is displayed in Fig. 5. The first significant advancement in education began in the West from the twelfth century, while the Middle group advanced two centuries later and the increase gained momentum in the seventeenth centuries fuelled by a marked increase in human capital in Russia, Turkey and Japan. In contrast, although the East had a higher level of human capital density than the West and the middle in the tenth century, it remained at a standstill for centuries and first advanced slightly after the fifteenth century. India was the country with the highest human capital level at the turn of the second millennium; however, the Muslim and Mongolian invasions destroyed the existing Buddhist education system.

Per capita income and the emergence of the Great Divergence

Three different income measures are considered here: Maddison's (1995, 2003) estimates of per capita GDP, urbanization (*Urban 1*) and the urbanization data constructed by Acemoglu *et al.* (2002) (*Urban 2*). The Urban 1 data are spliced with Maddison's purchasing power parity (PPP) per capita income in 1850 to ensure that the data are comparable across nations. Urban 1 is used to backdate Maddison's data from the year 1650 since data are not available from Maddison in the tenth century and between the twelfth and the sixteenth centuries. See Madsen and Yan (2013) for details and discussion on the construction of the data.

The three income data series are displayed in Fig. 6. The graphs give some intriguing insights. First, based on *Urban 1* and Maddison's data, the initial annual income level was around USD 450 in 1990 prices at PPP. Second,
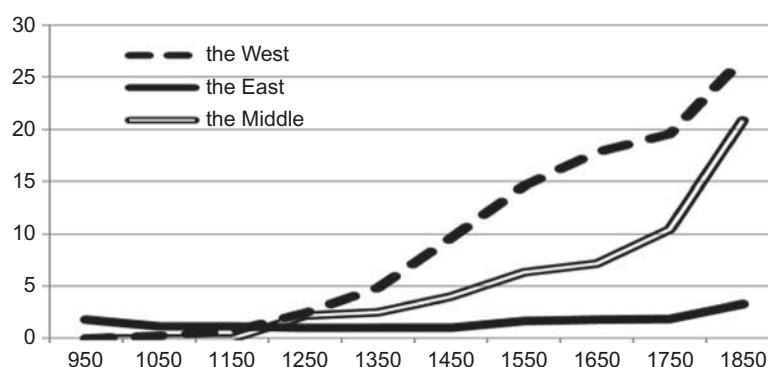
Fig. 5. Human capital
Notes: See the notes to Fig. 1. The vertical axis is an index with 1250 = 1. Human capital is measured as the number of university students divided by population.

per capita income stayed low during the whole period for the East, increased only slightly in the Middle group and increased several folds in the West. The West appears to have already escaped the Malthusian trap from around the year 1000. Thus, the graphs de-emphasize the importance of the First Industrial Revolution in the UK as the watershed of the Great Divergence. After the First Great Divergence between 1500 and 1350, the gap between east and west widened continually.

V. Empirical Estimates

The results of regressing restricted and unrestricted versions of Equation 1 are presented in Table 1. Consider first the results of regressing income against *Cul* (culture), *Con* (contracting institutions) and *Pro* (property right institutions) in the first three columns. The coefficients of *Cul, Con* and *Pro* are significant at the 10% level regardless of which income measure is used as the dependent variable, suggesting that they all have contributed to economic development over the past millennium. Furthermore, they jointly explain between 66% and 81% of the variance in per capita income.

Consider next the regressions in columns 4–6, in which per capita income is regressed on *S&T* and *HC* only. Both regressors are highly significant and explain a high fraction of the variance in per capita income, suggesting that both human capital and S&T are important determinants for economic development; a result that is not surprising given that almost all endogenous growth models are based on growth that is driven by R&D and human capital. What is, perhaps, more surprising is that significant events in the history of S&T and tertiary education explain productivity so well. An important factor here is that significant events
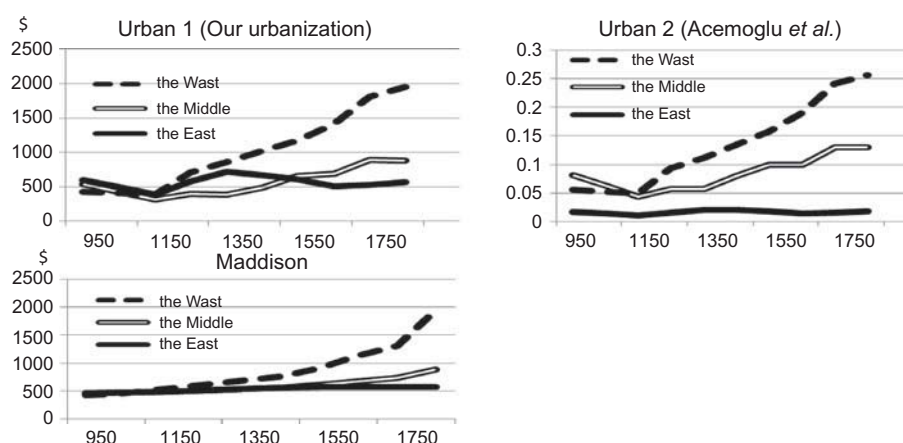
Fig. 6. Real per capita income
Notes: See the notes to Fig. 1. Urban 1 is the fraction of the population living in towns that exceed the size of 1000 and is adjusted to Maddison's (2003) 1850 per capita income data in 1990 USD in purchasing power parity. Urban 2 is the fraction of population living in cities of with more than more than 5000 inhabitants and is taken from Acemoglu *et al.* (2002). Maddison's (2003) data are backdated from 1650 using Urban 1.

Table 1. Parameter estimates of Equation 1

	1	2	3	4	5	6	7	8	9	10	11	12
Dependent variable	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$
ln *Cul*	0.47	0.60	0.52				0.32	0.33	0.33	0.48	0.44	0.44
	(2.88)	(3.61)	(4.89)				(1.49)	(1.70)	(2.26)	(2.44)	(2.29)	(3.03)
ln *Con*	0.40	0.36	0.21				0.29	0.19	0.12			
	(2.52)	(2.23)	(1.80)				(1.90)	(1.31)	(0.98)			
ln *Pro*	0.40	0.50	0.35				−0.01	−0.02	0.14			
	(2.40)	(2.82)	(2.49)				(0.56)	(0.15)	(1.20)			
S&T				0.22	0.25	0.14	0.18	0.21	0.10	0.19	0.22	0.11
				(4.82)	(4.87)	(6.15)	(3.70)	(3.91)	(3.98)	(4.09)	(4.30)	(4.70)
HC				662	752	846	−188	21.9	204	−34.8	114	206
				(3.22)	(3.71)	(5.63)	(0.48)	(0.06)	(0.69)	(0.09)	(0.32)	(0.76)
R^2	0.66	0.68	0.81	0.68	0.66	0.81	0.70	0.68	0.91	0.69	0.68	0.82

Notes: The numbers in parentheses are absolute *t*-values. Number of observations = 120. Country dummies and constant terms are included in all regressions but now shown. The *t*-ratios are based on robust SEs. Time-dummies are included in the regressions in the last two columns. Y_1 = Urban 1 (our urbanization data), Y_2 = Maddison's income data and Y_3 = Urban 2 (Acemoglu *et al*.'s (2002) urbanization data).

in S&T lead to subsequent supporting innovative activities that pushed the technology frontier out further.

The regressions in columns 7–9 show the results of unrestricted estimates of Equation 1. The coefficients of *Con* and *Pro* lose significance when *S&T* and *HC* are added to the model, indicating that *Con* and *Pro* influence productivity predominantly through S&T. *HC* is rendered insignificant when *Cul* is included in the estimates, which can be seen from the last three columns in Table 1 in which *Con* and *Pro* are removed from the regressions. The coefficient *Cul* is quite significant in these regressions, suggesting that *Cul* impacts on income independently of *HC* and *S&T* since the coefficients of *Cul* are almost the same as those in the regressions in the first three columns. The inclusion of *Cul* renders the coefficient of *HC* insignificant partly because of a high correlation between *HC* and *Cul* (the correlation coefficient is 92%), suggesting that secularity and individualism and human capital go hand-in-hand.

The results of the first-round regressions (Equations 2 and 3) are presented in Table 2. The regression in the first column of the table shows that *Cul, Con* and *Pro* are all significant determinants of *S&T*. The high value of the *F*-test of excluding restrictions suggests that *Cul, Con* and *Pro* are potentially good instruments for *S&T*. The regressions in the last two columns show that *HC* is almost entirely explained by *Cul*; thus, institutions did not play any significant role in the formation of the educational system during the past millennium.

The latter result squares with the discussion above that the increase in education was driven by secular states systems that encouraged individualism. It is also consistent with the argument of Galor and Moav (2006), who suggest that the rise of education was orchestrated by capitalists who saw an interest in enhancing education of the broad classes to enhance their profits. They argue that

physical and human capital increasingly became complements as the Industrial Revolution progressed, implying that increasing education enhanced the marginal productivity of capital and, consequently, the rate of profit. From this perspective, it follows that public provision of education was driven by the joint interests of capitalists and workers and that the quality of institutions did not play a direct role for education.

The second-round IV regressions are displayed in Table 3. Consider the regressions in the first three columns of the table in which productivity is regressed on the instrumented *S&T* and *HC*. Common for all regressions is that both *S&T* and *HC* are highly significant determinants of productivity through the channels of *Cul, Con* and *Pro*. Furthermore, the R^2s indicate that a high proportion of the variance in per capita income is explained by the model. The parameter estimates are insensitive to whether country dummies are included in the regressions (results without fixed effect dummies are not shown). This implies that the coefficients are predominantly identified by the

Table 2. Parameter estimates of Equations 2 and 3

Dependent variable	*S&T*	*HC*	*HC*
ln *Cul*	1.25(2.94)	0.0003(5.98)	0.0003(5.80)
ln *Con*	0.72(2.15)	0.0001(2.76)	0.0001(1.52)
ln *Pro*	2.46(3.28)	−0.0002(2.95)	
F(k, n−k)	19.4	43.2	53.5
R^2	0.72	0.79	0.77

Notes: See the notes to Table 1. *F(r, n−k)* is an *F*-test of exclusion restrictions and is distributed as *F(k, n−k)* under the null hypothesis, where *n* = 120 is the number of observations, *k* = 14/15 is the number of regressors including the constant term, and *r* = 2/3 is the number of restrictions.

Table 3. IV estimates of Equation 1

Dependent variable	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$	$\ln Y_1$	$\ln Y_2$	$\ln Y_3$
S&T	0.20(3.08)	0.23(3.23)	0.14(2.78)	0.11(1.93)	0.17(3.09)	0.12(1.83)
HC	1106(3.02)	1200(3.28)	1085(3.74)	774(1.58)	714(1.75)	1471(3.14)
R^2	0.62	0.56	0.81	0.84	0.78	0.84
Period	950–1850	950–1850	950–1850	1450–1850	1450–1850	1450–1850

Notes: See the notes to Table 1. CD indicates whether country dummies are included in the regression. *S&T* and *HC* are instrumented based on the regressions in the first two columns in Table 2.

time variation in the data and not so much by cross-country variations in the data.

The data period is limited to the post-1450 period in the regressions in the last three columns in Table 3. The parameter estimates remain significant in most cases and the coefficients are somewhat smaller, but not significantly smaller, than the full-sample estimates and probably reflect that the sample is on the small side when the sample is cut in half. The important issue here is that *HC* and *S&T* remain significant determinants of economic development in the second half of the sample period and, thus, reinforce that *HC* and *S&T* have been important determinants of economic development.

VI. Conclusion

Property rights institutions, contracting institutions and culture have been the key explanations of economic development and the Great Divergence between the East and the West; however, the validity of these theories in explaining the Great Divergence and economic development during the past millennium has not been tested. Using a millennium of data, this article has shown that property rights institutions, contracting institutions and culture have all been influential determinants of growth and development during the same period. Furthermore, it was shown that property rights institutions, contracting institutions and culture influenced productivity growth through the channels of S&T and human capital. The improved institutions and secularization of the West ensured prosperity the East failed to develop by maintaining a rigid caste system in India and the Imperial Examination in China.

Acknowledgements

References

Acemoglu, D. and Johnson, S. (2005) Unbundling institutions, *Journal of Political Economy*, **113**, 949–95.

Acemoglu, D., Johnson, S. and Robinson, J. (2002) Reversal of fortune: geography and institutions in the making of the modern world income distribution, *Quarterly Journal of Economics*, **117**, 1231–94.

Acemoglu, D., Johnson, S. and Robinson, J. (2005) The rise of Europe: Atlantic trade, institutional change, and economic growth, *American Economic Review*, **95**, 546–79.

Becker, S. O. and Woessmann, L. (2009) Was Weber wrong? A human capital theory of protestant economic history, Quarterly Journal of Economics, **124**, 531–96.

Davies, G. (1996) *A History of Money from Ancient Times to the Present Day*, University of Wales Press, Cardiff.

DeLong, J. B. and Shleifer, A. (1993) Princes and merchants: city growth before the industrial revolution, *Journal of Law and Economics*, **36**, 671–702.

Deng, G. (1999) *Maritime Sector, Institutions, and Sea Power of Premodern China*, Greenwood Press, Westport, CT.

Doepke, M. and Zilibotti, F. (2008) Occupational choice and the spirit of capitalism, *Quarterly Journal of Economics*, **123**, 747–93.

Galor, O. (2011) *Unified Growth Theory*, Princeton University Press, Princeton, NJ.

Galor, O. and Moav, O. (2006) Das human-kapital: a theory of the demise of the class structure, *Review of Economic Studies*, **73**, 85–117.

Galor, O. and Weil, D. N. (2000) Population, technology, and growth: from Malthusian stagnation to the demographic transition and beyond, *American Economic Review*, **90**, 806–28.

Hansen, G. D. and Prescott, E. C. (2002) Malthus to Solow, *American Economic Review*, **92**, 1205–17.

Heine, S. J. (2007) *Cultural Psychology*, W. W. Norton Company Inc., New York.

Huntington, S. P. (1996) *The Clash of Civilizations and the Remaking of World Order*, Simon & Schuster, New York.

Landes, D. S. (1998) *The Wealth and Poverty of Nations: Why Some Are So Rich and Some So Poor*, W. W. Norton Company Inc., New York.

Landes, D. S. (2006) Why Europe and the West? Why Not China?, *Journal of Economic Perspectives*, **20**, 3–22.

Langer, W. L. (1972) *An Encyclopedia of World History*, 5th edn., Houghton Mifflin Co., Boston, MA.

Lucas, R. E. (2002) *Lectures on Economic Growth*, Harvard University Press, Cambridge, MA.

Maddison, A. (1995) *Monitoring the World Economy 1820–1992: The World Economy: A Millennial Perspective*, OECD Publishing, Paris.

Maddison, A. (2003) *The World Economy: Historical Statistics*, OECD Publishing, Paris.

Mokyr, J. (2005) Long-term economic growth and the history of technology, in *Handbook of Economic Growth*, Aghion, P. and Durlauf, S. (Eds.), Elsevier, Amsterdam.

Murray, C. (2003) *Human Accomplishment: The Pursuit of Excellence in the Arts and Sciences*, *800 B.C. to 1950*, Harper Collins Publishers, New York.

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

Pacey, A. (1990) *Technology in World Civilization: A Thousand-year History*, Basil Blackwell Ltd., Oxford.

Pirenne, J. (1963) *The Tides of History, Volume II: From the Expansion of Islam to the Treaties of Westphalia*, George Allen, London & Unwin, E.P. Dutton & Co. Inc., New York.

Weber, M. (2002) (first published in 1905) 'Churches' and 'Sects' in North America, *The Protestant Ethic and the "Spirit" of Capitalism and Other Writings*. Available at http://www.archive.org/details/protestantethics00webe (accessed 27 April 2013).

Williamson, O. E. (1985) *The Economic Institutions of Capitalism*, The Free Press, New York.