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CULTURE, INSTITUTIONS AND THE WEALTH OF NATIONS

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ABSTRACT

We construct an endogenous growth model that includes a cultural variable along the dimension of individualism-collectivism. The model predicts that more individualism leads to more innovation because of the social rewards associated with innovation in an individualist culture. This cultural effect may offset the negative effects of bad institutions on growth. Collectivism leads to efficiency gains relative to individualism, but these gains are static, unlike the dynamic effect of individualism on growth through innovation. Using genetic data as instruments for culture we provide strong evidence of a causal effect of individualism on income per worker and total factor productivity as well as on innovation. The baseline genetic markers we use are interpreted as proxies for cultural transmission but others have a direct effect on individualism and collectivism, in line with recent advances in biology and neuro-science. The effect of culture on long-run growth remains very robust even after controlling for the effect of institutions and other factors. We also provide evidence of a two-way causal effect between culture and institutions.

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1. Introduction

One of the central questions in economics of growth and development is why disparities in income and development across countries are large and persistent. Despite decades of the quest to identify the fundamental forces explaining these differences, the question continues to puzzle the profession as the bulk of the differences are attributed to variation in productivity. It is widely perceived that the key conduit of economic growth and productivity enhancements is innovation that brings new goods and services to the economy as well as new ways to produce existing goods and services. In this paper, we argue theoretically and empirically that culture plays a key role in stimulating innovations and hence explaining long-run economic growth.

The idea that culture is a central ingredient of economic development goes back to at least Max Weber who, in his classical work "The Protestant Ethic and the Spirit of Capitalism," argued that the protestant ethic of Calvinism was a very powerful force behind the development of capitalism in its early phases. Weber saw culture as the driving force behind differences in economic development. His theory was in direct opposition to that of Karl Marx, who viewed culture as determined by the level of economic development and the economic interests of the various social classes. Although Landes (1998) and others have argued that culture played a fundamental role in explaining the wealth of nations, there has so far been little theoretical or empirical work examining the effect of culture on long-run growth and development.

We define culture as *the set of values and beliefs people have about how the world (both nature and society) works as well as the norms of behavior derived from that set of values*. This definition highlights that culture affects not only social norms but also economic behavior such as the propensity to save or to innovate and many other economic decisions such as fertility choices, investment in education, charitable contributions or the willingness to contribute to public goods. Culture is directly related to institutions in the sense that culture, like formal political or legal institutions as defined by North (1990), imposes constraints on individual behavior. Roland (2004) has argued that culture tends to be more slow-moving than political or legal institutions. Therefore, one can argue that culture might have an important effect on the choice of political and legal institutions itself. One can thus hypothesize that culture is a basic force underlying formal institutions and long-run growth.

In particular, we investigate theoretically and empirically one aspect of culture that may be relevant for long-run growth: the difference between *individualism* and *collectivism.* This distinction captures only one aspect of differences between cultures across the world but it is considered by cross-cultural psychologists to be the main dimension of cultural variation (see Heine, 2007) and it potentially has important economic effects. For example, Greif (1994, 2006) uses this distinction in his path-breaking work showing strong effects of culture on the economic outcomes.

We stress several main elements of the difference between individualism and collectivism in our theory. Individualism emphasizes personal freedom and achievement. Individualist culture therefore awards social status to personal accomplishments such as important discoveries, innovations or great artistic achievements. On the other hand, individualism can make collective action more difficult because individuals pursue their own interest without internalizing collective interests. Collectivism makes collective action easier in the sense that individuals internalize group interests to a greater degree. However, it also encourages conformity and discourages individuals from standing out. This framework implies that individualism should encourage innovation, everything else equal, but collectivism should have an advantage in coordinating production processes and in various forms of collective action.[1]

We put these ingredients in an endogenous growth model similar in spirit to models developed in Aghion and Howitt (1998). The model is standard in many respects. There is a competitive sector producing final goods using labor and intermediate inputs. Collectivist culture is assumed to give a competitive edge in the production of final goods, but so does a higher quality of intermediate inputs which is the result of innovation. Households own the firms producing intermediate inputs and derive utility not only from consumption but also from social prestige associated with producing a higher than average quality of intermediate products. This social prestige is stronger in individualistic cultures than in collectivist cultures. The quality of intermediate inputs is determined by the effort put into research, which in turn is a function of the monetary and social status rewards to innovation. The government can act in a predatory way by expropriating the rents from innovation. The main result generated by the model is that individualism leads to higher long-term growth via stronger incentives to innovate due to the culturally induced social rewards. This positive effect of social status rewards may offset the negative effects of predatory institutions. Although collectivism generates static efficiency gains, it has no growth effects.

We bring the model to the data by testing the effect of individualism versus collectivism on long-run growth. Since one can argue that culture might be endogenous to economic outcomes, finding a convincing causal effect of culture on long-run growth requires having a valid instrumental variable. Our main instrumental variable is a measure of genetic distance between the population in a given country and the population in the USA, which happens to be the most individualistic country in our sample. We know from Bisin and Verdier (2000, 2001) and others that parental transmission of culture is a fundamental determinant of the cultural values of individuals. Obviously, parents transmit their cultural values as well as their genes to their offspring. Populations that interbreed a lot should be genetically close and also culturally close because a very similar parental transmission mechanism is at work in both cases.

[1] There might also be an advantage of collectivism in terms of public good provision. We do not explore this aspect in this paper.

Therefore, measures of genetic distance can be seen as a proxy measure of differences in parental transmission of cultural values.

Since there are no identified genetic causes for why some countries became wealthier than others, genetic distance is very likely to satisfy the exclusion restriction. We strengthen the quality of our instrumental variable by using only "neutral" genetic markers (such as from mitochondrial DNA) which have no direct effect on genetic fitness. Thus, these markers are excellent instrumental variables (IVs) to correct for potential endogeneity of culture. In our baseline specifications we use genetic distance based on frequencies of blood types, which is the genetic information available for the largest number of countries. We aggregate genetic data from over 2,000 groups of population across the globe and construct country-level data using ethnic shares from Fearon (2003) and our data.

A potential problem with this identification strategy is that there may be multiple channels through which these neutral genetic markers are indirectly related to measures of economic performance. In an important check, we address this concern by using an alternative set of instrumental variables such as information on genes (e.g. the frequency of the S-allele in the serotonin transporter gene 5HTTLPR) that, according to recent advances in neuro-science, biology and epidemiology, appear to *directly* affect personality traits and, according to the recent literature in cross-cultural psychology, can explain the prevalence of collectivist culture. Although these data cover only a limited sample, this check confirms our causal analysis of culture's effects on long-run on growth.

Genetic distance data have been used by Guiso et al. (2009) and by Spolaore and Wacziarg (2009) in contexts that are close but different in various respects from the setting of our paper. Their data includes a broader set of genes but only for 42 groups across the world. Guiso et al. (2009) interpret genetic distance as proxying both cultural and genetic dissimilarity which is a source of a potential bias distorting people's propensity to trust each other and engage in trade. Spolaore and Wacziarg (2009) view genetic distance as a barrier to the diffusion of technologies as people that are more distant from each other will communicate less and thus benefit less from technological innovation.

Using genetic differences as an instrument for culture, we find a strong causal effect of individualism on income per worker, total factor productivity, and innovation as predicted by our theory. These results hold even when we exclude the Americas and Oceania where settler colonization played an important role. They also hold when controlling for measures of geographic distance, human capital, ethnic fractionalization, and other factors affecting growth. While we find an important role for the individualism-collectivism dimension of culture in determining long run growth, the measure of generalized trust which is also used as a cultural variable in various studies (or as a measure of social capital) does not have a robust effect on growth. Moreover, even after controlling for measures of institutions which were previously found (e.g., Hall and Jones, 1999, Acemoglu et al., 2001) to affect

long-run growth, culture continues to play a statistically significant and quantitatively important role, implying that culture has an effect on economic development that is independent of institutions. Furthermore, we find that there is a two-way causality between culture and institutions thus suggesting that institutions are in part determined by culture.

Our results are robust to the introduction of different types of controls and different measures of long-run growth as well as to using alternative instrumental variables (also used in Licht et al. (2007) and Tabellini (2008a)) based on linguistic properties of individualist cultures. In effect, we examine many other potential channels from the literature via which genetic distance might indirectly affect economic outcomes and we find that individualism still positively affects innovation and long-run growth after controlling for these other potential explanations. Together with the evidence of direct genetic effects on culture, these results unambiguously show that culture is empirically relevant for understanding economic development and should be included in theories of economic growth.

Our findings contribute to the nascent literature emphasizing the effects of culture on economic outcomes. Using a game theoretical approach, Greif (1994, 2006) studied the effects of individualist versus collectivist beliefs on contract formation, social stratification and the expansion of markets in the late Medieval trade in the Mediterranean. Bisin and Verdier (2000, 2001) examined the dynamics of intergenerational transmission of cultural preferences taking into account family choices of cultural transmission and effects of social environment. Tabellini (2008b) studied how the cultural transmission of values of cooperation can affect the form of institutions which in turn reinforces norms of cooperative behavior. Ashraf and Galor (2007) model the trade-off between non-conformism and conformism at different stages of development and provide a theory of why China was richer in the Malthusian stage of development but lagged behind in the industrialization stage. Doepke and Zilibotti (2008) developed a model to explain the cultural transmission of the values of the pre-industrial middle class (thriftiness, hard work) in the industrialization process as well as their eventual social success and the demise of the landed aristocracy. Fernandez, Fogli and Olivetti (2004), Fernandez and Fogli (2009) and Giuliano (2007) examined the effects of culture on fertility choices, family living arrangements and labor supply decisions. Barro and McCleary (2003) argue that economic growth is affected by religious beliefs (e.g., existence of hell and heaven). Knack and Keefer (1997) considered the effect of social capital on economic performance.[2] Aghion et al. (2008) found a negative correlation between trust and the level of regulation in societies. Guiso et al. (2003, 2009) examined the effect of trust on economic attitudes and international trade patterns, and Giuliano et al. (2006) investigated the link between geography, genetic

[2] Knack and Keefer (1997) use two instrumental variables for trust: *i*) the percentage of a country's population belonging to the largest "ethnolinguistic" group, and *ii*) the number of law students in 1963 as a percentage of all postsecondary students.

distance, transportation costs and economic variables. Tabellini (2008a) and Licht et al. (2007) provide evidence of a causal link from culture to institutions and Jellema (2009) provides evidence of a causal link from cultural practices to a society's basic achievements (such as the presence of writing, the wheel or money) documented for different cultures in Murdock's (1967) *Ethnographic Atlas*.

The rest of the paper is organized as follows. In section 2, we present our model. In section 3, we discuss the data used in our empirical analysis. In section 4, we present our empirical analysis of how culture can affect economic development. Section 5 contains a series of robustness checks. Sections 6 through 8 examine the interplay between culture, institutions and other factors. In Section 9, we investigate occupational choices of various ethnic groups in the USA. Section 10 makes concluding remarks.

2. The Model

Consider an economy producing two goods: a final good Y_t and a continuum of intermediate goods $x_{it}, i \in [0,1]$. The final good is produced by a competitive sector. Firms in this sector maximize profit

$$\Pi_t = Y_t - \int_0^1 p_{it} x_{it}\, di - w_t L_t \qquad (1)$$

subject to the production function constraint:

$$Y_t = \eta L_t^{1-\alpha} \int_0^1 (F_{it} x_{it})^{\alpha} di \qquad (2)$$

where i and t index variety and time, p_{it} is the price of x_{it}, w_t is the wage rate, F_{it} is the quality of intermediate good x_{it} , $L_t = \int_0^1 L_{it} di$ is aggregate labor input, and η is an efficiency parameter measuring how easy it is to combine intermediate inputs.

The parameter η is assumed to be a decreasing function of individualism in a given culture, i.e., $\eta = \eta(individualism)$ with $\eta' < 0$. This assumption captures three basic facts. First, combining inputs in production requires coordination of workers/units. Second, such coordination is easier to achieve in collectivist cultures that value harmony, conformity and team effort. Third, collectivist countries may be good at incremental innovations, which however have diminishing returns (i.e., one can relatively easily improve a cassette player in terms of design and functionality but one needs a radical innovation to create a CD player).

The common finding that blind copying of production techniques from collectivist culture to individualistic cultures led to poor results is consistent with this assumption. For example, Liker (2003) shows that teamwork and consensus building are among defining features of the Japanese way to run business. The attempts to copy the Japanese organization inside US automobile factories however failed to lead to catch up with the efficiency of Japanese automobile firms since American carmakers could replicate lean production but could not imitate Toyota's culture.

Other facts are consistent with our modeling of the trade-off between the innovation advantages of individualism and the production advantages of collectivism. The color TV was invented by RCA, an American firm, but Japan ended up making the best TV sets. Sony invented the walkman which was a great consumer success starting in the 1980s. However, the key invention of the compact cassette was made by Philips, a European firm. Similarly, Sony introduced the VCR but the technology was invented by the American company Ampex, which was unable to make its VCR affordable to households.

Intermediate goods are produced by entrepreneurial households who solve the following optimization problem

$$max \sum_{t=0}^{\infty} \beta^t \, (\ln C_{it} + \phi F_{it}/F_t) \tag{3}$$

subject to

$$F_{it} = \lambda(1 - L_t)F_{i,t-1} \tag{4}$$

$$C_{it} + A_{it} = (1 + r_t)A_{i,t-1} + \Pi_t + (1 - \tau)\pi_{it} + w_t L_{it} \tag{5}$$

$$\pi_{it} = p_{it}x_{it} - x_{it} \tag{6}$$

where $F_t = \int_0^1 F_{it} di$ is the average level of quality of intermediate goods in the economy, A_{it} is the amount of wealth, L_{it} is the fraction of labor supply devoted to producing the final goods, $1 - L_t$ is the fraction of labor supply devoted to research, and π_{it} is the profit from market power in producing an intermediate good. Total labor supply and the marginal cost of producing the intermediate variety are normalized to one for all households.

Equation (5) is the standard budget constraint. Equation (6) is the profit from producing an intermediate variety. Equation (3) is the value function showing that instantaneous utility is derived from consumption goods and from producing a superior than average quality of the intermediate good. The choice of the log utility function for consumption is standard in growth models. It makes the analysis easier as income and substitution effects offset each other and hence it is easy to construct a balanced growth path consistent with the Kaldor facts.

The term $\phi F_{it}/F_t$ in the utility function is meant to capture the social status reward from innovation. We assume that ϕ is increasing in the level of individualism, i.e., $\phi = \phi(individualism)$ with $\phi' > 0$. Hence, the social status reward for developing a better technology is higher in individualist cultures than in collectivist cultures. This assumption is consistent with numerous studies documenting that individualistic societies permit more innovation than collectivist societies by providing a higher status for individuals making important discoveries. In contrast, collectivist societies emphasize the role of collective effort and give less status reward to innovation. They reward conformity more and discourage individuals from standing out. There is also ample evidence (see Merton 1973) that social reward with heightened status is the most significant part of the total reward for scientists. Since

individual innovating entrepreneurs are small relative to the number of other entrepreneurs in the economy, we assume that an entrepreneur *i* takes F_t as given when deciding how much labor to allocate to research.

Equation (4) is the law of motion for the quality of the intermediate good. Quality is a positive function of the labor supply devoted to research. We assume a deterministic law of motion for simplicity only. We also assume that $\lambda(\cdot)$ is an increasing function of the labor supply devoted to research. To simplify the algebra, we assume that the elasticity $\varepsilon = (1 - L_{it})\lambda'(1 - L_{it})/\lambda(1 - L_{it})$ is constant in $1 - L_{it}$.

The government taxes profits of intermediate producers at rate τ and spends the receipts on (wasteful) consumption *G* which does not provide any utility to households.[3]

$$G_t = \tau \int_0^1 \pi_{it} di \tag{7}$$

Note that profit π_{it} is the only source of rents in this economy. The tax τ can also be interpreted as the level of expropriation risk, predatory behavior, lack of rule of law and institutional weakness more generally. We will henceforth interpret high levels of τ as predatory institutions expropriating rents generated by innovations.

The following equations are market-clearing conditions: equilibrium between aggregate demand and aggregate supply (8), equilibrium on the consumer goods market (9) and labor market equilibrium (10):

$$G_t + C_t = Y_t \tag{8}$$
$$C_t = \int_0^1 C_{it} di \tag{9}$$
$$L_t = \int_0^1 L_{it} di \tag{10}$$

Profit maximization in the final good sector implies that

$$\frac{\partial \Pi_t}{\partial L_t} = (1 - \alpha)\eta L_t^{-\alpha} \int_0^1 (F_{it} x_{it})^{\alpha} di - w_t = (1 - \alpha) Y_t / L_t - w_t = 0 \tag{11}$$
$$\frac{\partial \Pi_t}{\partial x_{it}} = \alpha \eta L_t^{1-\alpha} F_{it}^{\alpha} x_{it}^{\alpha-1} - p_{it} = 0 \tag{12}$$

Given the demand for the intermediate goods (12), the entrepreneurial households' optimality conditions are

$$C_{it}^{-1} = q_{it} \tag{13}$$
$$q_{it} = \beta(1 + r_{t+1}) q_{i,t+1} \tag{14}$$
$$\mu_{it} \lambda'(1 - L_{it}) F_{i,t-1} = q_{it} w_t \tag{15}$$
$$\mu_{it} = \phi F_t^{-1} + q_{it}(1 - \tau)\alpha^2 \eta L_{it}^{1-\alpha} F_{it}^{\alpha-1} x_{it}^{\alpha} + \beta\{\mu_{i,t+1} \lambda(1 - L_{i,t+1})\} \tag{16}$$
$$\alpha^2 \eta L_t^{1-\alpha} F_{it}^{\alpha} x_{it}^{\alpha-1} = 1 \tag{17}$$

[3] Our key qualitative results do not change if we allow government spending to be in the form of lump-sum transfers to households or to be an investment in public goods (e.g., infrastructure) which could raise η. Likewise, our key qualitative results do not change when we also allow status to be derived from the relative level of consumption.

Equation (13) is the standard relationship between consumption C_{it} and the marginal utility of wealth q_{it}. Equation (14) is the Euler equation for consumption. Equation (15) captures the instantaneous optimality condition for the allocation of labor to research and production activities. The return on labor has to be equalized between research and the final goods sector. Equation (16) is the Euler equation for the quality F_{it}, where μ_{it} is the shadow value of F_{it}. The value of a marginal increase in quality (the right hand side of equation on (16)) has three components. The first is the social status derived from developing a better technology (the first term on the left hand side). The second is the after-tax marginal revenue product from selling x_{it} units of the intermediate good of higher quality, and hence facing a larger demand from the final good sector. The third term captures the dynamic gains from better technology. By increasing the level of technology today an entrepreneur prepares the stage for future increases in the level of technology (see equation (4)). Equation (17) is the first order condition for the level of produced intermediate inputs. It states that the marginal revenue product from producing an additional unit of an intermediate input has to be equal to the marginal cost of producing this additional unit (recall that the marginal cost is normalized to one).

We can then derive the following result in the symmetric equilibrium:

Proposition 1: On a balanced growth path, the ratio of labor devoted to research $1-L$ to labor devoted to producing final goods L is given by:

$$\frac{1-L}{L} = \left\{\phi + \frac{(1-\tau)\alpha^2}{[1-\tau\alpha(1-\alpha)]}\right\}\frac{\varepsilon}{1-\beta}\frac{[1-\tau\alpha(1-\alpha)]}{(1-\alpha)} \qquad (18)$$

The ratio $\frac{1-L}{L}$ is increasing in ϕ, decreasing in τ, and is independent of η.

Proof: See appendix A.

Proposition 1 indicates that the share of labor devoted to research is increasing in the level of individualism (larger ϕ) and decreasing in the strength of predatory institutions (larger τ). Intuitively, a higher social status reward to innovation (larger ϕ) increases the allocation of labor to innovation. This culturally embedded incentive to innovate comes on top of the monetary reward to households via higher profits from innovation.

The fact that a high level of predatory institutions (larger τ) has a negative effect on innovation is less novel. Note that the latter effect is due to the fact that taxes are levied directly on the profit from intermediate goods so that τ directly affects the incentive to innovate. If taxation were on final output, its distortionary effect on innovation would be absent and would affect only levels of variables.[4]

[4] Note that profits in the final goods sector are equal to zero in equilibrium and cannot be a source of taxation. If labor income were taxed instead, there would be a *positive* effect of τ on innovation.

Note also that the cost of individualism captured by a low value of η only affects the level of output for any given average quality of intermediate input, but not the rate of innovation. Indeed, parameter η is not present in equation (18). The intuition is that a higher level of η will lead to the same proportional increase in the equilibrium level of intermediate output and equilibrium level of final output. Since returns to labor in the research and final good sector are equalized, changes in η do not affect the equilibrium level of allocation of labor between research and the final good sector.

The proposition also states that the negative effect of taxes on research effort becomes smaller when the status derived from research effort increases. In other words, high status rewards can counteract high tax rates because while income and wealth can be expropriated, social status cannot.[5] Thus even if a country has bad institutions, there can still be incentives to innovate if there is a high enough status reward to innovation. Clark (2007) argues against the view that institutions are important for long-run growth by pointing to the fact that institutions in England around the time of the Industrial Revolution were no better than in many developing countries today, whose institutional weaknesses are precisely cited as the main cause of their underdevelopment. Our model shows that the negative effect of predatory institutions on long-run growth can be offset by the social status reward to innovation under an individualist culture. Note also that $\lim_{\tau \to 1} \frac{1-L}{L} = \phi \frac{\varepsilon}{1-\beta} \frac{[1-\alpha(1-\alpha)]}{(1-\alpha)}$ and thus, if $\phi = 0$, no labor is devoted to research when institutions are fully predatory. In other words, if culture were absent in this model, predatory institutions would result in lack of innovation. With zero research effort, the growth rate in the economy is also equal to zero.

We now turn to the properties of the economy on the balanced growth path. First, from equation (4) on a balanced growth path we get that $\gamma_F \equiv \frac{F_t}{F_{t-1}} = \lambda(1-L)$ and consequently $\text{sgn}\left(\frac{\partial \gamma_F}{\partial \phi}\right) = \text{sgn}\left(\frac{\partial (1-L)/L}{\partial \phi}\right)$ and $\text{sgn}\left(\frac{\partial \gamma_F}{\partial \tau}\right) = \text{sgn}\left(\frac{\partial (1-L)/L}{\partial \tau}\right)$. Also observe that the level of total factor productivity (TPF) in the final goods sector is $TPF_t = \eta F_t^{\alpha}$ which varies over time only due to changes in F_t as we assume fixed cultural attributes. The results of Proposition 1 thus carry over to the growth rate of TFP, which will be higher for more individualist cultures and for lower levels of taxation.

Along a balanced path in a symmetrical equilibrium, $Y_t = \eta L^{1-\alpha} F_t^{\alpha} x_t^{\alpha}$. Using equation (17), we get $x_t = \alpha^2 Y_t$ so that $Y_t = (\eta \alpha^{2\alpha})^{1/(1-\alpha)} L F_t^{\alpha/(1-\alpha)}$ and therefore $\gamma_Y \equiv \frac{Y_t}{Y_{t-1}} = \gamma_F^{\alpha/(1-\alpha)}$. We conclude that the growth rate of output in the economy is determined by the growth rate of technology, which is pinned down by rewards to innovation. From equation (11), we have $\gamma_w \equiv \frac{w_t}{w_{t-1}} = \gamma_Y$. Given that

[5] One can argue that predatory institutions and individualist culture should not coexist easily and that under an individualist culture, there will eventually be strong pressures to reform political institutions so as to limit the executive powers of government. This would point towards a causal effect from culture to institutions. This observation is discussed in the empirical section. See also Roland (2004).

$x_t = \alpha^2 Y_t$ and equations (6), (7), and (8), we have $C_t = Y_t - G_t = [1 - \tau\alpha(1-\alpha)]Y_t$. Therefore, $\gamma_C \equiv \frac{C_t}{C_{t-1}} = \gamma_Y$ and income, consumption and wages grow at the same rate. From (14) and (13), we have $r_t = (\frac{C_{t+1}}{C_t})/\beta - 1 = \gamma_C/\beta - 1$ and thus the interest rate is constant. Finally, note that the value of capital, which is equal to the present value of profits generated in the intermediate goods sector, is proportional to output and hence the capital-output ratio is constant on the balanced growth path. These last results show that the model fits the Kaldor facts about economic growth.

Our model also sheds light on possible episodes of reversal of fortune. In the Malthusian stage when labor is allocated almost exclusively to production of final goods (food, clothes, etc.) and virtually no labor is allocated to innovation, collectivist societies, which enjoy a greater level of coordination and thus a larger value of η, may be richer than individualistic societies. This prediction is consistent with, for example, China being richer, more urbanized and more densely populated than much of Western Europe in 1500. However, as the economy exits the Malthusian stage, the collectivism-individualism difference across cultures starts to play a new and different role. Since individualistic societies grow faster than collectivist societies outside the Malthusian stage, countries with an individualistic culture eventually become richer and thus one may observe a "reversal of fortune", i.e. those countries catch up and become more affluent than collectivist countries which initially had a higher level of development.[6]

While there is a trade-off between the benefits and costs of individualism and collectivism, in our model the benefits of individualism affect the output *growth rate* while the costs of individualism affect the *level* of output.[7] Although there is a strong argument for the advantages of individualist culture for long-run growth via cultural incentives to innovate, one could think of other models where collectivism might affect not only the static output level but also long-run growth. For example, in a collectivist culture there might be better public good provision which could be complementary to private innovation, a feature that is not present in this model. We need solid empirical evidence to find out which cultural features have more favorable effects on long-run growth, and below we present some empirical evidence for the importance of the individualism-collectivism dimension of culture. In any case, our model has the advantage of *i*) spelling out precise mechanisms through which culture may affect long-run growth, and

[6] We replicated the exercise in Acemoglu et al (2002) with our measure of individualism instead of institutions and we find that culture is not robustly correlated with urbanization and population density in 1500. The estimated effects of culture do not change even after controlling for initial conditions and the level of institutions (i.e., we reproduce Table VIII in Acemoglu et al (2002)). Results are available upon request.

[7] Using information on the behavior of foreign firms operating in China, Huang et al. (2010) compare foreign firms owned by ethnic Chinese and firms owned by non-ethnic Chinese. Huang et al. find that firms run by ethnic Chinese have an initial advantage operating in China but that they have a dynamic disadvantage because they invest less in technology and human capital than firms owned by non-ethnic Chinese. These results are consistent with our model if non-ethnic Chinese owned firms are from more individualistic cultures.

ii) making the distinction between cultural features that affect the level of output and those that affect the long-run rate of growth.[8]

To summarize, the endogenous growth model derived in this section can match the basic Kaldor facts on economic growth but predicts importantly that a higher level of individualism in a country's culture should lead to higher long-run growth because of the social status reward attached to innovation, an effect that is independent of the monetary reward to innovation.

3. Data

A key question for our empirical analysis is how to measure individualism. A well-known measure of individualism (and other cultural dimensions) at the country level was developed by Hofstede (2001) who used surveys of IBM employees in about 30 countries. To avoid cultural biases in the way questions are framed, the translation of the survey into local languages was done by a team of English and local language speakers. With new waves of surveys and replication studies, Hofstede's measure of individualism has been expanded to almost 80 countries.[9] In a nutshell, the individualism score measures the extent to which it is believed that individuals are supposed to take care of themselves as opposed to being strongly integrated and loyal to a cohesive group. Individuals in countries with a high level of the index value personal freedom and status, while individuals in countries with a low level of the index value harmony and conformity. Hofstede's index as well as the measures of individualism from other studies use a broad array of survey questions to establish cultural values. Factor analysis is used to summarize data and construct indices. In Hofstede's analysis, the index of individualism is the first factor in work goal questions about the value of personal time, freedom, interesting and fulfilling work, etc. This component loads positively on valuing individual freedom, opportunity, achievement, advancement, recognition and negatively on valuing harmony, cooperation, relations with superiors.[10] Although Hofstede's data were initially collected mostly with the purpose of understanding differences in IBM's corporate culture, the main advantage of Hofstede's measure of individualism is that it has been validated in a number of studies.[11] For example, across various studies and measures of individualism (see Hofstede

[8] Much of previous research on culture's effects on economic outcomes (e.g., Knack and Keefer (1997) and Guiso et al. (2009)) focused on trust, social capital and similar concepts that emphasize collective effort. In contrast, we stress the individual's freedom from the collective in his or her aspirations. Our finding that individualism leads to higher development does not contradict previous results on the importance of trust, social capital, etc. for economic development. One can view our results as emphasizing growth effects, while previous studies as highlighting the level effects.

[9] The most current version of the data is available at http://www.geert-hofstede.com/.

[10] Appendix C provides the list of questions. See Hofstede (2001) for more details.

[11] See for example Hoppe's (1990) study among members of parliaments, labor and employer leaders, academics and artists in 18 countries, Shane's (1995) study across 28 countries for international companies other than IBM, Merrit's (2000) study on commercial airline pilots in 19 countries, de Mooij's (2003) survey among consumers in 15 European countries and van Nimwegen's (2002) research among employees of ABN-AMRO bank in 19 countries.

(2001) for a review) the United Kingdom, the USA and Netherlands are consistently among the most individualistic countries, while Pakistan, Nigeria and Peru are among the most collectivist. Figure 1 represents a world map of Hofstede's individualism scores.

We also use the data base established by cross-cultural psychologist Shalom Schwartz, built with the purpose of establishing a core set of values that have a common cross-cultural meaning. Schwartz (1994) gathered survey responses from K-12 schoolteachers and college students for a total of 195 samples drawn from 78 nations and 70 cultural groups between 1998 and 2000. Each sample generally consists of 180-280 respondents for a total of over 75,000 responses. Schwartz's value survey consists of 56-57 value items that ask respondents to indicate the importance of each as "a guiding principle in *my* life." Schwartz believes that it is crucial to identify what he calls *value types* which reflect the type of motivational goals that each individual expresses. As such, he identifies a list of 10 such value types. These value types are intended to be items that have an equivalent meaning across cultures. These value types have been used to create cultural mappings. In particular, similarly to the individualistic-collectivist dimension of cultures in Hosftede (2001), Schwartz differentiates cultures along the autonomy and embeddedness dimensions. In autonomous cultures, people are viewed as autonomous, bounded entities. They are encouraged to cultivate and express their own preferences, feelings, ideas, and abilities, and to find meaning in their own uniqueness by pursuing their own ideas and intellectual directions independently (intellectual autonomy) and by pursuing positive experiences for themselves (affective autonomy). In contrast, meaning in life for people in embedded cultures comes largely through social relationships, through identifying with the group, participating in its shared way of life, and striving toward its shared goals. Embedded cultures emphasize maintaining the status quo and restraining actions that might disrupt in-group solidarity or the traditional order. Countries that score high on embeddedness also score low on intellectual and affective autonomy. Although measures of individualism in Hofstede and Schwartz are based on different sources and indentifying procedures, the correlation between Hofstede's individualism score and Schwartz's embeddedness and autonomy scores is fairly high, ranging between 0.55 and 0.65. The key advantage of using Hofstede's measure relative to Schwartz's measures is that Hofstede's measure of individualism is one-dimensional while Schwartz uses three (correlated) variables.

As we will discuss later in greater detail, the causality between individualism and economic outcomes can flow in both directions. For example, our model suggests a causal effect of culture on growth where more individualist countries may be wealthier because individualism fosters innovation. On the other hand, a more affluent economy can support a more individualist culture. Indeed, there is a long tradition in social sciences starting with Marx claiming that economic development affects a country's culture.

To address this potential endogeneity problem, we use a measure of genetic distance between people in different countries as an instrumental variable (IV) for individualism. To the extent that culture is transmitted mainly from parents to children, so are genes. Thus, genetic markers can be used as a proxy for cultural markers and this instrumental variable should be seen as a proxy measure of cultural transmission.

The genetic data originate from Cavalli-Sforza et al. (1994) which provides measured genetic markers for roughly 2,000 groups of population across the globe. These data contain allele frequencies (alleles are variants taken by a gene) for various ethnic groups. Since we want to eliminate the feedback from economic outcomes to genetic variation, we focus on neutral genetic markers which are not related to evolutionary fitness. Furthermore, as discussed in Cavalli-Sforza et al. (1994), genetic variation for countries not affected by massive colonization since 1500s was largely determined during the Neolithic migration of early humans thousands of years ago. These markers are thus potentially excellent instrumental variables.[12]

Although there are many genetic markers potentially useful for our analysis, our instrument is the Euclidian (benchmark) or Mahalanobis distance between the frequency of blood types in a given country and the frequency of blood types in the USA, which is the most individualistic country in our sample.[13] The Euclidian distance measure is displayed in Figure 2.[14] Using the frequency of blood types is attractive because, apart from being neutral genetic markers, the frequency of alleles determining blood types is the most widely available genetic information and thus we can construct the most comprehensive (in terms of country coverage) measure of genetic distance.[15] Another key advantage of utilizing frequency of blood types is that we can exploit alternative sources of information (e.g., Red Cross) about frequency of blood types to corroborate our data from DNA studies.[16] In a series of robustness checks, we also employ

[12] Note that the genetic and cultural data were collected predominantly in 1950s through the early 1970s. On the other hand, our measures of economic outcomes are generally from the 21st century. This difference in the timing of explanatory/instrumental variables (i.e., culture and genetic variables) and dependent variables (i.e., economic outcomes) helps us to alleviate certain types of endogeneity (e.g., recent strong migration of skilled workers).

[13] The Mahalanobis distance between a vector x and y picked from distributions X is $d_M(x,y) = ((x-y)'\Sigma_X^{-1}(x-y))^{1/2}$ where Σ_X is the covariance matrix for X. In our contexts, $\Sigma_X = \text{var}([\bar{f}_{A,c} \ \bar{f}_{B,c}])$ where A and B denote blood types and c indexes countries. We obtain the Euclidian distance $d_E(x,y)$ when Σ_X is set to the identity matrix. Thus, the Euclidian distance between country c and the USA is equal to $d_E(c,USA) = \{(\bar{f}_{A,USA} - \bar{f}_{A,c})^2 + (\bar{f}_{B,USA} - \bar{f}_{B,c})^2\}^{1/2}$.

[14] Appendix E shows the geographical distribution of genetic distance relative to the UK. The advantage of using distance relative to the UK is that UK's population is genetically more homogenous and that UK is often described as the cradle of individualism and the Industrial revolution.

[15] In contrast, Spolaore and Wacziarg (2009) use genetic information for 42 ethnic groups while we use the full spectrum of genetic information for 2,000 groups. We complement genetic information from Cavalli-Sforza *et al.* (1994) with Mourant *et al.* (1976) and Tills *et al.* (1983).

[16] In some cases, we have information on the distribution of phenotypes of blood groups. In these cases, we convert phenotypes into genotypes using the Bernstein formula.

aggregate measures of genetic distance constructed in Cavalli-Sforza *et al.* (1994) and used in Spolaore and Wacziarg (2009).

Since the genetic data are available at the level of ethnic groups while our analysis is done at the country level, we have aggregated genetic information using ethnic shares of population from Fearon (2003).[17] Specifically, if we define blood frequency f_{bec} for blood type b and ethnic group e in country c, then the country level blood frequency for type b is calculated as $\bar{f}_{bc} = \sum_e s_{ec} f_{bec}$ where s_{ec} is the share of ethnic group e in the population of country c.

We also use other genetic and epidemiological data for which the recent literature in cross-cultural psychology has found a direct link between frequencies of particular genes and culture. A first set of data are from Chiao and Blizinsky (2009) who document a strong correlation between collectivism and the presence of a short (S) allele in the polymorphism 5-HTTLPR of the serotonin transporter gene SLC6A4 in 30 countries. This allele is known in psychology to put individuals at greater risk for depression when exposed to life stressors. The mechanism linking individual behavior and culture is that a collectivist culture protects individuals from these risks by embedding them more strongly in communities with strong social links thus providing strong psychological support networks. We also use data on 23 countries from Way and Liebermann (2010) showing that collectivism is also strongly correlated with the G allele in polymorphism A118G in the μ-opoid receptor gene that leads to higher stress in case of social rejection. Way and Liebermann (2010) reason that collectivist culture can be seen as providing psychological protection from social rejection.[18] Finally, we use epidemiological data put together by Fincher et al. (2008) for 73 countries on pathogen prevalence.[19] Given a strong correlation between pathogen prevalence and collectivism, Finch et al. argue that stronger pathogen prevalence pushed communities to adopt more collectivist values emphasizing tradition, putting stronger limits on individual behavior, and showing less openness towards foreigners. Collectivism is thus understood as a defense mechanism created to cope with greater pathogen prevalence.

In addition to DNA-based IVs, we also employ an instrumental variable based on linguistic peculiarities of individualistic cultures. Specifically, in languages where the pronoun cannot be dropped in a sentence there is a greater differentiation between the individual (first person of the singular) and the community, whereas in languages where pronouns can be dropped there is less emphasis on such a differentiation. Kashima and Kashima (1998) and others document that prohibition of pronoun drop is

[17] Whenever Fearon's (2003) data were too crude, we used additional sources of information. For example, Fearon (2003) reports on the share of whites in the USA. We used a variety of sources about migration patterns and information on ancestors to split whites into British, German, Italian, Polish, etc. Details are available upon request.
[18] We are very grateful to Romain Wacziarg for having drawn our attention to this study and to this literature.
[19] Fincher et al. (2008) use 9 pathogens: leishmanias, trypanosomes, malaria, schistosomes, filariae, leprosy, dengue, typhus and tuberculosis.

strongly correlated with individualism.[20] This instrumental variable was used in Licht et al. (2007), Tabellini (2008a) and other papers studying the effects of culture on socioeconomic outcomes.

The sources of data on economic outcomes are standard. We take income per worker data from the Penn World Tables (version 6.3). To control for differences in factor endowments, we use data on total factor productivity (TFP) from Hall and Jones (1999) and Jones and Romer (2010). These two measures have been widely used as measures of long-run growth in the literature.

Since the main conduit of individualism's effect on growth in our theoretical model is innovation, we proxy for the intensity of innovations with the *innovation performance index* and the *log patents per million population* from Economist Intelligence Unit (2007, 2009; henceforth EIU). EIU constructs *patents per million population* as the sum of patents granted to applicants (by residence) from the 82 economies by three major government patent offices—the European Patent Office, the Japanese Patent Office, and the US Patent and Trademark Office. The data are averaged over 2002-2007. Although the use of patent data has a number of problems, this is the single best available measure for innovation outputs. The *innovation performance index* incorporates information on patents and alternative indicators of innovation output such as royalty and license fee receipts as a percentage of GDP, high-technology manufacturing output per head, high-technology services output per head, etc. As documented in EIU (2007, 2009), these measures are highly correlated with other proxies for innovation performance such as citations from scientific and technical journals, UNIDO estimates of the share of medium- and high-technology products in a country's manufacturing output and its manufacturing exports, and the results of a survey question from the World Economic Forum's Global Competitiveness Report that asked respondents to rate the extent to which companies were adept at, or able to absorb, new technology. Thus, these measures of innovation are likely to capture salient features of innovative activities across countries.

4. Baseline econometric specification and results

Our theoretical model predicts that more individualistic countries should be more affluent since individualism encourages innovation. Consistent with this prediction, Figure 3 shows that countries with more individualistic cultures enjoy higher levels of income, TFP and rates of innovation. Also, innovation is strongly positively correlated with income and TFP (Figure 4). These raw correlations, some of which were reported earlier in Hofstede (2001), are informative but they do not control for other factors and cannot be interpreted as causal relationships.[21]

To address these concerns, we employ the following basic econometric specification:

[20] For example, English does not allow dropping pronouns and it is the only language which capitalizes "I".
[21] Note that Southeast Asian tiger economies have high innovation rates and a relatively low index of individualism. This might be explained by the fact that research effort in these countries was mostly directed and financed by the government rather than arising spontaneously.

$$Y_i = \alpha C_i + \beta X_i + e_i \quad (19)$$

where i indexes countries, Y_i measures an economic outcome (e.g., log income per worker), C_i is a measure of culture, X_i is a vector of control variables and e_i is the error term.[22] The vector X_i includes commonly used controls for geography such as countries' longitude and latitude and a dummy variable for being landlocked. In addition to this standard set of controls, we include the percentage of Muslims in a given country to ensure that our results are not driven by a Muslim effect. Finally, X_i includes a set of dummy variables for continents.

As discussed above, genetic distance is our main instrumental variable to deal with reverse causality in equation (19). Figure 5 shows that countries with more individualistic cultures are genetically less distant from the US. The converse applies to countries with collectivist cultures. At the same time, countries with individualist and collectivist cultures are genetically distant from each other. The strong negative correlation between genetic distance (computed relative to USA, which has a highly individualistic culture) and individualism suggest that genetic distance may be a strong instrument.

Table 1 (Panel A) presents the OLS and IV estimates for the basic specification (19) where the dependent variables is log income per worker. Irrespective of whether we use controls and/or continental dummies, the coefficient on individualism is positive and significant. Specifically, a one standard deviation increase in individualism (say from the score of Venezuela to Greece, or from that of Brazil to Luxemburg) leads to 60 to 87 percent increase in the level of income, which is a large effect. The magnitude of the effect is roughly similar regardless of whether we introduce continental dummies and control variables. The IV estimates are slightly larger than the OLS estimates which probably suggests that the instrumental variable corrects for measurement errors and thus for the attenuation bias. Note that the first stage fit is strong in all columns and thus our results are not likely to suffer from problems associated with using weak IVs. Overall, these empirical results confirm the insights from our theoretical model and strongly suggest that the advantages of individualism outweigh its disadvantages relative to collectivism, and thus that individualism has a positive causal effect on the wealth of nations.[23]

From Hall and Jones (1999) and others, we know that the main factor behind differences in incomes is differences in the level of TFP across countries. In Table 1 (Panels B and C), we replicate our estimation of equation (19) when log TFP rather than log income per worker is the dependent variable. Again, we find strong and positive effects of individualism on productivity. A one standard deviation increase in the individualism score leads to a 17 to 27 percent increase in TFP. Note that the effect on

[22] In light of the critique of regressions based on growth rates (see e.g. Easterly et al (1993), Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999)), we focus on levels of income and other economic variables. In Appendix Table 2, we report results for growth rates over long periods of time based on data constructed in Maddison (2003).

[23] Although we use GDP per worker in 2000 in our baseline regressions, the results are very similar when we use the level of income from other decades.

TFP is smaller than the effect on income. This should be expected since differences in income per worker are due to differences in factor accumulation on top of differences in TFP.

Finally, we perform a more direct test of our theory by regressing measures of innovation on individualism (Table 1, Panels D and E). With and without controls, we see a strong robust effect of individualism, confirming the channel going from individualism to innovation and to income and productivity. Importantly, this finding highlights that although countries may achieve a larger level of total factor productivity via diffusion of existing knowledge and willingness of people in individualistic cultures to accept new goods/services as well as new ways of producing goods/services, individualism affects the creation of knowledge. In other words, individualism not only helps countries to approach to the technological frontier, it also pushes the frontier.

To assess whether the magnitudes of individualism's effect on economic outcomes are plausible, consider differences in economic outcomes in Italy's South and North, which is a prime example of the importance of cultural effects. In his classic book, Putnam (1994) argues that the North of Italy is culturally similar to Switzerland and Germany (the individualism score for these countries is equal to 68) while the South of Italy is similar to Spain (the score is 51). Our baseline regression results (column (8) in Table 1) predict that the difference in income per capita and TFP between Italy's North and South should be $0.034 \times 17 \approx 58\%$ and $0.020 \times 17 \approx 34\%$ respectively. According to Italy's statistical office income per capita in Southern regions is about 50% smaller than income per capita in Northern regions. Using the methods developed in Hall and Jones (1999), Aiello and Scoppa (2000) estimate the difference in TFP across two regions to be 27%. Thus predictions made from our cross-country regression are remarkably similar to within-Italy variation in incomes and productivity and validate our parameter estimates.

One may be concerned that our results are driven by a set of countries which for historical reasons were disadvantaged in economic development. Likewise, if our theory explains income differences at the global scale, it is reasonable to expect our theory to explain income differences within continents where countries may be more similar. These concerns are important because, for example, Albouy (2008) argues that the theory of institutions as the fundamental cause of economic development has weak or no empirical support when tested within continents. More generally, we are interested in whether our results survive when we consider more homogenous countries.

Table 2 reports regression estimates for each continent separately and for OECD economies. By and large, we confirm our basic finding that individualism leads to higher income per worker. Even if we focus on OECD countries or relatively more developed countries in Europe and the Americas, individualism can explain a large fraction of variation in income. Although the coefficient on individualism is somewhat smaller for the subsample of developed countries, it does not necessarily mean that culture is less important. It simply reflects the fact that variation in incomes and individualism is

more compressed in these countries and thus, with less variation in our key variables, measurement errors can have a stronger attenuation bias. This observation can also explain why the estimated coefficients are the largest for Africa where countries are extremely diverse in the level of development and individualism. For example, Morocco has the highest individualism scores (same level as Argentina), excluding South Africa, whereas Nigeria, Sierra Leone and Ghana have the lowest scores (same as China, Singapore, Thailand and Vietnam).[24] Most importantly, to eliminate concerns that our results reflect migration patterns from the colonization era in which the Americas and Oceania were settled by European immigrants, column (5) gives result for Africa, Europe and Asia where there was no massive migration of European settlers. Note that the coefficient in the IV estimation is even larger than in the results from Table 1 where the Americas and Oceania were included. In summary, our results are not driven by a particular continent and the effect of culture is significant also within continents. We can also rule out that our results reflect only migration patterns of European settlers in the colonization period of the last 500 years.

To summarize, we have shown empirically a strong causal effect from culture to long-run growth and the level of innovation. These findings are consistent with the predictions of our theory indicating that more individualist cultures should lead to more innovation and hence greater economic development.

5. Robustness checks and direct genetic/epidemiological effects on culture.

Table 3 reports results for a series of robustness checks. In column (1), instead of using as instrument for culture the Euclidian distance of frequency of blood types A and B in a country relative to the USA, we use the Mahalanobis distance which takes into account the covariance between variables when calculating the distance. In column (2), we use the frequency of blood types A and B separately so that there are two instrumental variables instead of one and we do not need to construct a distance measure to a particular country. In column (3), we use the Euclidian distance for both blood types but this time relative to the UK rather than the USA. In column (4), instead of using the Cavalli-Sforza et al. (1994) data on blood types, we use the data from the Red Cross. Although the Red Cross data are available for a smaller set of countries, it does not require us to use ethnic shares in population to aggregate genetic data to the country level. In columns (5) and (6), we use the genetic distance data used by Spolaore and Wacziarg (2009). Their data also come from Cavalli-Sforza et al. (1994) data. In contrast to our blood distance, Spolaore and Wacziarg (2009) take genetic distances calculated by Cavalli-Sforza et al. (1994) for a larger set of genes. However, with a larger set of genes, the distance can be computed for only 42 subgroups of the world population. Similar to our approach, Spolaore and Wacziarg (2009) aggregate ethnic data to the

[24] Hofstede's score for South Africa is based on the sample of whites. None of our results change in any important way when we exclude South Africa.

country level using shares of ethnic groups in country populations. Column (7) uses the prohibition of pronoun drop as an instrument whereas in column (8), it is used as an instrument on top of blood distance. We find similar results in these robustness checks aimed at assessing the sensitivity to using alternative measures of genetic or linguistic distance between cultures.

In our analysis so far, we have used the genetic distance as a proxy for cultural transmission. In Table 4, we report regressions with genetic and epidemiological instrumental variables from the recent cross-cultural psychology literature. As we discussed in section 3, these alternative instrumental variables have a direct effect on individualism/collectivism as the factors captured by these instrumental variables are conducive for emergence of collectivist cultures. Column (1) presents results for the instrumental variable regression of log output per worker on individualism where the instrument is the frequency of the short (S) allele in the polymorphic region 5HTTPLR of the serotonin transporter gene (SLC6A4). Even though the data are available only for 30 countries, the first stage fit is remarkably strong and we continue to find a strong effect of culture on income. The instrumental variable in column (3) is the frequency of the G allele in polymorphism A118G in the μ-opoid receptor gene (data are from Way and Lieberman (2010)) that leads to higher stress in case of social rejection. The results stay significant despite the low number of observations (23). Column (5) uses as instrument a measure of historical pathogen prevalence from Fincher et al. (2008). We prefer the historical pathogen prevalence index because it uses data from old atlases of infectious diseases which were compiled before the epidemiological revolution in treating infectious diseases. Again, we find a strong effect of culture on economic development.

Note that the magnitudes of the effect for all alternative instrumental variables are similar to the magnitude we find for the baseline specification which uses blood distance as an instrumental variable. Furthermore, when we combine alternative instrumental variables with the blood distance (columns 2, 4, and 6 in Table 4), overidentifying restriction tests cannot reject the null of instrumental variables being correctly excluded at any standard significance level. This result not only helps us to justify our exclusion restrictions but also clarifies the role of genetic distance in our exercise. Specifically, Spolaore and Wacziarg (2009) interpret genetic distance as a proxy for barriers to the diffusion of knowledge. In contrast, we interpret genetic (blood) distance as a proxy for cultural distance between populations. For the former interpretation, we should not expect that genetic and epidemiological instruments with direct effect on culture should yield estimates of culture's effect on economic outcomes similar to estimates based on genetic distance as an instrumental variable. On the other hand, for the latter interpretation to be correct, this alternative set of instruments should lead to similar estimates. Thus, the overidentifying restriction tests fail to reject the null that our interpretation is correct. These results together with our benchmark results clearly show a causal link from culture to economic development.

Finally, we explore in Table 5 if our basic results are sensitive to alternative measures of individualism. Specifically, we re-run specification (19) using Schwartz's embeddedness and autonomy measures as the dependent variables. Again, we find that individualism leads to higher levels of income.

6. Culture and institutions

We now turn to the relationship between culture and institutions in the context of long-run growth. We have documented a strong causal effect of culture, along the individualism-collectivism dimension, on log income per worker and TFP. Acemoglu et al. (2001) and others on the other hand argue that there is a causal effect of institutions on long-run growth. This raises two interconnected questions. First, does culture have an effect separate from the effect of institutions? This question is important because culture and institutions are correlated and it is possible that culture simply captures the effect embodied in institutions. Second, what is the relative importance of culture and institutions in explaining economic development? This question aims to assess the quantitative importance of culture and institutions once they are considered simultaneously as factors determining economic development.

We already saw from the results of Table 2 that there was a robust and strong effect of culture on growth if we exclude the Americas and Oceania where there has been very strong migration from European settlers. However, it is useful to analyze the effects of culture when we introduce institutions in the empirical analysis. We augment the baseline econometric specification (19) with the average protection against expropriation risk between 1985 and 2009, a measure of institutions used by Acemoglu et al. (2001):[25]

$$Y_i = \alpha C_i + \gamma I_i + \beta X_i + e_i \qquad (20)$$

where I_i is a measure of institutions in country i. Estimates of equation (20) (see Table 6) show that culture (individualism) remains significant even after including institutions in the OLS and IV specifications. Culture thus has a robust effect that is separate from institutions. Furthermore, even after controlling for protection against expropriation risk, the causal effect of individualism is large. A one standard deviation increase in the individualism score leads to a 47 to 73 percent increase in the level of income without instrument for institutions and to a 56 to 77 percent increase in the level of income when the institutional variable is instrumented using the settler mortality variable as in Acemoglu et al. (2001).[26]

Note that the size of the effect of culture on income remains fairly robust to including institutions and other controls. We cannot say the same for the institutional variable which is rather sensitive to including controls and individualism in the regression. For example, with no controls and without culture

[25] Acemoglu et al. (2001) use the average of the same data between 1985 and 1999.
[26] We find similar results when we use long-run growth rates. See Appendix Table 2.

(column (2) in Panel A of Table 6), a one standard deviation increase in protection against expropriation risk raises the level of income by 84 percent as can be seen in the OLS specification in panel A of Table 6. Once we introduce controls and individualism (column (5) in Panel A of Table 6), the effect is reduced by nearly one half. Note also that the coefficient on institutions does not increase in the IV estimation (panel B) once culture is included but rather tends to decrease, which was not the case in Acemoglu et al. (2001). Note also that the effect of institutions ceases to be statistically significantly different from zero when we apply the correction for settler mortality as in Albouy (2008) and include culture in the regression (columns 8 and 9 in panel B). We observe similar results (not reported) when we use innovation or TFP (rather than income per worker) as the dependent variable.[27,28]

In brief, there is an important contribution of culture to economic development that is independent of institutions. In terms of magnitudes, culture explains income differences across countries at least as much as institutions.

7. Genetic distance and other channels for growth

Genetic distance may be correlated with variables other than culture which might affect development. Although this is not a concern for our results in Table 4 where we use genetic and epidemiological variables with a direct effect on culture as instrumental variables, it is important to rule out the influence of other potentially important determinants of long-run growth for our baseline approach of using genetic distance as an instrumental variable. Table 7 reports estimates of the effect of culture on our outcome variables when we control for a variety of additional factors.

For example, genetic distance may reflect geographical distance which has nothing to do with culture but relates to transport costs in international trade (see e.g. Giuliano et al. 2006). To address this concern, we introduce the log of the population-weighted distance of a country from the UK, which proxies for transportation costs from the cradle of the Industrial revolution. While this distance variable is negatively correlated with the log of income per worker, when it is combined with the individualism score, it is not statistically significant while our cultural variable remains robustly significant both in the OLS and IV specifications.

Genetic distance might also be related to other cultural variables. A variable that has been widely used in the social sciences literature is the measure of generalized trust constructed from the World

[27] Importantly, genetic distance is not significantly correlated with institutions and therefore our instrumental variable does not pick up variation of individualism correlated with institutions.

[28] We also looked at another popular measure of institutions, the legal origins variable put forward by La Porta et al. (1998) and in the literature that followed. In regressions similar to those reported in Tables 6 and 7, there are two striking findings. First, individualism remains robustly significant. Second, none of the legal origin variables are robustly significant which is consistent with the results in Jellema and Roland (2009) reporting that legal institutional variables did not play an important role in explaining growth.

Values Survey. It is often interpreted either as a cultural norm that reduces transaction costs or as a measure of social capital which reflects the density of social networks and a culture of participation and citizenship. While there is some correlation between log income per worker and trust, it is not robust. Once we regress log income per worker on both individualism and trust, trust ceases to be significant while individualism remains robustly significant and quantitatively important.[29]

Finally, we control for other potentially important factors: average protection against property rights, legal origins, ethnic fractionalization and human capital.[30] While institutions and the education index are strongly correlated with log of income per worker and the log of patents per capita, individualism remains strongly significant in all specifications. Also observe that since we do not instrument potentially endogenous controls such as trust, legal origins, education, etc., we likely bias the estimate of culture's effect downward and therefore the true effect of culture can be larger.[31] In other specifications (not reported), we also examined including other controls as indicators of the rule of law and indicators of democracy and the results are similar.

In summary, although genetic distance may be correlated with non-cultural factors or cultural factors other than individualism, none of the popular alternatives appears to change our main result that individualism plays an important role in determining economic development. These results together with the more direct instrumental variables used in Table 4 unambiguously show that culture cannot be ignored as an important determinant of long run growth.

8. Causal channels between culture and institutions.

The last question we try to address is whether culture causally affects institutions or vice versa. Arguments could go both ways. One can reason that culture shapes institutions. When institutions are put in place, they correspond to a view of how the world works and are thus based on culture. The political transformations that took place in the Western world between the eighteenth and twentieth century from absolute monarchy and autocracy to republican and democratic regimes can be seen as based on the values of the Enlightenment that go back to the Renaissance period and the rediscovery and

[29] Although the raw correlation between trust and genetic distance is significant, this correlation disappears after controlling for basic factors such as longitude/latitude, landlocked dummy, etc.

[30] Human capital is proxied with the 2000 education index from the United Nations. This index is measured by the adult literacy rate (with a weight of two thirds) and the combined primary, secondary, and tertiary gross enrollment ratio (with a weight of one third). We obtain very similar results if we use the Barro-Lee measures of educational attainment.

[31] One may argue that many of these variables should themselves be instrumented. Note however that we are facing potential difficulties when doing this. First of all, it may be very hard to find a good instrument for all relevant variables. Second, even if this were possible, the data sets for which all instruments would overlap would be considerably smaller. Already when using our genetic instrument together with settler mortality, our number of observations drops from 76 to 35. By not instrumenting an explanatory variable in the growth regression, we are biasing downward our estimate of the effect of the cultural variable which we instrument (see Appendix B for more details). Therefore, if we find a significant positive effect of culture on growth, the true effect is likely to be larger.

reappropriation of the Greek culture of rationality and democracy. The French revolution led to the abolition of monarchy and profound institutional changes that were inspired by the ideals of the Enlightenment. In contrast, large-scale revolts in China throughout its history led at best to the replacement of one emperor/dynasty by another one (Finer, 1997). This is because the Chinese imperial system was in line with the Confucianist culture and its view of the "good emperor" as father figure with the associated moral duties towards the people. Within that culture, dissatisfaction of the people tended to be interpreted as the result of having a "bad" emperor and replacing him with a "good" emperor who would behave according to the Confucianist moral cannons was seen as the appropriate response. Culture can thus be argued to affect institutional choices of a society.

However, one can also make a case in favor of an opposite causal channel. People lived for centuries under empires characterized by different institutional organizations, be it the Chinese imperial system, the Ottoman Empire or the Austro-Hungarian Empire. The administrative apparatus of empires (as well as of smaller political entities) made it possible to influence the world view of people living within its boundaries, usually by the spreading of religions such as Islam under the Ottoman Empire or Catholicism under the Austro-Hungarian Empire.[32] For example, Confucianism became widespread in China in part because it was adopted as the official ideology of the empire as early as the Han dynasty. Institutions can thus be argued to have affected the spread of specific culture, and thus also the degree of individualism and collectivism.

We thus test for the existence of two causal channels: from culture to institutions and from institutions to culture. For this test we employ two econometric specifications:

$$I_i = \upsilon_{C\to I} C_i + \beta_{C\to I} X_i + e_i \quad (21)$$

$$C_i = \upsilon_{I\to C} I_i + \beta_{I\to C} X_i + u_i \quad (22)$$

where I is a measure of institutions (i.e., protection against expropriation risk as in Acemoglu et al. (2001)), C is a measure of culture (i.e., individualism), X is a vector of controls, and e and u are error terms. In equation (21), individualism is instrumented with the blood distance we constructed before. In equation (22), protection against expropriation risk is instrumented with settler mortality. If we find that $\upsilon_{C\to I}$ is significant while $\upsilon_{I\to C}$ is not, culture can be interpreted as causing institutions. If $\upsilon_{I\to C}$ is significant while $\upsilon_{C\to I}$ is not, institutions can be interpreted as causing culture. Joint significance of $\upsilon_{I\to C}$ and $\upsilon_{C\to I}$ can be understood as causation flowing in both ways.

The results for equation (21) are reported in Panel A of Table 8. The effect of individualism on the strength of economic institutions is positive and significant thus implying a flow of causality from culture to institutions. This finding corroborates Tabellini (2008a) and Licht et al. (2007). We report

[32] Grosjean (2009) finds that having lived together under the same empire for more than 100 years reduced a measure of cultural distance between two localities by at least a third.

results for equation (22) in Panel B (which uses settler mortality from Acemoglu et al. (2001)) and Panel C (which uses settler mortality from Albouy (2008)) of Table 8. Results in Panel B indicate that causality also flows from institutions to culture. However, according to results in panel C, the effect of institutions on culture ceases to be significant once one introduces controls. Also note that the first stage fit in Panel C becomes quite poor so that the standard statistical inference probably overstates the significance of the estimated coefficients as weak instruments typically mean much wider confidence intervals. Hence, the effect of institutions on culture might be less robust than the other way round. One must however be careful in interpreting all these results since they are based only on 35 observations, the countries for which the data on culture and institutions and their instruments overlap. In summary, culture has a causal effect on institutions and is itself influenced by institutions, although the latter direction of causation is less clear cut than the former.

9. Within-country evidence

Cross-country analysis may fail to control fully for differences in institutional factors. However, we can examine the effect of culture within a given country, thereby holding institutional factors constant. Specifically, our model predicts that more individualistic cultures should *ceteris paribus* stimulate persons to choose research-oriented occupations that require independent thought and deviation from traditional ways of doing things. For this analysis, the U.S.A. is a particularly attractive research object since this country has many ethnicities and occupational opportunities are relatively open for peoples of all origins and cultures.[33]

We use ethnicity, age, gender, birth place, educational attainment from the 5 percent public micro data (IPUMS) of the U.S. Census in year 2000. Our sample includes only employed males who are aged between 25 and 60 and have non-missing information on ancestors (country of origin). The reason why we constrain the sample only to individuals with non-missing ethnicity information is because then we focus only on individuals who associate themselves with a particular culture (which could be different from the American one) and are likely to observe the traditions of their original cultures. We exclude females, unemployed and other ages to minimize the various possible selection effects.

We consider several sub-samples. The first sample split is determined by whether an individual is born in the U.S.A. so that we can attenuate the effects of high-human-capital migration into the USA (intuitively, high-human-capital migration from countries with low level of individualism could create a sample of highly individualistic U.S. persons from these countries, and thus the difference between persons from individualistic cultures/countries and collectivist cultures/countries would not be reflected in

[33] In this respect, our analysis is similar to Fisman and Miguel (2007) who study how norms determine corrupt behavior when institutions are the same.

the sample). The second sample split is based on educational attainment. By focusing on individuals with a bachelor (or higher) degree we can attenuate the effects of differences in initial conditions across ethnicities and also differences in abilities. The higher is the level of educational attainment, the smaller should be the effect of differences in initial conditions and abilities on the estimates.

Our approach has two steps. In the first step, we estimate the following probit:

$$ROO_i = \Phi(X_i\beta + \Sigma_k \alpha_k D_{ik} + \text{error}) \quad (23)$$

where *i*, *s*, *k* index individuals, categories of educational attainment, *ROO* is a dummy variable equal to one if an individual has a research oriented occupation and zero otherwise, *D* is a set of dummies of each ethnicity, and the vector *X* includes controls such as age, age squared, a set of dummies for educational attainment, states, metropolitan status, and marital status. The omitted category in the set of ethnic dummy variables is British.

In the second step we estimate the following specification by least squares:[34]

$$\hat{\alpha}_k = \theta \times Individualism_k + \text{error} \quad (24)$$

where $\hat{\alpha}_k$ is the set of estimated coefficients $\hat{\alpha}$ in regression (23) and *Individualism* is Hofstede's individualism score. Our theory predicts that θ should be positive.

Table 9 presents estimates from regression (24). Note that the estimate of θ is larger when we constrain the sample only to U.S. born persons and when we consider persons with a certain educational threshold. The estimates of θ indicate that persons coming from individualistic cultures are more likely to take research-oriented occupations than persons from collectivist cultures. Obviously, these estimates do not prove that persons from individualist cultures are more successful at innovation than persons from collectivist cultures but they clearly suggest that there is a cultural component at work in the choice of such occupations.

10. Concluding remarks

Our key finding is that individualistic culture has a strong causal effect on economic development, shedding new light on what determines the wealth of nations. The effect of individualism on long-run growth is robust and quantitatively important even after accounting for a variety of alternative theories. This result has a number of implications for positive and normative economics.

There are clearly many pitfalls that should be avoided in interpreting our results. By no means should our (or any other) research on economic effects of culture be seen as implying a "ranking" of cultures in the world or a need for cultural revolutions. On the contrary, this research is aimed to better understand the tradeoffs implied by different cultures which are deeply rooted in history and change very slowly. We must better understand the world we live in and the values and beliefs upon which people in

[34] To minimize the effect of outliers, we use Huber robust least squares regression.

different countries base their expectations, judgments and calculations. Identifying effects of culture on economic outcomes should be interpreted in a way that leads to better dialogue and communication across cultures.

On a more practical side, this research can help pinpoint effective margins of development policy and aid programs to developing countries. Depending on the strengths of various cultures, different emphases may have to be put on a spectrum of available policy tools. For example, in collectivist societies, aid for programs providing public goods may be more effective than in individualist countries. In the latter, aid programs counting on local initiatives might be more effective. Alternatively, organizational support may have to be stronger for infrastructure projects in individualist societies, whereas in collectivist societies one may have to make special effort to encourage creative initiatives.

Research on the economic effects of culture is still in its infancy. We hope that our results showing the importance of culture for long-run growth will help to spur research in this direction.

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Table 1. Income and individualism.

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Continent dummies	No	Yes	No	Yes	No	Yes	No	Yes
Controls	No	No	Yes	Yes	No	No	Yes	Yes
Panel A: Log income per worker								
Individualism	0.027***	0.024***	0.016***	0.020***	0.031***	0.037***	0.025***	0.034***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.009)	(0.009)	(0.010)
Observations	76	76	76	76	76	76	76	76
R^2	0.374	0.616	0.479	0.643	0.365	0.570	0.455	0.598
1st stage F-stat					42.97	19.70	19.96	13.47
1st stage partial R^2					0.388	0.308	0.301	0.260
Panel B: Total factor productivity from Hall and Jones (1999)								
Individualism	0.011***	0.011***	0.007**	0.011***	0.016***	0.019***	0.016***	0.020***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)
Observations	66	66	66	66	66	66	66	66
R^2	0.170	0.326	0.270	0.422	0.140	0.288	0.217	0.376
1st stage F-stat					42.40	17.78	20.06	13.21
1st stage partial R^2					0.418	0.324	0.338	0.292
Panel C: Total factor productivity from Jones and Romer (2010)								
Individualism	0.018***	0.014***	0.007***	0.011***	0.023***	0.018***	0.014***	0.017***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.006)
Observations	53	53	53	53	53	53	53	53
R^2	0.404	0.674	0.629	0.728	0.379	0.663	0.596	0.706
1st stage F-stat					37.64	16.69	18.02	11.03
1st stage partial R^2					0.452	0.350	0.353	0.306
Panel D: Log patents per capita								
Individualism	0.095***	0.093***	0.076***	0.084***	0.103***	0.134***	0.102***	0.132***
	(0.012)	(0.013)	(0.012)	(0.012)	(0.024)	(0.031)	(0.027)	(0.033)
Observations	63	63	63	63	63	63	63	63
R^2	0.420	0.546	0.637	0.667	0.418	0.500	0.618	0.617
1st stage F-stat					39.19	15.79	16.44	10.89
1st stage partial R^2					0.397	0.279	0.311	0.261
Panel E: Innovation performance index								
Individualism	0.060***	0.059***	0.048***	0.053***	0.066***	0.086***	0.066***	0.084***
	(0.008)	(0.008)	(0.007)	(0.008)	(0.015)	(0.019)	(0.017)	(0.021)
Observations	63	63	63	63	63	63	63	63
R^2	0.429	0.553	0.642	0.672	0.425	0.503	0.621	0.617
1st stage F-stat					39.19	15.79	16.44	10.89
1st stage partial R^2					0.397	0.279	0.311	0.261

Notes: In Panel A, the dependent variable is log income (at purchasing power parity) per worker from the Penn World Tables. In Panels B and C, the dependent variable is log total factor productivity relative to the USA from Hall and Jones (1999) and from Jones and Romer (2010). In Panels D and E, the dependent variables are *innovation performance index* and *log patents per million population* taken from Economist Intelligence Unit (2007, 2009). *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. The instrument is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. *Controls* include a dummy for landlocked countries, the percentage of Muslims in a country and absolute values of country longitude and latitude. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 2. Income and individualism by region.

	Asia	Europe	Africa	America	Africa Asia Europe	Africa Asia	OECD	non-OECD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: OLS				
Individualism	0.035*	0.022***	0.062***	0.017***	0.031***	0.046***	0.016***	0.033***
	(0.017)	(0.005)	(0.012)	(0.003)	(0.006)	(0.011)	(0.005)	(0.008)
Observations	19	26	11	17	56	30	29	46
R-squared	0.192	0.376	0.611	0.524	0.626	0.531	0.298	0.483
				Panel B: IV				
Individualism	0.061**	0.045**	0.080*	0.021***	0.059***	0.066***	0.028***	0.054***
	(0.027)	(0.021)	(0.046)	(0.005)	(0.018)	(0.024)	(0.009)	(0.017)
Observations	19	26	11	17	56	30	29	46
R-squared	0.087	-0.074	0.553	0.482	0.495	0.487	0.122	0.413
1st stage F-stat	6.874	2.572	4.563	8.962	11.65	10.59	6.609	14.52
Partial R2	0.352	0.157	0.232	0.441	0.200	0.299	0.318	0.250

Notes: the dependent variable is log income (at purchasing power parity) per worker from the Penn World Tables. *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. The instrument is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. Columns (5)-(8) include continent dummies. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 3. Robustness checks.

	Mahal. distance	Frequency of blood types A & B separately	Distance to UK	Red Cross blood info	Spolaore-Wacziarg		Pronoun drop	
					First distance	Nei distance	Individ.	Comb. With blood distance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Individualism	0.030***	0.043***	0.035***	0.040***	0.058***	0.058***	0.019***	0.023***
	(0.006)	(0.007)	(0.006)	(0.011)	(0.013)	(0.013)	(0.005)	(0.005)
Observations	76	76	76	37	76	76	40	40
R^2	0.369	0.285	0.348	0.225	-0.130	-0.134	0.421	0.419
1st stage F-stat	46.33	28.57	59.12	20.26	16.99	15.01	47.77	42.45
1st stage partial R^2	0.396	0.384	0.445	0.397	0.213	0.210	0.558	0.666
Over-id p-value		0.520						0.196

Notes: the dependent variable *log income per worker* (at purchasing power parity) is from the Penn World Tables. *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. In column (1), *Blood Distance* is computed with the Mahalanobis metric (instead of Euclidean). In column (2), we use raw frequencies (i.e., no distance) of blood types A and B as separate instruments. *Over-id p-value* is the p-value for the overidentifying restrictions test. In column (3), *Blood Distance* is computed relative to the United Kingdom (instead of the USA). In column (4), *Blood Distance* (relative to the USA) is computed based on data available from the Red Cross and similar agencies. In columns (5) and (6), the distance between nations is taken from Spolaore and Wacziarg (2009) who use a broader set of genetic polymorphisms. The first and Nei genetic distances for a given gene are computed as follows. Let p_{ij} be the frequency of gene i with L alleles in populations j=1,2. Then the first distance is $F_{ST} = \sum_{j=1}^{2} (p_{ij} - \overline{p}_i)^2 / \overline{p}_i(1-\overline{p}_i)$ where $\overline{p}_i = \frac{1}{2}(p_{i1} + p_{i2})$ and the Nei distance is $F_N = -\log\{J_{12} / (J_{11}J_{22})^{1/2}\}$ where $J_{12} = \sum_{k=1}^{L}\sum_{m=1}^{L} p_{k1}p_{m2}$ and $J_{dd} = 1 - \sum_{m=1}^{L} p_{md}^2$, $d = \{1,2\}$. See Table 1.10.1 in Cavalli-Sforza et al. (1994) for a more detailed description of how the first and Nei genetic distances are constructed. In columns (7) and (8), the linguistic instrument *Pronoun drop dummy* is a dummy variable (from Licht et al. 2007) equal to one if a language permits dropping a pronoun in sentences and zero others. In column (7), only *Pronoun drop dummy* is used as an instrumental variable. In column (8), *Pronoun drop dummy* and *Blood Distance* are instrumental variables. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 4. Effect of culture on growth with direct impact of genes on culture.

	Instrumental variables					
	Frequency of short (S) allele in the polymorphic region 5HTTLPR of serotonin transporter gene (SLC6A4)		Frequency of G allele in polymorphism A118G in μ-opoid receptor gene		Historical pathogen prevalence index	
	Separate	Combined with blood distance	Separate	Combined with blood distance	Separate	Combined with blood distance
	(1)	(2)	(3)	(4)	(5)	(6)
Second stage: regression of log output per worker on individualism						
Individualism	0.023**	0.031***	0.019***	0.023***	0.043***	0.039***
	(0.011)	(0.011)	(0.006)	(0.006)	(0.006)	(0.005)
First stage: regression of individualism on IV						
Alternative IV	-1.127***	-0.657**	-178.442***	-104.188*	-24.769***	-19.533***
	(0.230)	(0.291)	(40.004)	(54.860)	(2.210)	(2.235)
Blood distance		-217.636*		-291.052**		-225.387***
		(113.051)		(112.610)		(58.228)
Observations	30	30	23	23	73	73
R^2	0.442	0.394	0.509	0.509	0.256	0.311
1st stage F-stat	23.88	18.26	19.90	30.23	125.5	75.66
Over-id test p-value		0.261		0.473		0.206

Notes: The dependent variable in the second stage is log output per worker from the Penn World Tables. *Individualism* is Hofstede's index of individualism. The instrument in columns (1) and (2) is from Chiao and Blizinsky (2010), in columns (3) and (4) from Way and Lieberman (2010), in columns (5) and (6) from Fincher et al. (2008). In columns (1), (3), and (5) the set of instrumental variables does not include blood distance from the USA. In columns (2), (4), and (6) the set of instrumental variables includes the blood distance from the USA and an alternative instrumental variable shown in the heading of the column. *Over-id test p-value* reports the p-value for the overidentifying restriction tests that instruments are correctly excluded.

Table 5. Income and alternative measures of individualism (Schwartz).

	OLS (1)	IV (2)	OLS (3)	IV (4)	OLS (5)	IV (6)
Embeddedness	-1.889***	-2.208***				
	(0.194)	(0.412)				
Affective autonomy			1.293***	1.545***		
			(0.150)	(0.310)		
Intellectual autonomy					1.728***	2.813***
					(0.219)	(0.626)
Observations	73	73	73	73	73	73
R^2	0.599	0.582	0.533	0.513	0.461	0.279
1st stage F-stat		27.27		23.38		20.19
1st stage partial R^2		0.235		0.252		0.157

Notes: the dependent variable is log income (at purchasing power parity) per worker from the Penn World Tables. *Intellectual autonomy* encourages individuals to pursue their own ideas and intellectual directions independently. *Affective autonomy* encourages individuals to pursue affectively positive experience for themselves. In *Embeddedness* cultures, people are viewed as entities embedded in the collectivity. A larger value of *Intellectual autonomy* and *Affective autonomy* corresponds to a greater level of individualism. A smaller value of *Embeddedness* corresponds to a greater level of individualism. Schwartz's *Intellectual autonomy, Affective autonomy,* and *Embeddedness* are taken from Licht et al. (2007). The instrument is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 6. Relative effects of institutions and culture on economic development.

Panel A: Control for protection against expropriation risks.

	OLS			IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Individualism	0.012***		0.027***	**0.024*** **	**0.031*** **	**0.020*** **	**0.029*** **
	(0.002)		(0.003)	**(0.005)**	**(0.008)**	**(0.007)**	**(0.009)**
Protection against expropriation risk	0.141***	0.169***		0.112***	0.093***	0.121***	0.101***
	(0.016)	(0.015)		(0.020)	(0.016)	(0.020)	(0.014)
Continent dummies	No	No	No	No	Yes	No	Yes
Controls	No	No	No	No	No	Yes	Yes
Observations	76	76	76	76	76	76	76
R^2	0.723	0.666	0.374	0.665	0.746	0.708	0.781
1st stage F-stat				38.44	20.89	20.18	13.96
1st stage partial R^2				0.393	0.297	0.301	0.255

Panel B: Instrument and control for protection against expropriation risks

				IV				
	OLS			Blood Distance	Settler mortality	Blood Distance + Settler mortality	Settler mortality (Albouy)	Blood Distance + Settler mortality (Albouy)
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)
Individualism	0.021***		0.007*	**0.033*** **		**0.025** **		**0.024* **
	(0.004)		(0.004)	**(0.009)**		**(0.011)**		**(0.013)**
Protection against expropriation risk		0.208***	0.192***		**0.255*** **	**0.129* **	**0.288*** **	**0.136 **
		(0.023)	(0.024)		**(0.038)**	**(0.069)**	**(0.059)**	**(0.125)**
Observations	35	35	35	35	35	35	35	35
R^2	0.215	0.675	0.696	0.151	0.640	0.564	0.574	0.573
1st stage:								
F-stat					14.88	7.964	4.424	3.654
Partial R^2					0.424	0.424	0.174	0.185
F-stat				12.01		14.13		10.66
Partial R^2				0.377		0.553		0.482

Notes: the dependent variable is log income (at purchasing power parity) per worker from the Penn World Tables. *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. *Protection against expropriation risk* , taken from the International Country Risk Guide, is averaged between 1985 and 2009. It is the same variable Acemoglu et al. (2001) used to approximate the strength of a country's institutions. A larger value of the index corresponds to a greater strength of institutions. The instrument is *blood distance*, the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. The instrument for institutions (*Economic Risk*) is *Settler mortality* from Acemoglu et al. (2001) and *Settler mortality (Albouy)* from Albouy (2008). The Instrumented variables are in **bold**. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 7. Effect of individualism after using extended controls.

	Log income per worker		Log patents per capita		Log TFP (Hall and Jones, 1999)	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Individualism	0.008**	***0.017***	0.048***	***0.118****	0.010**	***0.021***
	(0.004)	***(0.007)***	(0.016)	***(0.037)***	(0.005)	***(0.009)***
Trust	-0.399	-0.536*	-1.167	-1.757	-0.519	-0.689*
	(0.289)	(0.286)	(1.361)	(1.360)	(0.443)	(0.396)
Protection against expropriation risk	0.097***	0.096***	0.351***	0.353***	0.100***	0.103***
	(0.015)	(0.014)	(0.080)	(0.080)	(0.025)	(0.021)
Education index	2.700***	2.096***	8.430**	2.609	-1.072	-2.097*
	(0.558)	(0.563)	(4.128)	(3.168)	(1.068)	(1.254)
Ethnic fractionalization	-0.217	-0.336	-1.139	-1.992	-0.461	-0.588
	(0.272)	(0.280)	(1.267)	(1.374)	(0.422)	(0.388)
Log geographic distance from the UK	-0.091	-0.008	0.002	0.751	-0.105	-0.002
	(0.128)	(0.128)	(0.487)	(0.629)	(0.148)	(0.145)
Legal origin						
French	0.132	0.235	-0.407	0.739	0.141	0.282
	(0.140)	(0.154)	(0.666)	(0.836)	(0.210)	(0.226)
German	-0.183	-0.025	0.143	1.821	-0.381	-0.189
	(0.207)	(0.204)	(1.298)	(1.152)	(0.312)	(0.303)
Scandinavian	-0.170	0.047	0.460	2.014	-0.014	0.255
	(0.292)	(0.314)	(1.293)	(1.450)	(0.433)	(0.435)
Observations	62	62	53	53	56	56
R-squared	0.926	0.916	0.870	0.813	0.703	0.672
1st stage F-stat		11.02		5.235		6.714
Partial R2		0.236		0.169		0.193

Notes: the dependent variable is log income (at purchasing power parity) per worker from the Penn World Tables. *Individualism* is Hofstede's index of individualism in columns (1) to (4) and *log patents per million population* taken from Economist Intelligence Unit (2007, 2009) in columns (5) to (8). A larger value of the index corresponds to a greater level of individualism. The instrument is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. *Legal origin* is from La Porta et al. (2002). British legal origin is the omitted category. *Protection against expropriation risk*, taken from the International Country Risk Guide, is averaged between 1985 and 2009. It is the same variable Acemoglu et al. (2001) used to approximate the strength of a country's institutions. A larger value of the index corresponds to a greater strength of institutions. *Trust* is percent of people agreeing that strangers can generally be trusted from the World Values Survey. *Education index* is for 2000 from the Human Development of the World Bank. Ethnic fractionalization is from Fearon (2003). *Geographic distance from the UK* is population weighted distance taken from CEPII database (http://www.cepii.fr/anglaisgraph/bdd/distances.htm). All regression include *controls* (a dummy for landlocked countries, the percentage of Muslims in a country and absolute values of country longitude and latitude) and continent dummies. The Instrumented variables are in ***bold italic***. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 8. Causal effects between culture and institutions.

	OLS	IV			
	(1)	(2)	(3)	(4)	(5)
Panel A: Dependent variable = *Protection against expropriation risk*; Instrument = *Blood Distance*					
Individualism	0.073***	0.061*	0.107**	0.070*	0.116**
	(0.019)	(0.035)	(0.043)	(0.040)	(0.051)
Continent dummies	No	No	Yes	No	Yes
Controls	No	No	No	Yes	Yes
Observations	35	35	35	35	35
R^2	0.163	0.159	0.366	0.277	0.359
1st stage F-stat		12.01	9.046	12.31	6.683
1st stage partial R^2		0.377	0.340	0.316	0.281
Panel B: Dependent variable = *Individualism*; Instrument = *Setter mortality*					
Protection against expropriation Risk	2.245*	5.107***	5.772***	5.039***	4.604***
	(1.134)	(1.620)	(1.912)	(1.862)	(1.614)
Continent dummies	No	No	Yes	No	Yes
Controls	No	No	No	Yes	Yes
Observations	35	35	35	35	35
R^2	0.163	-0.102	0.123	0.045	0.364
1st stage F-stat		14.88	6.101	7.003	4.880
1st stage partial R^2		0.424	0.272	0.273	0.240
Panel C: Dependent variable = *Individualism*; Instrument = *Setter mortality (Albouy)*					
Protection against expropriation Risk	0.073***	6.274**	5.733*	5.596	4.534
	(0.019)	(2.732)	(3.146)	(3.824)	(2.944)
Continent dummies	No	No	Yes	No	Yes
Controls	No	No	No	Yes	Yes
Observations	35	35	35	35	35
R^2	0.163	-0.362	0.130	-0.063	0.373
1st stage F-stat		4.424	2.100	1.789	1.383
1st stage partial R^2		0.174	0.116	0.102	0.0896

Notes: *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. *Economic risk* is from the International Country Risk Guide which Acemoglu et al. (2001) used to approximate the strength of a country's institutions. A larger value of the index corresponds to a greater strength of institutions. *Blood distance* is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. The instrument for institutions (*Economic Risk*) is *Settler mortality* from Acemoglu et al. (2001) and *Settler mortality (Albouy)* from Albouy (2008). *Controls* includes a dummy for Muslim countries, a dummy for landlocked countries, and absolute values of country longitude and latitude. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

Table 9. Propensity to choose research-oriented occupations in the USA.

	Narrow definition of research occupations			Broad definition of research occupations		
	Persons with all levels of education	Persons with bachelor degree or higher	Persons with Ph.D. degree or higher	Persons with all levels of education	Persons with bachelor degree or higher	Persons with Ph.D. degree or higher
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: U.S. born persons					
Individualism	0.007***	0.022***	0.195***	0.023**	0.070***	0.355***
	(0.003)	(0.006)	(0.044)	(0.012)	(0.021)	(0.060)
Observations	67	67	57	67	67	57
R-squared	0.111	0.191	0.267	0.058	0.142	0.386
	Panel B: All persons					
Individualism	0.004***	0.013***	0.105**	0.019**	0.029	0.110*
	(0.001)	(0.004)	(0.049)	(0.009)	(0.018)	(0.060)
Observations	67	67	67	67	67	67
R-squared	0.102	0.149	0.066	0.071	0.036	0.050

Notes: The table report Huber-robust estimate of parameter θ in specification (24). The dependent variable is the set of estimated coefficients α_k from regression. Huber-robust regression is used in estimation. *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels. *Narrow definition of research oriented occupations* includes Life, Physical, and Social Science Occupations (codes 160-196 in the 2000 census occupational classification system recorded in the IPUMS variable OCC). *Narrow definition of research oriented occupations* includes *Narrow definition of research oriented occupations* and Architecture and Engineering Occupations (codes 130-156 in the 2000 census occupational classification system recorded in the IPUMS variable OCC).

Figure 1. Map of individualism scores.

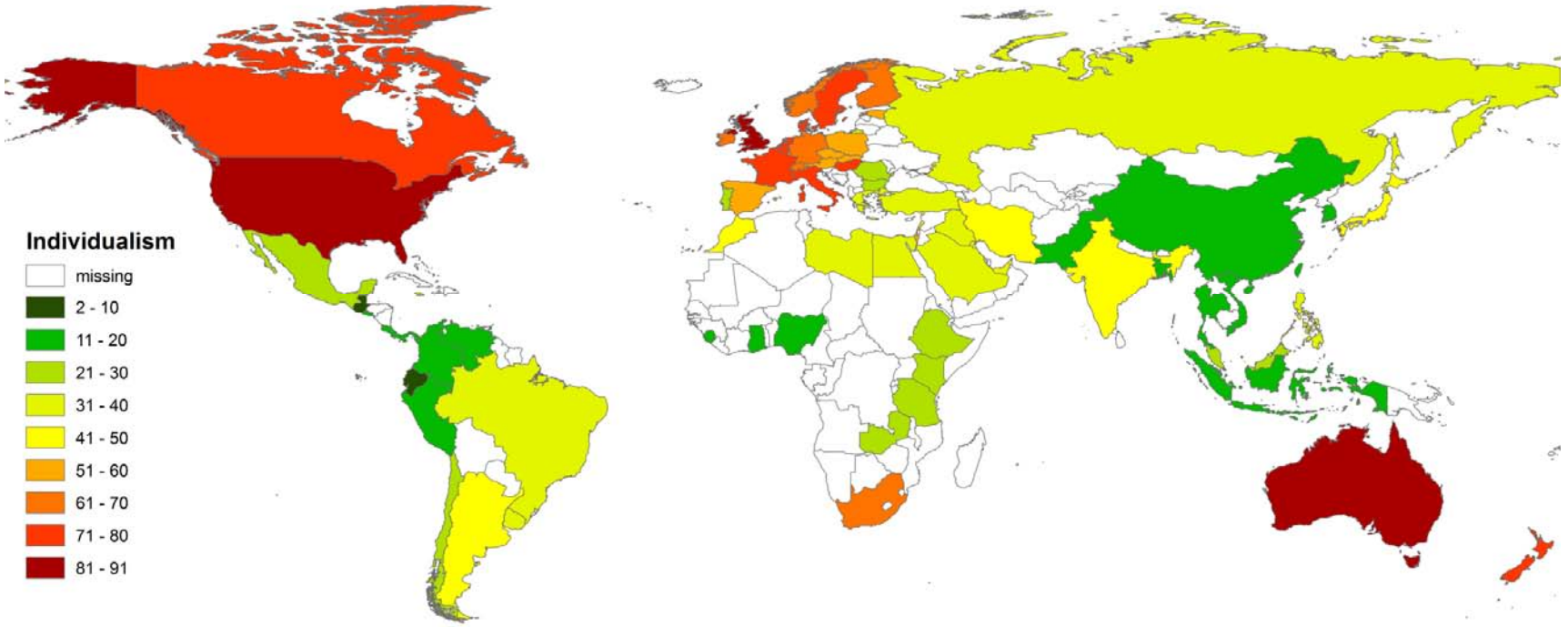


Figure 2. Map of the Mahalanobis distance of frequency of blood types A and B relative to the USA.

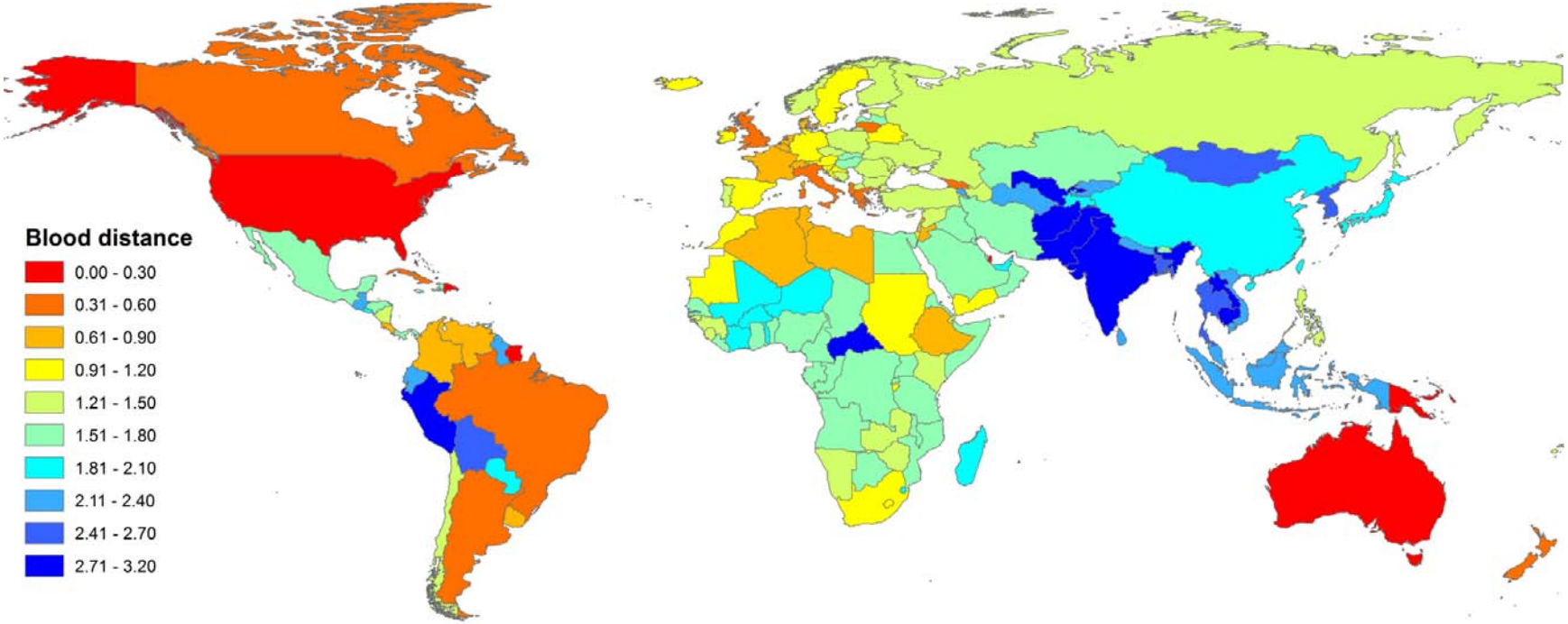
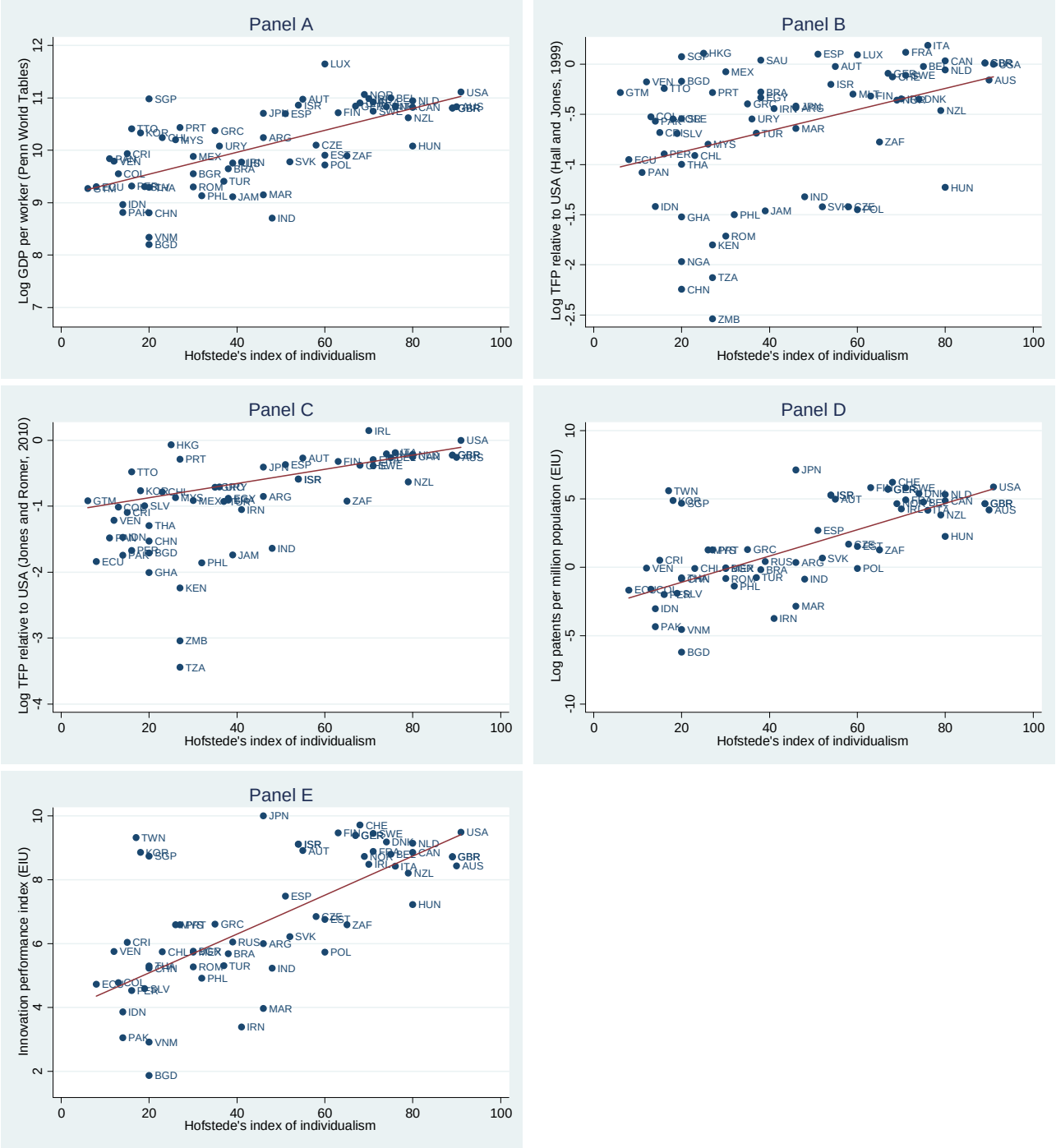
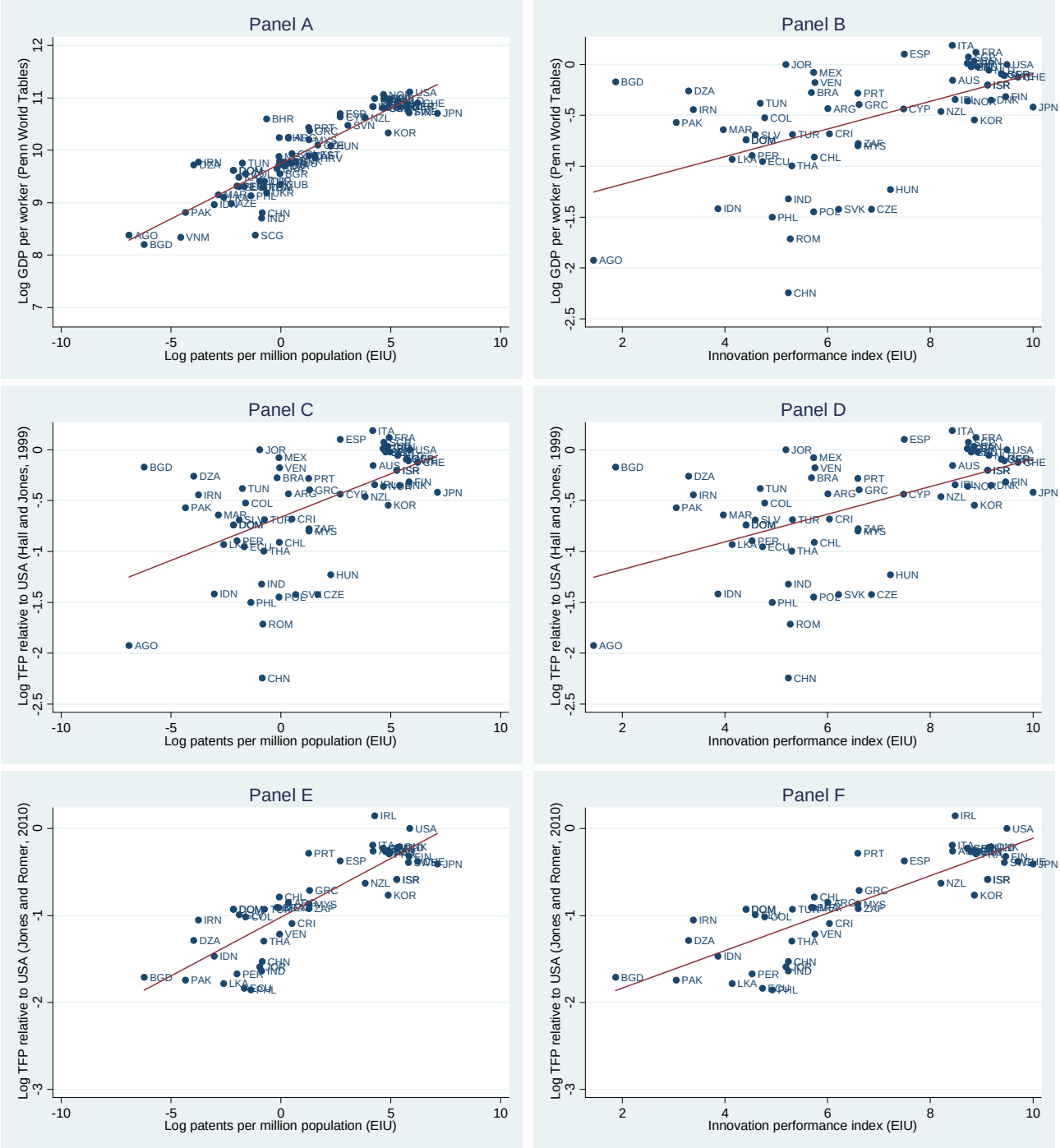


Figure 3. Individualism and economic outcomes.



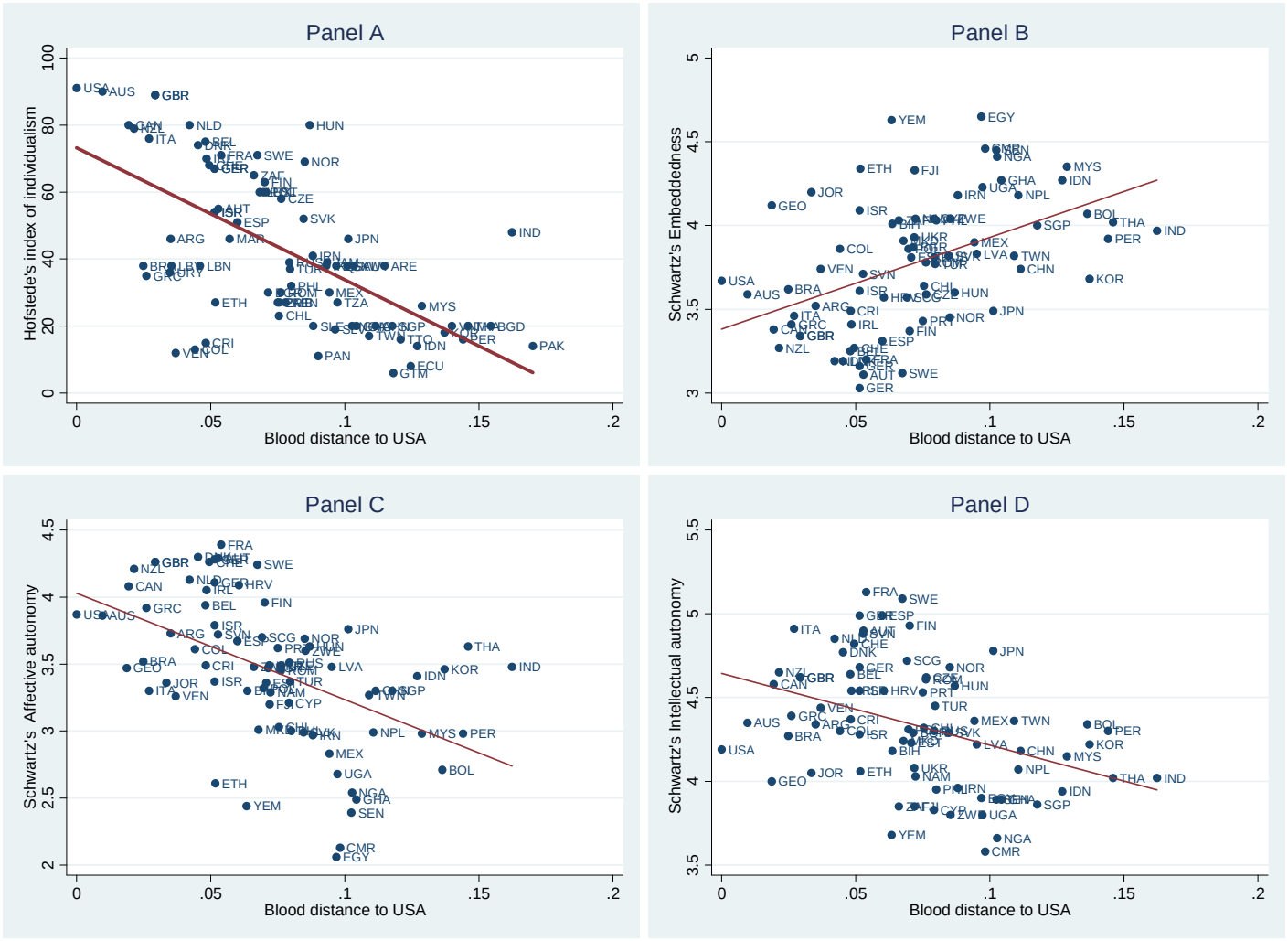
Notes: *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. Log income (at purchasing power parity) per worker is from the Penn World Tables. Log total factor productivity relative to the USA is from Hall and Jones (1999) and Jones and Romer (2010). *Log patents per million population* and *innovation performance index* are taken from Economist Intelligence Unit (2007, 2009).

Figure 4. Innovation, income and productivity.



Notes: Log income (at purchasing power parity) per worker is from the Penn World Tables. Log total factor productivity relative to the USA is from Hall and Jones (1999) and Jones and Romer (2010). *Log patents per million population* and *innovation performance index* are taken from Economist Intelligence Unit (2007, 2009).

Figure 5. Genetic and cultural distance



Notes: *Individualism* is Hofstede's index of individualism. A larger value of the index corresponds to a greater level of individualism. *Intellectual autonomy* encourages individuals to pursue their own ideas and intellectual directions independently. *Affective autonomy* encourages individuals to pursue affectively positive experience for themselves. In *Embeddedness* cultures, people are viewed as entities embedded in the collectivity. A larger value of *Intellectual autonomy* and *Affective autonomy* corresponds to a greater level of individualism. A smaller value of *Embeddedness* corresponds to a greater level of individualism. Schwartz's *Intellectual autonomy*, *Affective autonomy*, and *Embeddedness* are taken from Licht et al. (2007). *Blood distance to USA* is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA.

APPENDIX A

Proof of proposition 1:

In the symmetric equilibrium we have

$$Y_t = \eta L_t^{1-\alpha} F_t^{\alpha} x_t^{\alpha} \tag{A.1}$$

$$p_t = \alpha\eta L_t^{1-\alpha} F_t^{\alpha} x_t^{\alpha-1} = \alpha^{-1} \tag{A.2}$$

$$w_t = (1-\alpha) Y_t / L_t \tag{A.3}$$

$$x_t = \alpha^2 \eta L_t^{1-\alpha} F_t^{\alpha} x_t^{\alpha} = \alpha^2 Y_t \tag{A.4}$$

$$\pi_t = p_t x_t - x_t = \alpha(1-\alpha) Y_t \tag{A.5}$$

$$G_t = \tau\alpha(1-\alpha) Y_t \tag{A.6}$$

$$C_t = Y_t - G_t = [1-\tau\alpha(1-\alpha)] Y_t \tag{A.7}$$

$$1/C_t = q_t \tag{A.8}$$

$$q_t = \beta(1+r_{t+1}) q_{t+1} \tag{A.9}$$

$$\mu_t \lambda'(1-L_t) F_{t-1} = q_t w_t \tag{A.10}$$

$$\mu_t = \phi F_t^{-1} + \beta\left\{\mu_{t+1}\lambda(1-L_{t+1})\right\} + q_t(1-\tau)\alpha^2\eta L_t^{1-\alpha} F_t^{\alpha-1} x_t^{\alpha} \tag{A.11}$$

$$\alpha^2 \eta L_t^{1-\alpha} F_t^{\alpha} x_t^{\alpha-1} = 1 \tag{A.12}$$

$$F_t = \lambda(1-L_t) F_{t-1} \tag{A.13}$$

Using (A.3), (A.8) and (A.10), we have

$$\mu_t = \frac{1}{\lambda'(1-L_t)} \frac{1}{F_{t-1}} \frac{w_t}{C_t} = \frac{1}{\lambda'(1-L_t)} \frac{1}{F_{t-1}} \frac{(1-\alpha) Y_t / L_t}{[1-\tau\alpha(1-\alpha)] Y_t} = \frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1}{L_t \lambda'(1-L_t)} \frac{1}{F_{t-1}}. \tag{A.14}$$

Plus this expression for μ_t into (A.11) to find

$$\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1}{L_t\lambda'(1-L_t)} \frac{1}{F_{t-1}} = \phi \frac{1}{F_t} + \beta\left\{\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1}{L_{t+1}\lambda'(1-L_{t+1})} \frac{1}{F_t} \lambda(1-L_{t+1})\right\} + \frac{1}{C_t}(1-\tau)\alpha^2\eta L_t^{1-\alpha} F_t^{\alpha-1} x_t^{\alpha}$$

which simplifies to

$$\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1-L_t}{L_t} \frac{\lambda(1-L_t)}{(1-L_t)\lambda'(1-L_t)} \lambda'(1-L_t) \frac{F_t}{F_{t-1}} = \phi + \beta\left\{\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1-L_{t+1}}{L_{t+1}} \frac{\lambda(1-L_{t+1})}{(1-L_{t+1})\lambda'(1-L_{t+1})}\right\} + \frac{(1-\tau)\alpha^2}{[1-\tau\alpha(1-\alpha)]}$$

Given $\varepsilon = (1-L_t)\lambda'(1-L_t) / \lambda(1-L_t)$ and (A.13), we can further simplify to

$$\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1-L_t}{L_t} \frac{1}{\varepsilon} = \phi + \beta\left\{\frac{(1-\alpha)}{[1-\tau\alpha(1-\alpha)]} \frac{1-L_{t+1}}{L_{t+1}} \frac{1}{\varepsilon}\right\} + \frac{(1-\tau)\alpha^2}{[1-\tau\alpha(1-\alpha)]}$$

On a balanced growth path, we have $L_t = L$ and thus

$$\frac{1-L}{L} = \left\{\phi + \frac{(1-\tau)\alpha^2}{[1-\tau\alpha(1-\alpha)]}\right\} \frac{\varepsilon}{1-\beta} \frac{[1-\tau\alpha(1-\alpha)]}{(1-\alpha)} \tag{A.15}$$

Note that $(1-L)/L$ is monotonically decreasing in *L*. We can then derive:

$$\frac{\partial\left(\frac{1-L}{L}\right)}{\partial\phi} = \frac{\varepsilon}{1-\beta} \frac{[1-\tau\alpha(1-\alpha)]}{(1-\alpha)} > 0, \quad \frac{\partial\left(\frac{1-L}{L}\right)}{\partial\tau} = -\frac{\varepsilon\alpha^2}{1-\beta} - \phi\frac{\varepsilon\alpha}{1-\beta} < 0.$$

APPENDIX B

The downward bias on an instrumented variable when several variables need to be instrumented.

Suppose that the link between economic variable *Y*, culture *C* and institutions *I* is given by the following setup

$$Y = \alpha \mathrm{C} + \beta I + \varepsilon \quad \text{(B.1)}$$

$$C = D + u \quad \text{(B.2)}$$

$$I = Q + e \quad \text{(B.3)}$$

where equation (B.1) shows the effect of culture and institutions on economic outcomes (e.g., income per worker), equation (B.2) captures the first-stage for culture with *D* being exogenous genetic distance, equation (B.3) reflects the first stage regression for institutions with *Q* being exogenous (to economic outcomes) factors affecting the spread of institutions. We assume that

$\alpha > 0, \beta > 0$ which means that culture and institutions both positively affect economic outcomes,

$\mathrm{cov}(D, Q) > 0$ which means that factors affecting the spread of culture and institutions (or similar factors) are positively correlated,

$cov(\varepsilon, u) > 0, cov(\varepsilon, e) > 0, cov(u, e) > 0$ which captures the endogeneity of culture and institutions. The positive correlations mean that unobservables move economic outcomes, institutions and culture in the same direction.

We have a good instrument for culture (i.e., *D*) but for variables that measure institutions (or maybe other factors such as trust, rule of law, etc.) it may be hard to come by a good instrument which has a good coverage of countries. For example, settle mortality applies only to colonies and excludes European countries. Hence, the question is what would happen with an estimate of α if we instrument only culture.

Using the facts that $\hat{\gamma}^{IV} = \left[\hat{\alpha}^{IV} \;\; \hat{\beta}^{IV}\right] = (Z'X)^{-1}(Z'Y)$, we can show that if $Z = [D \;\; I]$ (rather than $Z = [D \;\; Q]$) then

$$\hat{\alpha}^{IV} = \alpha - \frac{[\beta \mathrm{var}(I) + \mathrm{cov}(e,\varepsilon)]\mathrm{cov}(D,Q)}{\mathrm{var}(D)\mathrm{var}(Q)\left(1-\rho_{DQ}^2\right) + \mathrm{var}(D)\mathrm{var}(e)\left(1-\rho_{DQ}\rho_{ue}\sqrt{\frac{(1-R_{CD}^2)/R_{CD}^2}{(1-R_{IQ}^2)/R_{IQ}^2}}\right)} \quad \text{(B.4)}$$

where $\rho_{DQ} = \frac{\mathrm{cov}(D,Q)}{\sqrt{\mathrm{var}(D)\mathrm{var}(Q)}}$, $\rho_{ue} = \frac{\mathrm{cov}(u,e)}{\sqrt{\mathrm{var}(u)\mathrm{var}(e)}}$, R_{CD}^2 is the R^2 in equation (B.2), R_{IQ}^2 is the R^2 in equation (B.3).

The numerator in the bias term in equation (B.4) is unambiguously positive. The sign of the denominator depends on the strength of correlations between error terms as well as correlation between *D* and *Q* and the relative strength of the fit in the first stage regressions (B.2) and (B.3). We can assess empirically if this term is positive. Specifically, the R^2 is the first stage fit is about 0.2 – 0.3 in both regressions (B.2) and (B.3) so that the range for $\sqrt{\frac{(1-R_{CD}^2)/R_{CD}^2}{(1-R_{IQ}^2)/R_{IQ}^2}}$ is 0.5 to 1.5 at most. The correlation between error terms in the first stage is 0.3. The correlation between predicted values of *C* and *I* (which would correspond to *D* and *Q*) is 0.1. Hence, the bias in unambiguously downward.

To conclude, if we do not instrument institutions or any other variable which satisfies conditions we spell out above, we would have a negative bias in the estimates. If the bias is downward and we still find a positive and significant value of $\hat{\alpha}^{IV}$, then the true value of α has to be even larger.

APPENDIX C

Questions from Hofstede's survey used to identify individualism (source Exhibit 5.11 in Hofstede (2001)):

1. Have challenging work to do – work from which you can get a personal sense of accomplishment [challenge].
2. Live in an area desirable to you and your family [desirable area].
3. Have an opportunity of high earnings [earnings].
4. Work with people who cooperate well with one another [cooperation].
5. Have training opportunities (to improve your skills and to learn new skills) [training].
6. Have good fringe benefits [benefits].
7. Get recognition you deserve when you do a good job [recognition].
8. Have good physical working conditions (good ventilation and lighting, adequate work space, etc.) [physical conditions].
9. Have considerable freedom to adapt your own approach to the job [freedom].
10. Have the security that you will be able to work for your company as long as you want to [employment security].
11. Have an opportunity for advancement to higher level jobs [advancement].
12. Have a good working relationship with your manager [manager].
13. Fully use your skills and abilities on the job [use of skills].
14. Have a job which leaves you sufficient time for your personal or family life [personal time].
15. Have the security that you will not be transferred to a less desirable job [position security].
16. Work in a department which is run efficiently [efficient department].
17. Have a job which allows you to make a real contribution to the success of your company [contribute to company].
18. Work in a company which is regarded in your country as successful [successful company].
19. Work in a company which stands in the forefront of modern technology [modern company].
20. Work in a congenial and friendly atmosphere [friendly atmosphere].
21. Keep up to date with the technical developments relating to your work [up-to-dateness].
22. Have a job on which there is a great deal of day-to-day learning [day-to-day learning].
23. Have little tension and stress on the job [stress-free].
24. Be consulted by your direct supervisor in his/her decisions [consulted].
25. Make a real contribution to the success of your company or organization [contribute].
26. Serve your country [country].
27. Have an element of variety and adventure in the job [variety].
28. Work in a prestigious, successful company or organization [prestige].
29. Have an opportunity for helping other people [helping].
30. Work in a well-defined job situation where requirement are clear [clear job].

APPENDIX D: Tables

Appendix Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Explanatory variables					
Individualism	78	41.717	22.980	6	91
Trust	114	51.453	28.210	7.900	148
Education index	147	0.764	0.197	0.118	0.993
Ethnic fractionalization	152	0.470	0.258	0.002	1
Log geographic distance from the UK	164	8.426	0.812	5.382	9.826
Protection against expropriation risk	138	33.728	5.777	16.5	44.96
Instrumental variables					
Pronoun drop	41	.560	0.502	0	1
Euclidian genetic distance from the USA	156	0.086	0.038	0	0.185
Mahalanobis genetic distance from the USA	156	1.504	0.660	0	3.163
Euclidian genetic distance from the UK	156	0.102	0.048	0	0.212
Mahalanobis genetic distance from the UK	156	1.752	0.809	0	3.586
Economic outcome variables					
Log income per worker	153	9.246	1.187	6.785	11.648
Log patents per million of population	81	0.705	3.363	-7.600	7.126
Innovation performance index	81	6.224	2.107	1.440	10
Log TFP relative to the USA					
Hall and Jones (1999)	117	-0.893	0.713	-2.538	0.188
Jones and Romer (2010)	79	-1.199	0.799	-3.440	0.146

Appendix Table 2. Long-term growth, 1500-2001 and 1820-2001.

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Controls	No	Yes	No	No	No	Yes	No	No
Continent dummies	No	No	Yes	No	No	No	Yes	No
				Panel A: 1500-2001				
Individualism	0.028***	0.016***	0.015**	0.015**	**0.040*** **	**0.042* **	**0.023* **	**0.036*** **
	(0.005)	(0.005)	(0.005)	(0.006)	**(0.011)**	**(0.023)**	**(0.013)**	**(0.013)**
Protection against expropriation risk				0.102***				0.043
				(0.024)				(0.041)
Observations	31	31	31	31	31	31	31	31
R-squared	0.479	0.683	0.684	0.678	0.375	0.446	0.661	0.486
1st stage F-stat					14.12	3.414	3.797	8.639
Partial R^2					0.466	0.292	0.200	0.420
				Panel B: 1820-2001				
Individualism	0.017***	0.009*	0.009**	0.006*	**0.025*** **	**0.028** **	**0.017* **	**0.020*** **
	(0.004)	(0.005)	(0.004)	(0.003)	**(0.007)**	**(0.012)**	**(0.010)**	**(0.007)**
Protection against expropriation risk				0.100***				0.062**
				(0.015)				(0.027)
Observations	46	46	46	46	46	46	46	46
R-squared	0.293	0.464	0.448	0.595	0.226	0.251	0.411	0.446
1st stage F-stat					28.16	8.695	10.11	19.41
Partial R^2					0.456	0.283	0.269	0.437

Notes: the dependent variable is log growth rate of income per capita from Maddison (2003). *Individualism* is Hofstede's index of individualism. The instrument is the Euclidian distance of frequency of blood types A and B in a given country relative to the frequency of blood types A and B in the USA. *Protection against expropriation risk*, taken from the International Country Risk Guide, is averaged between 1985 and 2009. It is the same variable Acemoglu et al. (2001) used to approximate the strength of a country's institutions. A larger value of the index corresponds to a greater strength of institutions. The instrumented variables are in **bold**. Robust standard errors in parentheses. ***, **, * denote significance at 0.01, 0.05, and 0.10 levels.

APPENDIX E: Figures

Map of the Mahalanobis distance of frequency of blood types A and B relative to the UK.