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Prediction of national wealth

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Abstract

In their book, IQ and the Wealth of Nations, Lynn and Vanhanen ([Lynn, R. and Vanhanen, T. (2002). IQ and the wealth of nations. Westport, CT: Praeger.]) proposed the hypothesis that "the intelligence of the populations has been a major factor responsible for the national differences in economic growth and for the gap in per capita income between rich and poor nations" (p. xv). They presented analyses showing that national wealth can be predicted by IQ, democracy, economic freedom, and oil production. This paper has four goals. First, we examine the robustness of Lynn and Vanhanen findings using updated IQ and wealth variables and updated sources of democracy, economic freedom, and oil production. Second, we evaluate the curvilinear relationship between IQ and national wealth. Third, we address concerns over the accuracy of IQ estimates in low IQ countries by evaluating whether the relationship between IQ and national wealth is dependent on precise estimates of IQ. Fourth, we extend the predictor space of national wealth by examining its correlates with public expenditures on health and education.

In their book, *IQ and the Wealth of Nations*, Lynn and Vanhanen (2002) proposed the hypothesis that "the intelligence of the populations has been a major factor responsible for the national differences in economic growth and for the gap in per capita income between rich and poor nations" (p. xv). To test their hypothesis empirically, Lynn and Vanhanen (2002) used mean IQ scores, first for 81 countries, and later using approximations based on neighboring country scores yielding a total of 185 observations/countries. They have since updated that database to include an additional 32 nations, for a total of 113 nations for whom they have original data (Lynn & Vanhanen, in press). They computed the correlations between national IQ and real gross domestic product (GDP) purchasing power parity for 1998 per capita. They then regressed GDP in 1998 on IQs using a linear model and accounted for 38% of the variance. They also investigated additional variables that added to the prediction of national wealth, such as economic freedom and an index of democracy and suggested the possibility that other variables also may contribute to national wealth, such as the extent to which a country produces oil.

These bold and controversial hypotheses have led to some degree of criticism (Barnett & Williams, 2004; Ervik, 2003; Richards, 2002; Volken, 2003). Many of the criticisms concern the representativeness of the samples, particularly at the lower end of the distribution of IQ means for countries. Ervik (2003) pointed to several alternative explanations for the variance in IQs between nations. These include differences in the designs of the IQ tests themselves, the numbers of people assessed in the various countries, the composition of the test-takers in terms of educational background and socio-economic status, and dates in which the studies were conducted.

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Barnett and Williams (2004) described the first of these criticisms, the problem of non-equivalence of measures, in detail. They provide an example of a question about why one should turn off the lights when not in use being appropriate for a British child who has been reminded that this is important because lights left on waste electricity, electricity is expensive, and the generation of it consumes fossil fuels. A replacement item for a child in an African village might be about why it is important not to waste water from the water bucket. Barnett and Williams (2004) asserted, without empirical support, that this adaptation of IQ questions would need to be accomplished in the countries included in the analysis.

A related concern is the extent to which the samples chosen represent each country. Richards (2002) mentioned the cross-cultural validity of IQ testing, especially where literacy levels are very low, and the challenge of establishing nationally representative norms for IQ. Volken (2003) stated that the IQ samples are not likely to be representative at the national level and that one should be particularly concerned about the sampling in remote rural areas of Africa during the 1960s. Barnett and Williams (2004) pointed to specific countries. Specifically, the country of Equatorial Guinea (with an IQ of 59; Table 6.5) is represented by data on "48 10- to 14-year-olds" (p. 203), the country of Ethiopia (with an IQ of 63; Table 6.5) is represented by data on "a sample of 250 15-year-old Ethiopian immigrants to Israel" (p. 204), and the IQ of Indonesia (with an IQ of 89; Table 6.5) was judged based on data for the Draw-A-Man test collected from an unspecified number of school children in the city of Bandung (p. 208).

In sum, these criticisms, both about the appropriateness of the IQ tests and about the representativeness of the samples, seem to be concerned about the lower end of the distribution of IQ means for countries. That is, by using potentially non-equivalent tests and by using samples that have extremely low IQs in underdeveloped, non-industrial nations and African countries which fall at the lower end of the IQ distribution, are the estimates of variance accounted for in GDP falsely inflated?

This paper has four goals. Our first goal is to examine the robustness of Lynn and Vanhanen's (2002) findings using updated IQ and GDP variables and different operationalizations of democracy, economic freedom, and oil production. If we cannot replicate the Lynn and Vanhanen findings using this data set, the Lynn and Vanhanen findings would lack credibility. Our second goal is to evaluate empirically whether there is a curvilinear relationship between IQ and national wealth. Although Lynn and Vanhanen examined the linear relationship between IQ and GDP, our inspection of the scattergram in Lynn and Vanhanen (Fig. 8.5, p. 142) suggests a curvilinear relationship. Our third goal is to conduct analyses evaluating the extent to which potential inaccuracies in IQ estimates overstate the relationship between IQ and national wealth. Our fourth goal is extend the predictor space of national wealth by examining its correlates with public expenditures on health and education.

1. Method

1.1. Measures

1.1.1. Economic freedom and democracy

Lynn and Vanhanen (2002) used economic freedom drawn from Gwartney, Lawson and Samida (2000). Their measure of national democracy was Vanhanen's Index of Democratization, (The Polyarchy Dataset, 2000; see also Vanhanen, 1997). To examine the robustness of conclusions, we obtained alternate and more recent measures of economic freedom and democracy. For economic freedom, we used the 2005 Index of Economic Freedom (The Heritage Foundation, 2005). For democracy, we used the Overall Polity Score from the Country Indicators for Foreign Policy (2003). We refer to this variable as "level of democracy." The source of these data, the Country Indicators for Foreign Policy, is a research organization affiliated with Carleton University and funded by the Canadian International Development Agency. We transformed the democracy variable so that strongly democratic countries have the highest scores. We also transformed the economic freedom variable so that countries with high economic freedom have the highest scores. Fig. 1 provides additional information on our economic freedom and democracy variables.

1.1.2. Public spending on health and education

Public health spending was operationalized as public health spending per capita in United States dollars in 1998. These data originated from a World Bank publication. We obtained them from www.nationmaster.com. Public education spending was operationalized as government spending on primary education per student. These data originated in a publication of the United Nations Educational Scientific and Cultural Organization (UNESCO, 2003) and were obtained from www.nationmaster.com. Fig. 1 provides additional information on these variables.

1.1.3. Oil production

Lynn and Vanhanen (2002) cited oil production as a determinant of national wealth but did not examine this

Level of Democracy (Overall Polity Score) (Time Series: 1985-1999) (Source: Polity IV)

"The Overall Polity Score is on a 21 point scale ranging from +10 (strongly democratic) to -10 (strongly autocratic). In the definition of Polity IV, democracy is conceived as three essential, interdependent elements. One is the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. Second is the existence of institutionalized constraints on the exercise of power by the executive. Third is the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. Autocracy is defined operationally in terms of the presence of a distinctive set of political characteristics. In mature form, autocracies sharply restrict or suppress competitive political participation. Their chief executives are chosen in a regularized process of selection within the political elite, and once in office they exercise power with few institutional constraints." For the global rank based index (nine-point scale) of the Overall Polity Score, 1 is "strongly democratic" and 9 is "strongly autocratic." (Source: Country Indicators for Foreign Policy, 2003; www.carleton.ca/cifp/rank.htm)

In our analyses, we reversed scored this variable so that the most democratic countries had the highest scores,

Index of Economic Freedom

"The 2005 Index of Economic Freedom measures 161 countries against a list of 50 independent variables divided into 10 broad factors of economic freedom. Low scores are more desirable. The higher the score on a factor, the greater the level of government interference in the economy and the less economic freedom a country enjoys. These 50 variables are grouped into the following categories:

- Trade policy,
- Fiscal burden of government,
- Government intervention in the economy,
- Monetary policy,
- Capital flows and foreign investment,
- Banking and finance,
- Wages and prices,
- Property rights,
- Regulation, and
- Informal market activity."

(Source: The Heritage Foundation, 2005; www.heritage.org/research/features/index/index.cfm)

In our analyses, we reversed scored this variable so that the countries with the highest levels of economic freedom had the highest scores.

Public Health Spending – Per person

Public Health Spending per capita (PPP) in $US 1998. (Source: World Bank 2002. World Development Indicators, 2002. Washington, DC; www.nationmaster.com)

Public Education Spending per Student

"Public expenditure per student, primary level is the total reported current spending by the government on primary education, divided by the total number of pupils in primary education, expressed as a percentage of per capita GDP." (Source: United Nations Educational Scientific and Cultural Organization [UNESCO]; www.nationmaster.com)

Oil Production

"Oil production figures (bbl/day)" (Source: CIA World Factbook, March 2005; www.cia.gov/cia/publications/factbook/rankorder/2173rank.html) Oil production per capita was calculated by the authors as oil production / country population, and thus oil production per capita is missing for three countries for which there were no population data.

Fig. 1. Variables used in this study (not including IQ).

relationship empirically. We operationalized oil production as oil production per capita. The oil production data were reported in the CIA World Factbook (2005) and were obtained from the CIA website. Additional information on this variable is provided in Fig. 1.

1.1.4. GDP

Lynn and Vanhanen (2002) used national Gross Domestic Product (GDP) using purchasing power parity (PPP) per capita in US dollars for the year 2002. Purchasing power parity measures how much a currency can buy in terms of an international measure (usually dollars), since goods and services have different prices in some countries than in others. It is used in international comparisons of standard of living. The purchasing power parity measurement considers a bundle of goods, and calculates the price of this bundle in each country (using the country's local currency). A simple example of a measure of absolute PPP is the Big Mac Index, popularized by *The Economist* (Wikipedia, 2006), which looks at the prices of a Big Mac burger in McDonald's restaurants in different countries. If a Big Mac costs USD 4 in the US and GBP 3 in Britain, the PPP exchange rate would be £3 for $4. However, the exchange rate for the Big Mac is not necessarily the exchange rate for other goods. For example, the differences in food prices may be smaller or larger than the differences in housing. To examine to robustness of the Lynn and Vanhanen results, we used the 2002 version of the GDP measure. Our data originated in a World Bank publication (World Bank, World Development Indicators 2002. CD-ROM. Washington, DC) and we obtained the data from www.nationmaster.com. Such data were available for 156 countries. Since the correlation between the Lynn and Vanhanen estimate of GDP-1998 and the GDP-2002 was .98, we used the Lynn and Vanhanen estimate for the remaining 29 countries for which GDP-2002 data were unavailable.

1.1.5. IQ

We obtained revised national IQ data from Table 4.1 in Lynn and Vanhanen's (in press), IQ data were available on 113 countries (up from the 81 counties in Lynn and Vanhanen, 2002). Lynn and Vanhanen estimated the remaining IQs based on estimates from neighboring countries. For example, the national IQ of Luxembourg was estimated to be 100 because its neighboring countries, Belgium and Netherlands had national IQs of 99 and 100, respectively. Similarly, Namibia had an estimated national IQ of 70 because the neighboring countries, South Africa, Zambia, and Zimbabwe had national IQs of 72, 71, and 66, respectively. The correlation between the actual IQs (Lynn & Vanhanen, in press) and the estimated IQs (Lynn & Vanhanen, 2002) was .91. Therefore, we believe that the method of estimating IQs based on those of neighboring countries is sound.

We noted that the countries Burma and Yugoslavia were not included in the new (in press) dataset and the two Congo countries were labeled differently from the original dataset, so they were not included in our analysis. In all, we had IQ data on a total of 181 countries.

To respond to criticisms of the representativeness of the national IQ data, particularly at the lower end of the distribution of IQ means for countries, we created an additional IQ variable by truncating the distribution of national IQs such that any country's IQ that was less than 90 was set to 90. We label this variable "IQ truncated."

1.2. Analyses

We analyzed the data using correlation and multiple regression.

2. Results and discussion

Table 1 shows the means, standard deviations and a correlation matrix for all the variables in the analyses. We note that GDP is positively correlated with both IQ variables (IQ and IQ truncated), democracy, economic freedom, oil production and education and health spending, Tables 2–9 present multiple regression analyses examining the joint relationships of IQ and other variables in predicting GDP.

The results of our various data manipulations using the linear model and the curvilinear model as well as truncating the distribution (also using the linear and curvilinear models) are shown in Table 2. The top part of Table 2 shows the results for predicting Lynn and Vanhanen's GDP-1998; the lower part of the table shows the results for predicting GDP-2002. The remaining analyses use GDP-2002 as the dependent variable.

The results for IQ using the curvilinear model for both the full and truncated IQ variables and democracy to predict GDP-2002 are shown in Table 3; the results using IQ and economic freedom are shown in Table 4. The results for IQ and oil production per capita are shown in Table 5. The results for combining the variables IQ, economic freedom, democracy, and oil production per capita are shown in Table 6.

The results for IQ and public education spending per student to predict GDP-2002 are shown in Table 7; the results using IQ and health spending per capita are shown

Table 1
Means, standard deviations and correlations among study variables

	Mean	SD	N	IQ from L and V	IQ truncated	Democracy	Economic freedom	Oil production per capita	Public education spending per student on primary school	Health spending per person	GDP-1998	GDP-2002
IQ from L and V	84.47	11.35	181	1.00								
IQ truncated	92.38	4.08	181	.76	1.00							
Democracy	4.41	2.75	156	.47	.42	1.00						
Economic freedom	7.00	.73	152	.51	.52	.62	1.00					
Oil production per capita	.04	.15	182	−.02	−.06	.24	.01	1.00				
Public education spending per student for primary school	15.07	9.56	124	.19	.26	.14	.20	−.03	1.00			
Health spending per person	507.33	869.16	132	.56	.67	.53	.65	.25	.26	1.00		
GDP-1998	7099.79	7474.14	185	.62	.65	.50	.73	.29	.22	.92	1.00	
GDP-2002	7836.17	8480.42	185	.60	.65	.54	.74	.24	.21	.91	.98	1.00

in Table 8; the results for the highest predictors of GDP from previous analyses are shown in Table 9.

Note that due to differences in data available for the various predictors, the sample sizes (number of countries) are different for the various analyses. As mentioned above, due to these differences in sample sizes, the IQ contribution to GDP-2002 may be different depending on which countries had data for a particular predictor. Thus, the first two rows of Tables 3-9 show the contribution of IQ curvilinear alone for predicting GDP-2002 for each analysis. These should be used as the point of comparison when additional predictors are added to the equation, rather than the total sample multiple *R*s shown in Table 2.

Table 2
Percent of variance accounted for using altered distributions for two different models using Lynn and Vanhanen's criterion GDP-1998 and GDP-2002

Predictor(s)	N	Multiple R	R^2	Significance of the model
IQ linear (GDP-1998)	181	.62	.38	$p<.01$
IQ curvilinear (GDP-1998)	181	.67	.44	$p<.01$
IQ truncated linear (GDP-1998)	181	.65	.42	$p<.01$
IQ truncated curvilinear (GDP-1998)	181	.68	.46	$p<.01$
IQ linear (GDP-2002)	181	.60	.36	$p<.01$
IQ curvilinear (GDP-2002)	181	.67	.44	$p<.01$
IQ truncated linear (GDP-2002)	181	.65	.42	$p<.01$
IQ truncated curvilinear (GDP-2002)	181	.70	.48	$p<.01$

Below, we describe the results of this research by posing seven questions about the prediction of national wealth consistent with the four goals of the paper.

1) *Are the results obtained by Lynn and Vanhanen robust using the updated data set?*

Yes.

Using the linear model, Lynn and Vanhanen obtained a correlation of .62 between national IQ and GDP-1998 (p. 142). Using the newer values for IQ (Lynn and Vanhanen, in press) and our 2002 GDP variable we obtained a correlation of .60 with GDP-2002 (see Table 1).

Table 3
Regression model of IQ (curvilinear and truncated) and democracy against GDP-2002

Predictor(s)	N	Multiple R	R^2	Significance of the model	Significance of the increment to the model
IQ curvilinear	154	.68	.46	$p<.01$	–
Democracy	154	.53	.28	$p<.01$	–
IQ curvilinear + democracy	154	.72	.52	$p<.01$	$p<.01$
IQ truncated curvilinear	154	.71	.50	$p<.01$	–
IQ truncated curvilinear + democracy	154	.73	.54	$p<.01$	$p<.01$

The results for analyses using IQ curvilinear and IQ truncated curvilinear differ from the results in Table 2 due to the restriction of the analysis to the 154 countries with non-missing democracy data.

Table 4
Regression model of IQ (curvilinear and truncated) and economic freedom against GDP-2002

Predictor(s)	*N*	Multiple *R*	R^2	Significance of the model	Significance of the increment to the model
IQ curvilinear	151	.66	.43	$p<.01$	–
Economic freedom	151	.74	.55	$p<.01$	–
IQ curvilinear + economic freedom	151	.80	.64	$p<.01$	$p<.01$
IQ truncated curvilinear	151	.69	.48	$p<.01$	–
IQ truncated curvilinear + economic freedom	151	.81	.66	$p<.01$	$p<.01$

The results for analyses using IQ curvilinear and IQ truncated curvilinear differ from the results in other tables due to the restriction of the analysis to the 151 countries with non-missing economic freedom data.

When Lynn and Vanhanen added Index of Democratization to IQ in the prediction, they obtained a multiple *R* of .72 and when they added Economic Freedom ratings to IQ, their multiple *R* was .79 when predicting GDP (p. 155). When we added Level of Democracy to the full distribution of IQ, the multiple *R* was .72 and when we added Index of Economic Freedom to the full distribution of IQ, the multiple *R* was .80 for predicting GDP-2002, as shown on Tables 3 and 4, respectively.

Table 5
Regression model of IQ (curvilinear and truncated) and oil production per capita against GDP-2002

Predictor(s)	*N*	Multiple *R*	R^2	Significance of the model	Significance of the increment to the model
IQ curvilinear	181	.67	.44	$p<.01$	–
Oil production per capita	181	.23	.06	$p<.01$	–
IQ curvilinear + oil production per capita	181	.71	.51	$p<.01$	$p<.01$
IQ truncated curvilinear	181	.70	.48	$p<.01$	–
IQ truncated curvilinear + oil production per capita	181	.75	.56	$p<.01$	$p<.01$

The results for analyses using IQ curvilinear and IQ truncated curvilinear differ from the results in other tables due to the restriction of the analysis to the 181 countries with non-missing oil per capita data.

Table 6
Regression model of IQ (curvilinear and truncated), economic freedom, democracy, and oil production per capita against GDP-2002

Predictor(s)	*N*	Multiple *R*	R^2	Significance of the model
IQ curvilinear + economic freedom + democracy	143	.80	.65	$p<.01$
IQ truncated curvilinear + economic freedom + democracy	143	.81	.65	$p<.01$
IQ curvilinear + economic freedom + democracy + oil production per capita	143	.85	.72	$p<.01$
IQ truncated curvilinear + economic freedom + democracy + oil production per capita	143	.85	.72	$p<.01$

The analyses are based on the 143 countries with non-missing data on IQ, economic freedom, democracy, and oil production per capita.

When democracy and economic freedom were both added to IQ, the multiple *R* obtained by Lynn and Vanhanen was .79; the multiple *R* obtained in the current study was .80, as shown in Table 6. We conclude that the results obtained by Lynn and Vanhanen were very robust using our updated dataset.

Table 7
Regression model of IQ (curvilinear and truncated) and public education spending per student against GDP-2002

Predictor(s)	*N*	Multiple *R*	R^2	Significance of the model	Significance of the increment to the model
IQ curvilinear	123	.75	.56	$p<.01$	–
Public education spending per student	123	.21	.04	$p<.01$	–
IQ curvilinear + public education spending per student	123	.75	.56	$p<.01$	$p>.05$
IQ truncated curvilinear	123	.73	.54	$p<.01$	–
IQ truncated curvilinear + public education spending per student	123	.73	.54	$p<.01$	$p>.05$

The results for analyses using IQ curvilinear and IQ truncated curvilinear differ from the results in other tables due to the restriction of the analysis to the 123 countries with non-missing public education spending per student data.

Table 8
Regression model of IQ (curvilinear and truncated) and public health spending per capita against GDP-2002

Predictor(s)	N	Multiple R	R^2	Significance of the model	Significance of the increment to the model
IQ curvilinear	131	.73	.54	$p<.01$	–
Public health spending per capita	131	.91	.83	$p<.01$	–
IQ curvilinear + public health spending per capita	131	.93	.86	$p<.01$	$p<.01$
IQ truncated curvilinear	131	.76	.58	$p<.01$	–
IQ truncated curvilinear + public health spending per capita	131	.93	.86	$p<.01$	$p<.01$

The results for analyses using IQ curvilinear and IQ truncated curvilinear differ from the results in other tables due to the restriction of the analysis to the 131 countries with non-missing public health spending per capita data.

2) *Is the relationship between IQ and national wealth best described as curvilinear, as opposed to the linear model offered by Lynn and Vanhanen (2002)?*

Yes.

Our inspection of the scattergram between IQ and GDP (Fig. 8.5, p. 142) in Lynn and Vanahnen (2002) caused us to believe that the relationship was curvilinear. We modeled a curvilinear relationship by entering IQ-squared in addition to IQ in the prediction of GDP. In a similar manner we modeled the curvilinear relationship for IQ truncated. Analyses in Table 2 show that the multiple *R* increases by a fairly large amount regardless of which criterion is used (i.e., GDP-1998 or GDP-2002). Using the full IQ distribution, the multiple *R*s increased from .62 to .67 for GDP-1998 and from .61 to .67 for GDP-2002. The increases were similar for both the full and truncated distributions of IQ. Our analyses showed that a non-linear equation explained meaningfully more variance than the linear model.

3) *Are the results affected by truncating the IQ distribution such that IQs lower than 90 are made to equal 90?*

Yes.

Contrary to what one would expect when truncating a distribution, which would restrict variance, the level of prediction increased. Using IQ alone, as shown in Table 2, the multiple *R* for the linear model increased from .62 to .65 using Lynn and Vanhanen's GDP-1998 and the multiple *R* increased from .60 to .65 using the GDP-2002 criterion. With the exception of public education spending, this result is the same regardless of which additional predictors are added to the equation as shown in Tables 3–9. When we set all the IQ estimates below 90 to equal 90, the linear equation accounted for 38% of the variance while the quadratic equation accounted for 42%. Our truncated analysis suggests that any mean IQ less than 90, on average, is a detriment to GDP regardless of its specific value.

In summary, debates about the exact mean IQ of any country are not detrimental to Lynn and Vanhanen's arguments concerning the impact of IQ on GDP. Whether one uses the mean IQ values used by Lynn and Vanhanen or the truncated IQ data presented here, the mean IQ of countries is a major predictor of GDP. Due to the better fit of the data points to the curvilinear model, comparisons using the curvilinear model only will be provided. To respond to criticisms that low mean IQs are artifactually low, we will describe analyses for the full distribution of IQs and the truncated IQs in our responses to the questions below.

4) *Do economic freedom, democracy, and oil production per capita add to the prediction of national wealth over IQ?*

Yes.

Economic freedom and democracy add to the prediction of national wealth over IQ, but economic freedom explains more variance in GDP than democracy. When all three predictors are entered together, oil increases the multiple *R* over economic freedom and democracy.

As shown in Table 3, the contribution of IQ curvilinear is .68 and adding democracy increases the multiple *R* to .72. For economic freedom, the multiple *R* increases from .66 to .80, as shown in Table 4. As shown in Table 5, adding oil production per capita to the truncated IQ for predicting national wealth moves the multiple *R* from .67 to .71. The zero-order correlation in Table 1 shows that economic freedom contributes to more of the variance in

Table 9
Regression model of IQ (curvilinear and truncated), economic freedom, and public health spending per capita against GDP-2002

Predictor(s)	N	Multiple R	R^2	Significance of the model
IQ curvilinear + economic freedom + public health spending per capita	121	.95	.90	$p<.01$
IQ truncated curvilinear + economic freedom + public health spending per capita	121	.95	.90	$p<.01$

The analyses are based on the 121 countries with non-missing data on IQ, economic freedom and public health spending per capita.

GDP than democracy. When democracy and economic freedom are added together to the full IQ distribution, the multiple *R* is .80 (Table 6), the same as economic freedom alone, as shown in Table 4. This is likely due to the substantial correlation between economic freedom and democracy (.62), as shown in Table 1. When oil is added to the prediction, the multiple *R* increases to .85, as shown on Table 6. This is not too surprising given the low correlation between economic freedom and oil production (.01), as shown in Table 1. We note that the distribution for oil production per capita is skewed with a few countries having substantial oil production and many countries producing no oil. We also note that many of these oil producing countries have fairly low IQs. For example, the countries Iran, Kuwait, Qatar, Saudi Arabia, United Arab Emirates, and Equatorial Guinea all have national IQs less than 90.

5) *Does public spending per student on education affect the prediction of national wealth when added to IQ?*

No.

The correlation between public spending per student on education and GDP is .21. However, as seen in Table 7, education spending does not provide meaningful incremental prediction beyond IQ.

6) *Does public health spending per capita affect the prediction of national wealth when added to IQ?*

Yes.

The multiple *R* for national wealth rose from .76 using the curvilinear truncated IQ distribution alone to .93 when public health spending per capita was added to the multiple *R*, as shown in Table 8. This suggests that 86% of the variance in countries' wealth is a function of national IQ (truncated at 90) and health spending per capita.

7) *What are the highest predictors of national wealth and when added together, what is the level of prediction?*

The analyses described above show that the highest predictors of national prosperity are IQ (truncated at 90), economic freedom, and health spending per capita. When these three variables are added together to predict national prosperity, the multiple *R* rises to .95, as shown in Table 9. This suggests that almost all variance (90%) in the national prosperity of countries can be linked with IQ, health spending, and economic freedom.

2.1. The robustness of results offered by Lynn and Vanhanen (2002)

Our analyses provide substantial support for the results offered by Lynn and Vanhanen (2002). Using a revised set of IQ data, GDP from a different year, and different and more recent operationalizations of democracy and economic freedom, we were able to demonstrate very similar results to those offered. We also confirmed Lynn and Vanhanen's speculation about oil production explaining variance not accounted for by IQ.

Our analyses based on the truncation of national IQ at 90 argue against claims made by some that inaccuracies in IQ estimation of low IQ countries invalidate conclusions about the relationship between IQ and national wealth. We note that our choice of 90 as the point of truncation was arbitrary. A curvilinear relationship has no clear breaking point. We could have picked 88 or 92 as the truncation point. Based on an inspection of the scatterplot, 90 was a reasonable truncation point.

The truncated IQ variable was actually more predictive of national wealth than the untransformed IQ measure. In fact, an earlier presentation of these analyses (McDaniel & Whetzel, 2004) using Lynn and Vanhanen (2002) data showed that trichotomizing national IQ into high, medium and low raised the correlation with national wealth from .62 to .67. Although we encourage efforts to improve the accuracy of national IQ estimates, increased precision is not needed to conclude that IQ and national wealth are substantially related. The substantial relationship between national IQ and national wealth is extremely robust to even gross modifications (i.e., truncation and trichotomization) of IQ.

2.2. Additional predictors of national wealth

This paper sought to extend the work of Lynn and Vanhanen (2002) by examining the predictive value of public expenditures on education and health. Although both expenditure variables were correlated with national wealth, health spending is extremely highly correlated with national wealth ($R = .91$ to .92). While public expenditures on education did not increment the prediction of national wealth over and above IQ, public health spending adds substantial incremental prediction. The multiple *R* for IQ and health spending in the prediction of national wealth is .93. The interpretation of this relationship brings us to casual quandary of interpreting these data.

2.3. Causal quandary

Lynn and Vanhanen (2002) have been criticized for drawing causal relationships between IQ and national wealth based on correlational data. Lynn and Vanhanen noted that IQ is substantially heritable and used this and other arguments to support the contention that IQ is the

cause of national wealth. Their conclusion is not universally accepted. Our analyses do little to resolve the causal directions of relationships between national wealth and the variables we have labeled as predictors. Consider the substantial relationship (R=.91 to .92) between public per capita health spending and national wealth. Does health spending increase national wealth (say, by improving worker health and productivity) or does being wealthy cause a nation to spend more on health care? Or is there reciprocal causality? Our data show that expenditures on health are more correlated with national wealth than expenditures on education. Should national policy be changed to favor health spending over education spending? Or is national wealth a major antecedent of health spending more so than education spending? We do not know the answer to any of these questions. What is sorely needed in this literature is theory development and efforts at causal modeling.

2.4. Increasing national IQ

If one accepts the Lynn and Vanhanen (2002) conclusion that IQ causes national wealth, how is a country to improve its national IQ? Since IQ is substantially heritable, the IQ of a nation could be altered by encouraging high IQ individuals to procreate and discouraging low IQ individuals from procreation. For example, although not specifically addressing intelligence, Lykken (2001) has advocated the licensing of parents. However, we suspect that there would be resistance to the regulation of procreation. Although not related to IQ, China's and Vietnam's efforts to regulate procreation have met resistance (Goodkind, 1995; Tien, 1991). Such policies might face greater resistance in countries that value personal rights. Another strategy would be to encourage the immigration of high IQ individuals and discourage the immigration of low IQ individuals. For example, a country could make immigration visas readily available to those with graduate degrees and less available to others. However, with respect to immigration, one country's gain is another's loss.

2.5. Limitations

Psychologists are typically cognizant of the accuracy of their variables and routinely report reliability information. For our variables of gross domestic product, democracy, economic freedom, oil production, and public expenditures of health and education, we could locate no documentation addressing their accuracy. We are aware that estimates of gross domestic product purchasing power parity per capita can be imprecise due the difficulty in estimating purchasing power parity since it varies as a function of the goods compared. Inaccuracy in any of these variables could be addressed as psychometric reliability (unbiased random error) or systematic distortions of the data (systematic underestimation or overestimation of data values). We note that any departures from perfect reliability would cause the relationships reported in this paper to be underestimates. What would be more worrisome would be systematic distortions in the data that would spuriously inflate relationships. Although we have no reason to believe that these data are suspect, it would be prudent to know their reliabilities and the extent to which the measures are subject to systematic distortion.

3. Conclusions

This paper has shown that Lynn and Vanhanen's (2002) results regarding the relationship between IQ, democracy and economic freedom are robust. The analyses are robust with respect to time period of GDP (1998 vs. 2002) and sources of data for democracy and economic freedom. Most importantly, the current research addresses criticisms concerning the measurement of IQ in purportedly low IQ countries. When we truncated all IQ scores below 90 to equal 90, the relationship between IQ and wealth of nations remained strong and actually increased in magnitude. The strength of the relationship also was increased when fitting a curvilinear model. Regarding the additional variables that we added to the prediction, public spending on health had a greater contribution to GDP than public spending on education.

Although this paper has documented the robust and strong relationship of IQ with national wealth, the issue of casual direction remains in dispute. Lynn and Vanhanen (2002) argued that intelligence was the cause of national wealth. The crux of their argument rested on the substantial evidence that intelligence is largely determined by genetics. Despite the substantial evidence for the hereditability of intelligence, we are not optimistic that intelligence will be widely accepted as a cause of national wealth. Many scholars and the general public find more comfort in alleged alternative conceptualizations of intelligence, such as practical intelligence and emotional intelligence. Advocates of such alleged constructs make no statements about the genetic contribution to such measures and leave the door open as to the possibility of environmental interventions that might improve one's standing on these alleged alternative intelligences.

The current study also faces a quandary of causal inferences concerning other variables as well as IQ. For example, does increased health spending cause increases in GDP or do wealthy nations choose to spend more on health or is their mutual causation? These causal questions cannot be answered readily with these data.

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