ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/341736066

Rushton, Jensen, and the Wealth of Nations: Biogeography and Public Policy as Determinants of Economic Growth

Article *in* The mankind quarterly · June 2020

CITATIONS
0

READ
1

1 author:

Gregory Christainsen
California State University, East Bay
24 PUBLICATIONS **373** CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Palgrave Books on Hayek View project

All content following this page was uploaded by Gregory Christainsen on 29 May 2020.

The user has requested enhancement of the downloaded file.

MANKIND QUARTERLY 2020 60:4 458-486

Rushton, Jensen, and the Wealth of Nations: Biogeography and Public Policy as Determinants of Economic Growth

Gregory B. Christainsen*
California State University-East Bay, Hayward, USA

*E-mail: gregory.christainsen@csueastbay.edu

This paper offers a review of some of the empirical literature on economic growth and discusses its recent evolution in light of developments in intelligence research and genomics. The paper also undertakes the first regression analysis of economic growth to use the most up-to-date version (VI.3.2) of David Becker's data set of international IQ scores. The analysis concerns the growth of 94 countries from 1995-2016. The new regression analysis replicates the results of Jones and Schneider (2006) in finding IQ to have a robust impact on economic growth. Political and economic institutions are represented in the regressions via a country's "degree of capitalism" (aka "economic freedom"), which is found to have an impact that is positive and statistically significant. A change from communism to a market economy does much to increase growth, but the paper finds diminishing returns to free markets. Countries whose people are mostly of sub-Saharan African descent have low average IQ scores, but the paper finds that other factors also have lessened economic growth not only in Africa, but in Haiti and Jamaica as well. Rushton and Jensen (2005, 2010) put forth the hypothesis that average IQ differences across ethnic groups are 50% due to genetic differences, and 50% due to differences in natural and social environments. Applied to international IQ scores, the paper finds the hypothesis to be very reasonable.

Key Words: Intelligence, Biogeography, Institutions, Economic growth, Causation, Brain size, Genomics

1. Background

If racial differences in cognitive ability have a substantial genetic component, as argued by Rushton and Jensen (2005, 2010), the consequences are far-reaching. For example, it is often asserted that differences in average labor market earnings across ethnic groups are largely due to unwarranted discrimination. However, there was a pronounced shift in the stance taken by labor economists as a result of a paper by Neal and Johnson (1996). The authors found that differences in cognitive ability measured at age 13 account for much of the difference in the average earnings of blacks and whites.

Heckman and co-authors (Carneiro et al., 2005) made adjustments for differences in the quality of the schooling received by students, but essentially concurred with Neal and Johnson. They also emphasized that ethnic differences in cognitive ability actually go back at least as far as ages 3-4.[1] Fryer and Levitt (2013) found no substantial racial differences in cognition at age 1 — perhaps a small cognitive deficit for *East Asians* — but Rushton (1997, p. 149) often mentioned Daniel Freedman's finding that, on average, black children walk at 11 months, whites at 12 months, and East Asians at 13 months. There is a period of time during which racial differences in physical maturity may mask emerging, early-age differences in cognitive ability. If Rushton and Jensen were correct about the nature of racial differences in cognitive ability, significant differences in labor market earnings are to be expected and not simply deplored.

This paper takes the discussion to an international level. It reviews some of the formal economics literature pertaining to the growth of average living standards across countries. The paper's main research question is the extent to which differences in cognitive ability across nations were responsible for country differences in rates of economic growth from 1995-2016. The matter is investigated with the help of the new international IQ data set of David Becker (2019, Version VI.3.2). It also examines the extent to which differences in public policy accounted for growth differences, and it discusses the extent to which the quality of public policy depends on cognitive ability.

"Human capital," referring to the human capacity to contribute to the production of goods and services, has long been a part of the literature on economic growth. However, researchers have tended to view human capital primarily as skills acquired through education and training. With the notable

[1] In addition, they highlighted personality differences that are evident as early as ages 5-6. Heckman (2012) believes that early childhood education is important for addressing both cognitive and noncognitive differences.

exception of Garett Jones (Jones, 2012; Jones & Schneider, 2006, 2010) and a few others (Lim et al., 2018), economists have tended to ignore IQ as a measure of human capital and as a determinant of economic growth. Going further, they have done little to investigate the extent to which differences in average IQ across nations are a reflection of biogeography — i.e., the geography of genes. Without focusing on IQ, some writers have noted the persistent role of ancestry in patterns of economic development (Ashraf & Galor, 2013; Chanda et al., 2014; Comin et al., 2010; Fulford et al., 2019; Putterman & Weil, 2010; Spolaore & Wacziarg, 2013).

The formal economics literature dates back to the work of Nobel Prize winner Robert Solow (1956, 1957). Early on, technological progress was taken to be "exogenous" or "manna from heaven". Technological progress was simply assumed and not explained. There did exist a recognition that all labor is not equally productive, and education was incorporated into formal models as a factor that increased "effective labor". Saving and investment were analyzed for their effects on the capital stock and labor productivity. There was no discussion of intelligence per se. The Wikipedia article on economic growth likewise makes no reference to intelligence.

Apart from its assumption of exogenous technological progress, Solow's work was criticized for neglecting the role of public policy or "institutions" in affecting economic performance. The Soviet-bloc countries emphasized state-control over production and prices. Western countries stressed free and open markets, but there was a lack of formal work on the importance of private property rights for technological progress and the growth of living standards. Even by the end of the 20th century — 10 years after the fall of the Berlin Wall — Temple's (1999) outstanding survey of the empirical growth literature could cite only *three* papers that had a significant role for institutions in affecting the trajectory of average living standards.

This paper examines not only the impact of country IQ differences on rates of economic growth; it also is concerned with the impact of IQ differences relative to country differences in public policy. In some cases, the IQ differences between two countries seem less important for their respective rates of economic growth than the countries' public policy differences. In other cases, differences in public policy seem to account for only a small portion of the difference in growth rates.

Section 2 of this paper discusses research on economic growth since the fall of the Berlin Wall. Economic growth is discussed mostly in terms of the factors that affect the average annual growth rate of per capita gross domestic product (GDP), adjusted for inflation. In order to highlight the paper's overriding message, Section 3 offers brief case studies of the growth experiences of Korea, Chile,

China, and New Zealand. Section 4 offers a basic model of economic growth and estimates its parameters. IQ is found to be the single most robust and significant factor affecting growth across countries. Section 5 offers some discussion of the nature of international IQ differences and includes consideration of genetic factors and country brain size. Transferring the work of Rushton and Jensen to the wealth of nations, the paper's hypothesis is that differences in average IQ across countries are, very roughly, 50 percent due to genetic differences and 50 percent due to differences in natural and social environments. Public policy is found to have important effects on economic growth, but public policy itself is affected by a country's human capital.

2. Research on Economic Growth since the Fall of the Berlin Wall

As noted, formal empirical research on the sources of economic growth was slow to incorporate a role for institutions. After the fall of the Berlin Wall — not before — the inclusion of institutional variables in regression analyses started to become more frequent. Champions of free and open markets believed that growth is obviously promoted more by capitalistic institutions — e.g., private property — than by government control over economic decision-making.

In the 1990s Robert Hall and Charles Jones (1999) created a variable that they called "the degree of capitalism". It categorized (without much data collection) countries on an integer scale from zero (least capitalistic) to five (most capitalistic), and researchers began to enter the numbers into regressions. In the epic research of Sala-i-Martin (1997), the variable was found to have a robust impact across countries on the growth rate of per capita GDP from 1960-1992. Garett Jones also has used this variable. However, two serious issues eventually emerged: (1) the variable was not very sophisticated compared to alternatives that became available; and (2) however measured, the degree of capitalism does not come close to being a satisfactory explanation for many of the international differences in growth rates.

To cite more of the relevant research that emerged, Hanushek and Kimko (2000) found that differences in student achievement across countries, measured as scores on international scholastic achievement tests, accounted for a sizable portion of country differences in economic growth. Acemoglu, Johnson, and Robinson (2001) emphasized the primacy of institutions and public policy. Glaeser and co-authors (2004) again wrote on behalf of human capital.

Jeffrey Sachs played a role in Poland's transformation from centrally-planned socialism to capitalism, but argued (Sachs 2003) that geography was being unduly neglected in discussions of economic growth. Africa and Central Asia, he maintained, were very disadvantaged in this respect. He noted that no less an

authority than Adam Smith, author of *The Wealth of Nations*, had said (Book I, Chapter III) that Europe had greatly benefited from easy access to navigable waterways.

The first version of Lynn and Vanhanen's international IQ data set was published in 2002 (Lynn & Vanhanen, 2002). At an early stage, it was derided by social scientists (Barnett & Williams 2004) who encountered it. However, the data was used for an article on economic growth that was published in the very same year by Weede and Kämpf (2002) in the European journal *Kyklos*. Though not published in one of the mainline journals on economic growth, the article was also noteworthy for using the at that time relatively new "Economic Freedom of the World" research spearheaded by the Fraser Institute in Vancouver.

This research (www.freetheworld.com) estimated the degree of capitalism in a country on a scale from 0 (least capitalistic) to 10 (most capitalistic) and ended up using 42 public policy variables to do so, a far more extensive consideration of public policy and institutional factors than had been present previously in the empirical economic growth literature. The variables were put in five categories: (1) size of government; (2) private property rights and the rule of law (clear, impartial, enforced rules as opposed to arbitrary decrees); (3) the soundness of money (e.g., low and stable inflation, freedom to deal in foreign currencies); (4) free trade vs. protectionism; and (5) the extent of domestic regulation. At the outset, efforts were made to gather data for countries in five-year intervals going back to 1970. In due course, estimates of "economic freedom" were pushed further back in time for numerous countries (Murphy and Lawson 2018), but based on only eight variables. Economic freedom is now estimated for many countries on an annual basis, and researchers are putting together more extensive panel data for former Soviet-bloc countries as well as others.

Weede and Kämpf also highlighted a possible independent role for saving and capital investment in affecting economic growth and they noted the "advantages of backwardness" (Gerschenkron 1962 [2000]). It is argued that less developed countries have opportunities for faster rates of growth than more developed countries insofar as they can adopt technologies developed elsewhere without having to do a lot of innovation on their own. They found that all four of the factors highlighted — IQ, economic freedom, the rate of capital investment, and the advantages of backwardness — had a noteworthy impact on the rate of growth. The impacts of intelligence and economic freedom, respectively, were claimed to be similar in magnitude.

As far as more mainstream growth journals are concerned, Garett Jones and William Schneider (2006) introduced IQ to the *Journal of Economic Growth*. Jones and Schneider's audacious research pitted IQ against the variables used

in the regressions of Sala-i-Martin, which had been updated two years before (Sala-i-Martin et al., 2004). Jones and Schneider ran a thorough variety of regressions, numbering in the thousands, which was not a very auspicious format for IQ given the strong possibility that IQ would be correlated with many of the other explanatory variables. One might think that the regressions would be unable to disentangle an independent effect of IQ on economic growth, but they did. It was found to have an extremely robust impact. From 1960-1996, each additional point added to a country's average IQ was estimated to add 0.11 percentage points to the annual rate of growth.

In both the 2006 article and a related piece a few years later (Jones & Schneider, 2010), the authors downplayed the possible existence of reverse causality. The Flynn effect suggests that a country's average IQ can be significantly increased by improvements in living conditions such as education, dietary quality, literacy, health, and other socioeconomic factors. Jones and Schneider nevertheless maintained that their results were not confounded by possible causality running from economic growth to IQ.[2]

Rindermann (2007) made a notable contribution by showing that countries' average IQ scores are highly correlated (r>0.80) with their average scores on student achievement tests such as those of the Programme for International Student Assessment (PISA). This research helped to validate Lynn and Vanhanen's international IQ data set, which was expanded and updated in 2006 and 2012 (Lynn & Vanhanen, 2006, 2012) and is now continuously updated online (Becker, 2019). The IQ scores are more plentiful than the student achievement scores, covering a much greater number of countries. Hanushek and Woessmann (2008, 2012) re-emphasized the relevance of countries' student achievement scores. A World Bank paper (Angrist et al., 2019) was similar in spirit.

In another paper, Rindermann (2008) undertook a cross-lagged path analysis and found two-way causality between IQ and economic welfare, but with more causality from IQ to economic welfare than the reverse. Both standard IQ tests and student achievement tests were used to assess "cognitive

[2] Jones and Schneider were cognizant of Flynn effects. However, the international IQ scores published by Lynn and Vanhanen made adjustments for them, assuming gains of 3 points per decade in all countries. The question then became whether there was a substantial amount of shifting of the *adjusted* scores relative to British norms as economic growth occurred. Jones and Schneider concluded that there was not. The present paper revisits this issue in Section 4.

competence". Economic freedom was included in the analysis, but had a weaker impact than cognitive competence on subsequent economic outcomes.

Jones (2012) used as a dependent variable the growth rate of total factor productivity, defined as output per unit of input. For the 1960-1996 time period, he pitted IQ against education, measured in terms of years of schooling, and he also pitted IQ against 66 other variables in Sala-i-Martin's data set (IQ data from the 2nd edition of the Lynn-Vanhanen data set). A principal finding was that, with IQ in the regressions, years of schooling did *not* have a robust impact on the rate of growth. Nor did *any* of the other variables have a robust impact, including the degree of capitalism (as assessed by Hall & Jones, 1999).

3. Case Studies: Korea, Chile, China, and New Zealand

The performance of the Hall-Jones variable for the degree of capitalism was disappointing in the updated version of Sala-i-Martin's research and also in Garett Jones' 2012 paper. The fall of the Berlin Wall seemed to be conclusive evidence for capitalism's superiority vis-à-vis socialism, so why wasn't the degree of capitalism more robust in growth regressions? Does IQ definitely have a greater impact on economic growth than public policy? In this section we look at countries that can help to shed light on the matter: Korea, Chile, China, and New Zealand. The following section discusses new regression work.

Korea

A controlled experiment would seem to have been conducted in Korea. The two Koreas, North and South, are populated by similar peoples and share the same language. South Korea clearly has been more capitalistic than North Korea. According to the economic freedom index of the Fraser Institute, South Korea stood at 5.84 in 1970 (on a scale from 0 to 10), and the degree of capitalism gradually increased to 6.92 in the year 2000 and 7.21 in 2001 (vs. 8.47 in the US). In the 8-variable version of the economic freedom index, China stood at 2.31 in 1960, and in 1980 (according to the comprehensive version of the index) it stood at 3.64. We can thus surmise that North Korea has been below 4.00, perhaps far below 4.00.

Estimates of per capita living standards in North Korea are sketchy, but the Penn World Tables, Version 6.2 provide some estimates for 1970-2003. The consensus view is that prior to World War II, the North was somewhat more industrialized than the South; the South was more agrarian. Average living standards in the South started to surpass those in the North in the late 1960s. By 1990 average living standards in the South were almost 6 times as high, despite support given to the North by the Soviet Union. When support collapsed with the

dissolution of the USSR, a nationwide famine ensued. By the year 2000 average living standards in the South were more than 10 times as high as those in the North.

Chile

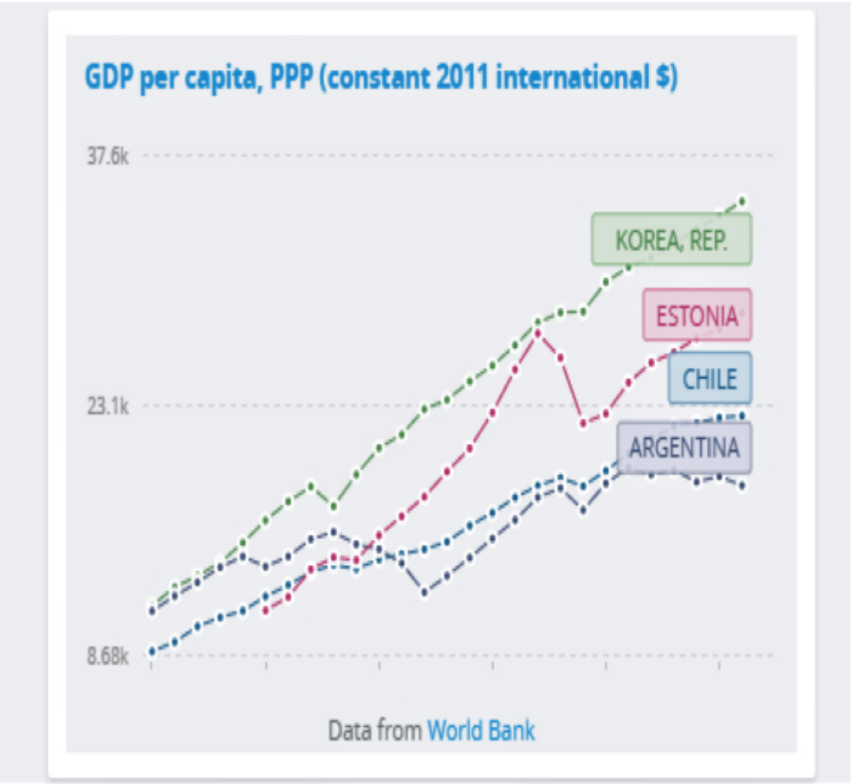

Figure 1. *Growth from 1990-2016 in selected countries*

In 1970 average living standards in Chile were below those in Argentina, but higher than those in South Korea (Penn World Tables 9.0). In that year Salvador Allende, an ardent socialist, became Chile's president. In 1973 the Allende government was overthrown. The coup was led by General Augusto Pinochet. Pinochet enlisted as advisers the so-called "Chicago Boys", who promulgated free market policies recommended by University of Chicago economists Milton Friedman and Arnold Harberger, whose wife was Chilean. In 1975, the degree of capitalism stood at only 3.34. It then rose steadily and reached 7.36 by the year

2000. More recently, it has been 7.80, close to that in the present-day United States. Meanwhile, the degree of capitalism in Argentina has been more erratic and fell below 5.00 starting in 2013. Per capita GDP in Chile surpassed that in Argentina early in the 21st century and is now a few thousand dollars per person above its neighbor. Average living standards in Chile were below those in Venezuela in 1975, but are now comfortably higher, as economic freedom in the latter country essentially disintegrated, falling below 3.00 in recent years.

Another victory for capitalism? Yes, but note that Eastern European countries such as the Baltic states — Estonia, Latvia, and Lithuania — which have had comparable changes in economic freedom to those in Chile, are now *richer* than Latin America's model country. Chile's average living standards are closer to Argentina's than they are to Estonia's. Furthermore, South Korea, which has less economic freedom than Chile, is now far ahead of it in terms of per capita GDP. Figure 1 above offers line graphs over time for South Korea, Estonia, Chile, and Argentina.

China

China is of extreme importance for both its history and its size. IQ testing, which is a comparatively recent phenomenon in the country, generally indicates that China has high average intelligence. Yet, China was historically backward and mostly illiterate. It did not catch up to *North* Korea in terms of average living standards until 1989 (Penn World Tables, Version 6.2). According to the Barro-Lee (2013) data on educational attainment, in 1955 the average amount of formal schooling of Chinese adults, age 25 and above, was only 1.09 years. By 1980 it had increased to 4.16 years, and in 2010 it had reached 7.53 years.

The hyper-communist regime of Mao Zedong lasted from 1949-1976. After a struggle for power, Deng Xiaoping emerged as a pragmatic leader who launched economic reforms in 1979. From 1980-1985, the degree of capitalism increased from 3.84 to 4.82. By 1990 it had fallen back to 4.09, but it then increased for most of the time until 2016, when it was 6.46. During the same period of time Mexico was mostly above 6.00 and was at 6.90 in 2016. Adjusted for inflation, China's per capita GDP, according to a recent version of the Penn World Tables (PWT 9.0), increased at an average annual rate of 1.84 percent from 1955-1980. From 1980-2014, it grew at an average annual rate of 6.05 percent, which enabled China to *double average living standards about every 12 years*.

In 1955 Mexico's average living standards were 5 times as high as China's. In terms of what US dollars could buy in 2011, China was at $1000 per person in 1955, and Mexico was at $5000. In 1980, *Mexico's living standards were about 7 times as high,* because Mexico had been growing faster than the People's

Republic. Since 1980, however, China has essentially eliminated the gap in living standards. It is tempting to credit China's growth to its adoption of increasingly capitalistic institutions. Note, however, that Mexico continues to have somewhat greater economic freedom, and even now, its adults have had as much or more schooling than China's. But — barring political upheaval or massive policy reversals — does anyone *not* believe that China will pull away from Mexico in terms of average living standards in the years ahead? China has much higher average IQ (104 vers. 88), and it devoted 35 percent of GDP to capital investment from 1995-2014.

New Zealand

In 1950 average living standards in New Zealand were not far below those in the US. By 1970 they still were more than 3/4 as high. By 1985, they were less than 3/4 as high and by 1990 they were less than 2/3 as high. New Zealand embarked on a thorough program of economic reforms during the late 1980s and 1990s. Economic freedom was below 6.00 for most of the time from 1950-1980. By 1990 it was 7.86, and in 1995 it reached 8.84 (!). Since 1995 it has been significantly above 8.00 — mostly higher than in the United States. Growth from 1995-2016 was somewhat greater in percentage terms than that in the US, but average living standards remain below 2/3 of the US level.

Summary

In the case of Korea, capitalism seems clearly to have shown its superiority over government planning. Chile also represents a strong showing for increases in economic freedom, but in relative terms, the country's performance vis-à-vis South Korea, Estonia, and Poland has not been so impressive. Based on IQ testing, the other countries have smarter people on average. It is tempting to credit an increase in economic freedom for much of China's growth since 1980, but its improved literacy also deserves mention. High average IQ is another factor that merits attention as a factor in China's growth, raising questions as to what the IQ level was during earlier decades. As for New Zealand, its economic growth rate has been only a little higher than that for the US despite very high economic freedom and some advantages of backwardness.

Pre-regression hypotheses

It is hypothesized that increasing the degree of capitalism has a strong impact on the rate of economic growth in cases where economic freedom starts at a very low level — for example, at 3 or 4. In cases where the level of economic freedom is already at 6 or 7, raising it to 8 or even 9 (close to Hong Kong's level)

seems not to have as much of an impact on the rate of growth. On the other hand, IQ seems to have an impact that is quite robust. High IQ best explains why China is in the process of passing Mexico in terms of average living standards, and why South Korea, Estonia, and Poland are richer than Chile. There may be diminishing returns to increases in economic freedom, but, as a rule, there do not seem to be diminishing returns with respect to increases in average IQ. It must be said, however, that Japan has a very high average IQ and has not grown very fast in recent decades.

4. Data Limitations, New Regression Work, and Early Findings

At this point, data on economic freedom for the Soviet Union and Eastern Europe is very limited for the years from 1955-1990. Much more data is available from 1995 onward. Official GDP estimates for Venezuela became unavailable after 2014, at a time when its economic freedom had become less than 3.00. Of course, economic freedom data for North Korea is non-existent, and GDP estimates are also very difficult to come by. While public policy is discussed here mostly in terms of the degree of capitalism, it should be noted that public policy can also affect educational attainment (i.e., years of schooling) and rates of saving and investment.

This paper undertakes a new regression analysis with the help of David Becker's (2019) recent work on country IQ levels as well as the Fraser Institute's estimates of the degree of capitalism in each country over time. Of particular interest is whether the findings of Jones and Schneider on IQ and growth can be replicated with the Becker data set. The Barro-Lee (2013) data set offers estimates of educational attainment (average number of years of schooling) for adults age 25 or higher for most countries until 2010. World Bank estimates of per capita GDP are used, measured in terms of the purchasing power of US dollars in 2011. The Penn World Tables (Version 9.0) offer related data, including information about saving and investment as a percent of GDP through 2014. The variable used here is abbreviated as 'csh_i' and refers to gross capital formation as a percent of GDP.

Becker computed a weighted average for IQ in each country based on the quality of the samples used by IQ researchers and the number of test-takers at each test administration. He includes the results of student achievement tests, converted to an IQ scoring scale. See his Column F under the 'FAV' tab for Version VI.3.2. Lynn and Becker (2019) have published a book based on Version VI.3.1. Becker's data set includes IQ estimates for countries where no acceptable formal testing has occurred. The estimates are obtained by looking at the IQs of neighboring countries. By the time of the second edition of Lynn and Vanhanen's

IQ data set, testing had been undertaken in many countries that had not been tested before. The Pearson correlation coefficient between the new country IQ estimates and the estimates that had previously been done on the basis of the IQs in neighboring countries was .913. The suggestion is thus that the use of IQ scores from neighboring countries is quite reasonable in cases where a country has not had formal testing.

Countries with populations below 1 million are not included in the research for the present paper. Thus, Estonia and Botswana are included in this paper's core data set, but St. Lucia, in the Caribbean, is not.

The very low average IQ scores that have been calculated by Becker for some countries have sparked controversy. The problem is that, for some test-takers, answering the questions on an IQ test is little more than guesswork. The general approach of Lynn and Vanhanen in such cases was to view the test-takers as having low IQ's, but they did not take the test results literally. Instead, they scored the test-takers at the 1st percentile for the test, based on British norms. Thus, the average score on the test was put at 64 in many cases (where average British IQ would be 100). This paper simply disregards the countries estimated by Becker to have an average IQ below 60.

Disregarding super-low scores, the range of average IQ scores for world regions is shown below (with average British scores on standard IQ tests set at 100). Singapore, Israel, and Sudan have been singled out for having national IQs that are distinctly higher than the ranges given for their respective regions.

Northeast Asia	102-107
Europe	87-102
Southeast Asia	79-100 (Singapore = 106)
Latin America	77-88
North Africa/South Asia	63-89 (Israel = 92)
Sub-Saharan Africa	63-76 (Sudan = 78)

Wicherts et al. (2010) found that the correlation between scores on Raven's IQ tests and *g*, a general factor of intelligence extracted from the results of cognitive-ability subtests, is .55 in samples from sub-Saharan Africa. This correlation is not as strong as the .80+ figure typical in Western countries, but it is still respectable. The IQ scores give credence to the existence of substantial differences in average *g* between sub-Saharan Africa and other world regions. They are predictive of African educational outcomes.

Whether there is strict measurement invariance between African and Western IQ scores, as maintained by Taylor (2008), is debatable. Wicherts et al.

(2010) were skeptical. Jones (2012) has said that if the IQ scores across countries and world regions are "biased", then "they appear to be biased in favor of productivity growth." The present paper uses new IQ data to see how well the new data explains growth differences across countries.

For the present paper there are 80 countries with populations above 1 million that have both IQ data and data for the other variables of interest for (almost all of) the years from 1995-2016. The data for these 80 countries is referred to as the "core data set". Including countries whose IQs were imputed from those in neighboring countries, the sample size is 94. None of the additional countries has a very advanced economy, and there may be above-average measurement error in the added data.

A serious question that this paper tries to address is the extent to which regression results involving IQ are affected by reverse causality. A country's average IQ could affect its economic growth, but economic growth, in turn, could possibly affect its average IQ. Note, first, that Becker's IQ data set *already* offers adjustments for the so-called Flynn effect — the inflation in raw IQ scores that seems to have occurred in many countries over time. This inflation may have been caused in part by improvements in nutrition and education. Many researchers do not regard the increase in raw scores as a "real" gain in intelligence, but a rise of specialized cognitive skills. For example, there has been very little change in arithmetic and vocabulary scores.

For the present paper, the regression work tests for possible reverse causality that goes beyond a routine inflation in raw IQ scores. The paper has addressed the matter by selecting out IQ research involving representative, normative, or random samples that was published during the 1990s or before. For each country, a median average IQ is determined from the average IQ results of the selected samples. This median average IQ is then used in regressions.

Economic growth in the late 1990s and since the year 2000 could possibly have affected some IQ test results (adjusted for Flynn effects) during the last two decades, but this growth could not have affected the results for test administrations of earlier years. IQ research with publication dates before the year 2000 is thus used to control for (almost all of) the possible reverse causality; the IQ tests themselves would have been taken at earlier times than the publication dates. Before the advent of the Internet it was common for test results to be published one or two years after the date of the test administration. However, the approach taken here shrinks the study's sample size very noticeably, and we are left with 45 countries that have both the relevant IQ data and data for the other variables.

The results of the regressions are therefore presented in three parts. One part refers to the 80 countries with complete data, regardless of the time of the IQ testing. A second part refers to 94 countries, including ones whose IQs were imputed based on IQ scores from neighboring countries, and a third part refers to the 45 countries in the Becker data set that have acceptable IQ data from the 1990s and before.

The Model

The dependent variable in this paper is the average annual rate of per capita GDP growth, measured as the average annual change in the natural logarithm of per capita GDP (adjusted for inflation) from 1995-2016. The average logarithmic change is multiplied by 100 for convenience. The explanatory variables used include a country's average IQ, which enters the regression equation in a linear form, as has been standard in the economics literature (Cawley et al., 1996; Dickerson, 2006).

The other variables in the regressions are as follows:

(1) *The country's per capita GDP level in 1995, expressed as a natural logarithm, multiplied by average IQ*

Going back to Alexander Gerschenkron (1962), economists have argued that countries that start at a lower level have an opportunity to grow faster in percentage terms than the countries ahead of them. In traditional models of economic growth, the more backward the country is, the greater the expected growth. However, Benhabib and Spiegel (1994, 2005), building on the work of Nelson and Phelps (1966), developed a model in which technological advancement depends on human capital, measured in terms of years of education. Below a critical level of human capital, a country may still grow, but its ability to innovate and to adopt other countries' technologies may be stunted to such an extent that it falls further and further behind advanced economies. Indeed, the authors highlighted specific countries that were falling further and further behind.

Jones (2012) relied on the work of Benhabib and Spiegel, but used IQ instead of years of education as his measure of human capital. Jones included an interaction term for IQ and the natural logarithm of productivity at the beginning of the period under study, but (as with Benhabib and Spiegel) the logarithmic-level of productivity itself (measured at the beginning of the period under study) did not enter the model as a non-interacted variable. A noteworthy empirical

finding of Jones (2008, p. 7) was that the sign and statistical significance of the interaction term does not depend on whether the non-interacted term is included.[3]

(2) *The natural logarithm of average educational attainment in 1995*

The logarithmic specification has built into it an assumption of diminishing returns to schooling. Primary education is alleged to be especially important for economic growth, as claimed by Sala-i-Martin (1997). Secondary and tertiary education may also contribute to economic growth, but additional years of schooling do not (it is claimed) contribute as much (per year) as the early years devoted to learning reading, writing, and arithmetic. This specification was formally tested and accepted. Economic growth after 1995 is likely to have affected educational attainment in many countries. Developed countries can afford to send more children to school for longer periods of time than poorer countries. In order to isolate the impact of education on economic growth — and control for possible reverse causality — we ignore changes in average educational attainment that occurred after 1995.

(3) *The natural logarithm of the average amount of economic freedom that the country had from 1995-2016*

Again, the logarithmic specification assumes diminishing returns. Transitioning from communism to a market economy with significant taxation, regulation, and government spending is claimed to improve economic growth more so than changing a Western market economy into one resembling Hong Kong (which has had comparatively little taxation, regulation, or government spending).

(4) *Gross capital formation as a percent of GDP, averaged for the years from 1995-2014*

Investing a substantial amount in new equipment, new facilities, and research & development is assumed to contribute more to economic growth than devoting almost all income to consumption.

---

[3] The research for the current paper likewise found that the sign and statistical significance of the regression coefficient for the interaction term is unaffected by inclusion of the non-interacted term. It should be emphasized that non-inclusion of the non-interacted term is not simply an arbitrary preference; the model specification was derived by Benhabib and Spiegel. Benhabib and Spiegel also estimated the parameters of a model in which the non-interacted term *was* used on the assumption that the growth rates of the least developed countries should be especially high, but their specification tests ended up rejecting this assumption.

(5) *Dummy variables for Northeast Asian ancestry and sub-Saharan African ancestry*

It is possible that there are idiosyncratic non-IQ factors that affect the economic growth experienced by various peoples. Note that Singapore is included here as a country of predominantly Northeast Asian ancestry; Han Chinese developed out of tribes thousands of years ago in the Yellow River valley of northern China. Haiti and Jamaica are included as sub-Saharan African.

(6) *Absolute latitude*

This is measured in degrees, but referring to distance from the equator. People who must live and work in tropical conditions are alleged to be disadvantaged in comparison to those who live in more temperate zones.

Results

Least-squares regressions were run on the model. As mentioned, the main results are presented in three parts. For the core data set of 80 countries, the model performs well, explaining more than 70 percent of the variance in growth rates across countries. All of the explanatory variables are statistically significant at least at a 1% level. The standard error of the regression is 0.9; on average, a country's rate of growth, as predicted by the model, is 0.9 percentage points different from the actual growth rate. See Table 1 below.

Table 1. *OLS regression models predicting average annual growth rate of per capita GDP, 1995-2016. logGDP is logarithm of per capita GDP in 1995. Three models are shown with the IQ core data set (Model 1), core data set + estimates (Model 2), and the smaller data set of countries having pre-2000 IQ scores (Model 3). Unstandardized betas with t-statistics in parentheses. * p<.10; ** p<.05; ***p<.01; **** p<.001.*

	Model 1	Model 2	Model 3
IQ measured	0.1795 (6.3642)****		
IQ measured + imputed		0.2226 (7.5893)****	
Pre-2000 IQ			0.1815 (4.7960)****
IQ * logGDP	-0.0227 (-11.8683)****	-0.0232 (-11.2954)****	-0.0211 (-6.8172)****
log (capitalism)	3.4745 (3.2696)****	2.3905 (2.1745)**	2.4545 (1.4855)*

	Model 1	Model 2	Model 3
log (education)	1.6803 (3.8079)****	1.3275 (3.4317)****	1.2851 (1.7215)**
Investment/GDP (x 100)	0.0813 (3.2587)****	0.0734 (2.8983)***	0.0840 (2.3579)**
Northeast Asian	1.3862 (2.3965)***	0.8680 (1.3082)*	1.4054 (2.0867)**
Sub-Saharan African	-2.5023 (-6.3063)****	-2.2878 (-5.5626)****	-3.2623 (-5.8469)****
Latitude	0.02418 (2.8469)***	0.0143 (1.5213)*	0.0243 (1.9142)**
N	80	94	45
R^2	.71	.65	.72

The coefficient for average IQ in the regression for the core data set is 0.1795, disregarding for now the variable referring to additional opportunities for rapid growth that less-developed, high-IQ countries may have. The coefficient for IQ is somewhat higher here than the estimate of Garett Jones (0.11). A logarithmic specification for IQ does not fit the data very well, suggesting that IQ does not suffer from diminishing returns in its effects on economic growth.

The coefficient for average IQ in the regression involving the 45 countries with acceptable pre-2000 IQ data (0.1815) is similar to the one for the core data set, indicating that a regression almost completely devoid of reverse causality nevertheless shows a strong relationship between IQ and growth. The coefficient is statistically significant at a 0.1 percent level. The association between IQ (adjusted for Flynn effects) and economic growth is therefore viewed as a causal relationship, with most of the causation going from the former to the latter. Garett Jones (2012) obtained the same kind of result with pre-1970 IQ scores. In another study, Christainsen (2013) found statistically significant reverse causality (beyond standard Flynn effects), but only of a modest magnitude.[4]

[4] East Asia probably constitutes the most important outlier during the last several decades. Te Nijenhuis, Cho, Murphy, and Lee (2012) found that accelerated Flynn effects occurred first in Japan and then in South Korea. Rapid economic growth appears to have produced substantial gains in average IQ, measured against British norms. Somewhat later, China may have gone through a similar process. Raven, Raven, and Court (1999) found that by 1986, Chinese children were matching British children in terms of average IQ, but that Chinese who were one or two generations older had average scores that were

The coefficient of the dummy variable for sub-Saharan ancestry is quite negative and significant at the 0.1 percent level. Low sub-Saharan African (SSA) IQ scores help to account for low rates of growth, but there also are other factors that seriously depress the economic performance of SSA countries. Candidates for the "other factors" include a lack of navigable rivers and a very high parasite load. In the data set with 94 countries there are four sub-Saharan African countries with negative growth. Haiti and Jamaica also had negative growth from 1995-2016.

To give the reader a sense of the magnitudes involved: the average country IQ for all the sub-Saharan nations in the core data set is 71.45. According to Becker the average IQ of the whole world is 81.98, a difference of 10.53 points. Based on the coefficient for the IQ variable, low sub-Saharan IQ thus reduces economic growth, including growth in Haiti and Jamaica, by about 1.9 percentage points per year compared to the world average. Other factors (besides latitude, noted below) reduce it by 2.5 percentage points, as indicated by the coefficient for the sub-Saharan dummy variable. As far as latitude is concerned, the estimates here indicate that the tropical nature of the countries reduces the average annual growth rate even further — about 0.5 percentage points comparing countries at the equator with those at the tropic of cancer or the tropic of capricorn, at latitude ±23.4.

The regression coefficient for Northeast Asians is positive and significant. If it is true, for example, that Northeast Asians work especially hard on average, they would be able to adopt foreign technologies faster than would otherwise be the case, and thereby achieve higher growth rates. Dummy variables were also tried for Latino countries and for 15 countries heavily dependent on oil production, but their respective coefficients were not statistically significant even at a 10 percent level.

In the core data set the variable for the logarithmic measure of economic freedom performs well. A quadratic form for economic freedom performs equally well. The F statistic for the joint impact of the relevant variables (economic freedom and economic freedom-squared in the case of a quadratic form) is greater than 5, which indicates statistical significance at a 1 percent level. Considering the core data set and the data set with 94 countries, the relevance of the degree of capitalism for the average annual rate of economic growth is summarized in Table 2 for the case of a logarithmic specification.

---

a half or a full standard deviation *lower* than their British counterparts. More recent IQ testing finds that Chinese children score *higher* than their British counterparts.

Table 2. *The effect of economic freedom on the annual rate of economic growth, 1995-2016.*

Change in Economic Freedom	Change in economic growth rate	
	Core Data Set (N=80)	Alternative data + estimates (N=94)
From 3.00 to 6.00:	+2.41 pct. pts.	+1.66 pct. pts.
From 6.00 to 7.00:	+0.54 pct. pts.	+0.37 pct. pts.
From 7.00 to 8.00:	+0.46 pct. pts.	+0.32 pct. pts.

A change in economic freedom from 3.00 to 6.00 would be typical for a post-communist country that has not yet fully adjusted to the demands of a market economy. Further changes in economic freedom might produce additional benefits, but would typically encounter diminishing returns. Of course, there may be other policy objectives besides economic growth.

To offer some perspective, remember that the standard error of the regression for the core data set is 0.9. The model is imperfect. In the larger data set (N = 94), the degree of capitalism has a somewhat milder impact on economic growth. Keep in mind that China now greatly outperforms Mexico, which has had somewhat greater economic freedom. South Korea has outperformed Chile, a paragon of economic reform.

Country differences in average IQ often matter more for economic growth than differences in economic freedom. 7½ points (one half of a standard deviation on a standard IQ scale) added to average IQ clearly mean more for the rate of economic growth than a change in the degree of capitalism from 7.00 to 8.00, which is the range in which left vs. right political debates in developed countries are typically waged.

Poland's average IQ is a little less than 8½ points above Chile's. From 1995-2016, Poland's average economic freedom score (6.78) was a little less than a full point *lower* than Chile's, but its average annual rate of growth was more than a full percentage point *higher*. In fact, 5 or fewer extra IQ points may be worth more than a change in economic freedom from 7.00 to 8.00, depending on the regression coefficients used for the calculation. On the other hand, countries with average IQs in the 80s have had better economic growth than North Korea.

China has had dramatic institutional change since 1979. The degree of capitalism increased by almost 3 full points until 2016. China's economic freedom score still is less than 7.00, but its workforce is now more literate as well as intelligent. Based on the model and the core data set regression results, China's

institutional change increased its growth rate by 2 percentage points per year compared to what it otherwise would have been.

Does high IQ affect economic performance directly, or does human capital's impact operate via an effect on institutional quality, as claimed by Adams-Kane and Lim (2016)? In this paper's core data set, the correlation between average IQ and the degree of capitalism is .62. Smart countries tend to have better institutions, which contribute to growth. In the path analysis of 201 countries by Rindermann, Kodila-Tedika and Christainsen (2015), IQ had a direct impact on productivity, and the IQ of governing elites very much affected "government effectiveness" (a World Bank concept) via impacts on innovation, economic freedom, and "competitiveness" (as defined by the World Economic Forum). IQ thus had a straightforward economic effect and an indirect one operating through institutions. Jones and Potrafke (2014) had previously found that cognitive ability does indeed enhance institutional quality.

On the other hand, the regression work in the present paper emphasizes that institutions also have effects on economic performance that are independent of cognitive ability. If an additional term for the interaction of IQ and the degree of capitalism (in logarithmic form) is added to the regression for the core data set, the coefficient for IQ becomes 0.14 and the coefficient for the interaction term carries a positive sign, but it is not statistically significant. Adjusted for the degrees of freedom in the regression, the R^2 falls slightly.

5. Discussion

Sala-i-Martin et al. (2004) have warned that coefficient estimates for a single model and data set may be unreliable. Estimates may change from one model to the next and one data set to the next. It is safer to average estimates and interpret the averages with a good dose of judgment. Ironically, Sala-i-Martin et al. ignored the perhaps most robust regressor of them all, IQ. Without clinging to a single coefficient estimate, we can say confidently that the impact of IQ is strong and highly certain in a statistical sense. We also can say confidently by now that the impact is causal although some reverse causality also exists. Jones's and Schneider's (2006) results do replicate with Becker's data set.

With the Flynn effect having stopped and even (to some extent) reversed in some countries, especially in Northern Europe, many commentators, for example, Gerhard Meisenberg (2014), have talked of a *narrowing* of IQ differences as other countries continue to have gains in raw scores. However, insofar as a positive Flynn effect continues in China, China's IQ advantage over Northern Europe is likely to *widen*.

Wicherts and co-authors (2010) argued that the Flynn effect had not yet taken hold in sub-Saharan Africa. However, for the Becker data set the slope of a trend line for the average IQ scores (adjusted for Flynn effects) of 60 sub-Saharan African test administrations based on representative, normative, and random samples is not statistically different from zero (+0.01 IQ points per year).

The publication dates for the African IQ data spanned a period from 1966-2019, but most of the scores are comparatively recent. In the case of six test administrations for which Becker calculated the average IQ score to be below 60, the average was put at 60. If those test administrations are simply disregarded, the time trend becomes somewhat negative (-0.06 IQ points per year), but again, it is not statistically different from zero. In other words, test scores in sub-Saharan Africa, adjusted for Flynn effects, have not been showing an appreciable tendency to move either up or down since the 1960s. The implication is that the raw scores *have* crept up in accordance with standard Flynn effects. If they had not, the slope of the trend line for the scores, adjusted for standard Flynn effects, would have been significantly negative. Whether reverse causality will emerge in a big way in sub-Saharan Africa remains to be seen.

Recall that IQ may operate in part by facilitating countries' adoption of technologies developed elsewhere. The research for this paper also tested whether "advantages of backwardness" may exist with the help of education. If one takes "the log of per capita GDP in 1995" and multiplies it by educational attainment instead of IQ, strong regression results are still often obtained. The statistical problem is that the correlation between "log of per capita GDP in 1995, multiplied by IQ" and "log of per capita GDP in 1995, multiplied by educational attainment" is 0.95 in the core data set. It is difficult to separate out all of the independent effects of IQ and education, respectively. Some of the credit given to IQ in this paper may belong to education, insofar as "advantages of backwardness" are concerned.

In a similar fashion, human capital can improve institutional quality, but some improvement can be achieved through education, even if a country does not have high average IQ. Rwanda saw its economic freedom score rise from 3.71 (1995) to 7.48 (2016) after a terrible civil war in the early 1990s. Respectable economic growth (an average annual rate of 4.61 percent from 1995-2016) then occurred despite low average IQ (70). Of course, this growth started from a very low base.

In general, regressions for this paper that explicitly employed education in interactions with other variables did not explain as much of the variance in the dependent variable as regressions that featured IQ in such interactions. If IQ has a strong causal effect on economic growth, are biogeographic factors involved? Do average IQ differences across peoples and countries have a genetic

component? Research is ongoing. Consider turn-of-the-century data for the following countries: China, Mexico, Qatar, Dominica, and Barbados (Table 3).

Table 3. *Per capita GDP and biological conditions in some countries.*

	IQ	GDP 1999	Malnutrition (WHO)	Parasite prevalence	Avg. brain Size (c.c.)	Polygenic score Edu
China	104	4	253	986	1420	1.09-1.61
Mexico	88	16	241	787	1341	-0.29
Qatar	81	108	180	605	1325	?
Dominica	66[5]	8	149	950	1305	?
Barbados	80	15	123	1372	1304	-1.30

Data Sources: IQs from Becker (2019) (Version VI.3.2) except for Barbados (Lynn & Vanhanen 2012 used a reasonably representative sample for Barbados; Becker's Barbadian samples are not representative); per capita GDPs (in 1000 $) from the World Bank; malnutrition and parasite prevalence data from the WHO (2004), 'DALY' measure used to assess parasite prevalence; average brain size data from Becker's 'NAT' tab, Column FU; genetic variant polygenic scores from Piffer (2019a), weighted by the extent of each variant's association with educational attainment (estimate for Mexicans obtained from Mexican-Americans in Los Angeles).

China has had higher average IQ than the other countries despite having had worse living conditions. It has had more malnutrition and a heavier parasite load than the other countries, except for Barbados, which has had greater parasite prevalence. With reference to the above table, if it is said that high average test scores reflect "Chinese culture", one must first confront the fact that Chinese also have significantly higher average brain size, despite having had greater malnutrition. The most recent evidence shows that, even among individuals in the same family (whose members share the same natural and social environment), the relationship between brain size and intelligence is positive, albeit moderate, and it is causal (Lee et al., 2019).

Brain size is of interest as a biogeographic variable, but nobody claims that it is a dominating consideration. As far as direct genomic research is concerned, the process has moved from its early stages into a middle period, with provocative findings but still plenty of scope for doubters. Based on a recent genome-wide association study (GWAS) of 1.1 million people that identified more than 2,400 genetic variants linked to educational attainment (Lee et al., 2018), Chinese are

[5] The work of Meisenberg, Lawless, Lambert, and Newton (2005) suggests a higher figure, but less than 80.

considerably more likely to have the trait-increasing alleles than people descended from sub-Saharan Africa (Piffer, 2019a). Ethnic Europeans also are more likely than sub-Saharan Africans to have these alleles.

The GWAS was done primarily on ethnic Europeans. If the analysis is limited to genetic variants that already were present in Africa before large-scale out-migrations to other continents 60,000 to 100,000 years ago, there is a slight narrowing of the sub-Saharan/ethnic European difference in the frequency of the highlighted alleles, but it still favors ethnic Europeans decisively. On the other hand, the differences between ethnic Europeans and various East Asian populations (favoring the East Asians) *widen* (Piffer, 2019b). Why are cognitive alleles that presumably originated in Africa more common among ethnic Europeans and East Asians than among Africans?

The focus of the GWAS was educational attainment, which reflects intelligence, but it also may reflect conscientiousness, as noted by Piffer (2019a) and shown by Smith-Woolley, Selzam and Plomin (2019). The correlation between the polygenic scores for the 2400+ educational attainment alleles and factor scores (Piffer, 2017) for 18 IQ alleles identified by Sniekers et al. (2017) is .94. The polygenic scores and factor scores were calculated for the 26 population groups of the *1000 Genomes* data set, based on DNA from people on five continents. It would be desirable to have more GWAS's done on sub-Saharan Africans and ethnic Chinese, respectively, but Chinese already outscore ethnic Europeans on IQ tests written by ethnic Europeans, and they have higher polygenic scores than ethnic Europeans for genetic variants that were deemed relevant by studying ethnic Europeans.

Jews are not represented in the *1000 Genomes* data set, but when the new *gnomAD* data set is used, the obtainable polygenic scores are predictive of a higher average IQ for Ashkenazi Jews than for East Asians (Piffer, 2019a; see also Dunkel et al., 2019).

People of sub-Saharan African (SSA) descent tend to have significantly smaller brain volumes on average than ethnic Chinese even in cases where the SSA's have been somewhat better nourished, a difference of about 8 percent. On average, SSA's score reasonably well on tests of short-term memory — probably better than Amerindians — but when asked to recite a series of digits in *reverse* order, the performance of SSA's relative to other population groups deteriorates (Ganzach, 2016).

Kirkegaard et al. (2019) found that, across self-identified racial and ethnic groups in the US, biogeographic ancestry has a significant effect on cognitive ability. Among African-Americans with various amounts of European admixture, Lasker et al. (2019) found higher European admixture to have a positive effect on

cognitive ability, with the relationship being substantially mediated by polygenic scores for educational attainment (based on the aforementioned 2400+ relevant alleles). For *both* the monoracial African-Americans and the ethnic Europeans in the study, the polygenic scores were predictive of *g*.

There is a consensus among intelligence researchers that, by adulthood, IQ differences across individuals are influenced by genetic differences (Plomin & Deary, 2015). In the most recent survey of researchers, education differences were most often cited as the leading cause of differences in average IQ scores across countries. Genetic differences were the second most-cited factor (Rindermann, Becker & Coyle, 2016). The hypothesis of Rushton and Jensen was that differences across ethnic groups in average IQ are 50% due to genetic differences and 50% due to differences in natural and social environments. This paper transfers the hypothesis to country differences in average IQ. In the wake of research that now has been done, the hypothesis seems to be a reasonable one. In short, there is likely to be a significant genetic component to some of the major international IQ differences, with consequences for living standards, but we should be open-minded about the matter, and there is much more work to be done. In the spirit of Sir Karl Popper (2002), the hypothesis has not been proven to be true, but thus far it has not been falsified.

Funding: This research received no external funding.

Acknowledgment: The author would like to thank Emil Kirkegaard for helpful comments and for links to some of the reference material. John Fuerst and Gerhard Meisenberg also made helpful comments.

Conflicts of interest: The author declares no conflict of interest.

References

Acemoglu, D., Johnson, S. & Robinson, J.A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review* 91: 1369-1401.

Adams-Kane, J. & Lim, J. (2016). Institutional quality mediates the effect of human capital on economic performance. *Review of Development Economics* 20: 426-442.

Angrist, N., Djankov, S., Goldberg, P. & Patrinos, H. (2019). Measuring human capital. World Bank, Washington, DC, Discussion Paper 783, ISSN 0956-8549-783.

Ashraf, Q. & Galor, O. (2013). The 'out of Africa' hypothesis, human genetic diversity, and comparative economic development. *American Economic Review* 103: 1-46.

Barnett, S. & Williams, W. (2004). Review: IQ and the wealth of nations. *Contemporary Psychology* 49: 389-396.

Barro, R. & Lee, J.-W. (2013). A new data set of educational attainment in the world, 1950-2010. *Journal of Development Economics* 104: 184-198.

Becker, D. (2019). *The NIQ-dataset (VI.3.2).* https://viewoniq.org.

Benhabib, J. & Spiegel, M.M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics* 34: 143-173.

Benhabib, J. & Spiegel, M.M. (2005). Human capital and technology diffusion. In: P. Aghion & S. Durlauf (eds.), *Handbook of Economic Growth*, vol. 1, pp. 935-966. New York: Elsevier.

Carneiro, P., Heckman, J. & Masterov, D. (2005). Labor market discrimination and racial differences in premarket factors. *Journal of Law and Economics* 48: 1-39.

Cawley, J., Connelly, K., Heckman, J. & Vytlacil, E. (1996). Cognitive ability, wages, and meritocracy. NBER Working Paper 5645.

Chanda, A., Cook, C.J. & Putterman, L. (2014). Persistence of fortune: Accounting for population movements, there was no post-Columbian reversal. *American Economic Journal: Macroeconomics* 6: 1-28.

Christainsen, G. (2013). IQ and the wealth of nations: How much reverse causality? *Intelligence* 41: 688-698.

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

Dickerson, R.E. (2006). Exponential correlation of IQ and the wealth of nations. *Intelligence* 34: 291-295.

Dunkel, C.S., Pallesen, J. & Kirkegaard, E.O. (2019). Polygenic scores mediate the Jewish phenotypic advantage in educational attainment and cognitive ability compared with Catholics and Lutherans. *Evolutionary Behavioral Sciences* 13: 366-375.

Fryer, R. & Levitt, S. (2013). Testing for racial differences in the mental ability of young children. *American Economic Review* 103: 981-1005.

Fulford, S., Petkov, I. & Schiantarelli, F. (2019). Does it really matter where you came from? Ancestry composition and economic performance of US counties, 1850-2010. Boston College Working Papers in Economics, 28.

Ganzach, Y. (2016). Another look at the Spearman's hypothesis and relationship between digit span and general mental ability. *Learning and Individual Differences* 45: 128-132.

Gerschenkron, A. (2000). Economic backwardness in historical perspective. 1962. Reprinted in: S. Corbridge (ed.), *Development: Critical Concepts in the Social Sciences*, pp. 85-104. London: Routledge.

Glaeser, E., La Porta, R., Lopez-de-Silanes, F. & Shleifer, A. (2004). Do institutions cause growth? *Journal of Economic Growth* 9: 271-303.

Hall, R. & Jones, C. (1999). Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics* 114: 83-116.

Hanushek, E. & Kimko, D. (2000). Schooling, labor force quality, and the growth of nations. *American Economic Review* 90: 1184-1208.

Hanushek, E. & Woessmann, L. (2008). The role of cognitive skills in economic development. *Journal of Economic Literature* 46: 607-668.

Hanushek, E. & Woessmann, L. (2012). Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation. *Journal of Economic Growth* 17: 267-321.

Jones, G. (2008). Cognitive ability and technology diffusion: An empirical test. American Economic Association Annual Meeting. https://www.semanticscholar.org/paper/Cognitive-Ability-and-Technology-Diffusion-%3A-An-Jones-Mason/7ce646c68eb3bdad749af44a813f9a7cfde280c8

Jones, G. (2012). Cognitive skill and technology diffusion: An empirical test. *Economic Systems* 36: 444-460.

Jones, G. & Potrafke, N. (2014). Human capital and national institutional quality: Are TIMMS, PISA, and national average IQ robust predictors? *Intelligence* 46: 148-155.

Jones, G. & Schneider, W. (2006). Intelligence, human capital, and economic growth: A Bayesian averaging of classical estimates (BACE) approach. *Journal of Economic Growth* 11: 71-93.

Jones, G. & Schneider, W. (2010). IQ in the production function: Evidence from immigrant earnings. *Economic Inquiry* 48: 743-755.

Kirkegaard, E., Woodley, M., Williams, R. & Fuerst, J. (2019). Biogeographic ancestry, cognitive ability and socioeconomic outcomes. *Psych* 1(1): 1-15.

Lasker, J., Pesta, B., Fuerst, J. & Kirkegaard, E. (2019). Global ancestry and cognitive ability. *Psych* 1(1): 431-459.

Lee, J.J., Wedow, R., Okbay, A., Kong, E., Maghzian, O., Zacher, M., Nguyen-Viet, T.A., Bowers, P., Sidorenko, J., Karlsson Linnér, R. et al. (2018). Gene discovery and

polygenic prediction from a genome-wide association study of educational attainment in 1.1 million individuals. *Nature Genetics* 50: 1112-1121.

Lee, J.J., Iacono, W., Michael, A. & Chabris, C. (2019). The causal influence of brain size on human intelligence: Evidence from within-family phenotypic associations and GWAS modeling. *Intelligence* 75: 48-58.

Lim, S.S., Updike, R., Kaldjian, A., Barber, R., Cowling, K., York, H. … & Leaver, A. (2018). Measuring human capital: A systematic analysis of 195 countries and territories, 1990-2016. *Lancet* 392: 1217-1234.

Lynn, R. & Becker, D. (2019). *The Intelligence of Nations*. London: Ulster Institute for Social Research.

Lynn, R. & Vanhanen, T. (2002). *IQ and the Wealth of Nations*. Westport CT: Praeger.

Lynn, R. & Vanhanen, T. (2006). *IQ and Global Inequality*. Augusta GA: Washington Summit.

Lynn, R. & Vanhanen, T. (2012). *Intelligence: A Unifying Construct for the Social Sciences*. London: Ulster Institute for Social Research.

Meisenberg, G. (2014). Cognitive human capital and economic growth in the 21st century. In: T. Abrahams (ed.), *Economic Growth in the 21st Century: New Research*, pp. 49-106. Hauppauge, NY: Nova.

Meisenberg, G., Lawless, E., Lambert, E. & Newton, A. (2005). The Flynn effect in the Caribbean: Generational change of cognitive test performance in Dominica. *Mankind Quarterly* 46: 29-69.

Murphy, R. & Lawson, R. (2018). Extending the Economic Freedom of the World Index to the Cold War era. *Cato Journal* 38: 265-284.

Neal, D. & Johnson, W. (1996). The role of premarket factors in black-white wage differences. *Journal of Political Economics* 104: 869-895.

Nelson, R. & Phelps, E. (1966). Investment in humans, technological diffusion, and economic growth. *American Economic Review* 56: 69-75.

Piffer, D. (2017). Piffer's results replicated (again) by latest GWAS (N=147,194). https://topseudoscience.wordpress.com/2017/07/21/piffers-results-replicated-again-by-latest-gwas-n147194/.

Piffer, D. (2019a). Evidence for recent polygenic selection on educational attainment and intelligence inferred from Gwas hits: A replication of previous findings using recent data. *Psych* 1(1): 55-75.

Piffer, D. (2019b). Eurasian specific alleles and polygenic scores. https://rpubs.com/Daxide/488754.

Plomin, R. & Deary, I. (2015). Genetics and intelligence differences: Five special findings. *Molecular Psychiatry* 20: 98-108.

Popper, K. (2002). *The Logic of Scientific Discovery*. London: Routledge.

Putterman, L. & Weil, D. (2010). Post-1500 population flows and the long-run determinants of economic growth and inequality. *Quarterly Journal of Economics* 125: 1627-1682.

Raven, J., Raven, J.C. & Court, J.H. (1999). *Manual zu Raven's Progressive Matrices and Vocabulary Scales*. Frankfurt: Swets & Zeitlinger.

Rindermann, H. (2007). The big G-factor of national cognitive ability. *European Journal of Personality* 21: 767-787.

Rindermann, H. (2008). Relevance of education and intelligence at the national level to the economic welfare of people. *Intelligence* 36: 127-142.

Rindermann, H., Becker, D. & Coyle, T. (2016). Survey of expert opinion on intelligence: Causes of international differences in cognitive ability tests. *Frontiers in Psychology* 7: 339.

Rindermann, H., Kodila-Tedika, O. & Christainsen, G. (2015). Cognitive capital, good governance, and the wealth of nations. *Intelligence* 51: 98-108.

Rushton, J.P. (1997). *Race, Evolution and Behavior*. New Brunswick, NJ: Transaction.

Rushton, J.P. & Jensen, A. (2005). Thirty years of research on race differences in cognitive ability. *Psychology, Public Policy and Law* 11: 235-294.

Rushton, J.P. & Jensen, A. (2010). A theory-based review of the research in Richard Nisbett's *Intelligence and how to get it*. *The Open Psychology Journal* 3: 9-35.

Sachs, J. (2003). Institutions matter, but not for everything. *Finance and Development* 40: 38-41.

Sala-i-Martin, X. (1997). I just ran two million regressions. *American Economic Review Papers & Proceedings* 87: 178-183.

Sala-i-Martin, X., Doppelhofer, G. & Miller, R. (2004). Determinants of long-term growth: A Bayesian averaging of classical estimates (BACE) approach. *American Economic Review* 94: 813-835.

Smith-Woolley, E., Selzam, S. & Plomin, R. (2019). Polygenic score for educational attainment captures DNA variants shared between personality traits and educational achievement. *Journal of Personality and Social Psychology* 117: 1145-1163.

Sniekers, S., Stringer, S.,… & Posthuma, D. (2017). Genome-wide association meta-analysis of 78,308 individuals identifies new loci and genes influencing human intelligence. *Nature Genetics* 49: 1107-1112.

Solow, R. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics* 70: 65-94.

Solow, R. (1957). Technical change and the aggregate production function. *Review of Economics and Statistics* 39: 312-320.

Spolaore, E. & Wacziarg, R. (2013). How deep are the roots of economic development? *Journal of Economic Literature* 51: 325-369.

Taylor, N. (2008). Raven's Standard and Advanced Progressive Matrices among adults in South Africa. In: J. Raven & J. Raven (eds.), *Use and Abuses of Intelligence*. *Studies Advancing Spearman and Raven's Quest for Non-Arbitrary Metrics*, pp. 371-391. Unionville, NY: Royal Fireworks Press.

te Nijenhuis, J., Cho, S.H., Murphy, R. & Lee, K.H. (2012). The Flynn effect in Korea: Large gains. *Personality and Individual Differences* 53: 147-151.

Temple, J. (1999). The new growth evidence. *Journal of Economic Literature* 37: 112-156.

Weede, E. & Kämpf, S. (2002). The impact of intelligence and institutional improvements on economic growth. *Kyklos* 55: 361-380.

WHO (2004). *Global Burden of Disease: 2004 Update*. Geneva: World Health Organisation.

Wicherts, J., Dolan, C., Carlson, J. & van der Maas, J. (2010). Raven's test performance of sub-Saharan Africans: Average performance, psychometric properties, and the Flynn effect. *Learning and Individual Differences* 20: 135-151.

View publication stats