

Are international differences in living standards really so hard to explain?

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A cross-country regression using only a handful of deeply rooted explanatory variables accounts for 80 percent of the variation in living standards across countries. Most of the biggest residuals from the regression can also be explained, at least partially, with rudimentary facts about the associated countries. What remains may be a useful indicator of a country's openness and innovative capacity throughout its economic history.

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1. Introduction

The Neoclassical Growth Model implies that countries with similar technology and intangibles will converge to similar average living standards in the long term. Exactly which intangibles are important has been the subject of much research and debate.

Some scholars, notably Jeffrey Sachs, have stressed immutable factors with direct economic consequences, such as climate and geography (see, for example, Mellinger et al. [1999]). Others, including Jared Diamond have suggested that geography has even farther-reaching effects on health and human capacity (as in Wolfe et al. [2007]). Andrei Shleifer and Robert Vishny introduced the human element, studying the importance of legal foundations laid by colonial powers (summarized in La Porta et al. [2008]). Finally, Daron Acemoglu and James Robinson added a slightly different set of manmade factors with their work on “inclusive” institutions [Acemoglu and Robinson, 2012].

In my own work, I have cited several of these so-called “deep factors”, and a few others, as potential drivers of living standards in the long term [Altman, 2011]. To the extent that these factors have been set in stone – sometimes literally – for centuries, the economic destinies of many countries may be predetermined. So it is of special interest when countries either overachieve or fall short of generating the living standards one might have expected.

Here I examine how much of current differences in living standards can be explained by these deep factors established long ago. Then I try to explain the performance of countries that exceed or undershoot the targets determined by these factors. Finally, I ask whether the countries whose performance cannot

easily be explained by other exogenous forces are in fact the greatest exponents of human innovation.

2. Methods

I use ordinary least squares regression to measure the relationships between several deep factors and average living standards in a large sample of countries and territories. My measure of living standards is the log of gross domestic product per capita in purchasing power terms, according to the World Bank's World Development Indicators database. The data are for 2010 or, in a few cases where figures are unavailable, for 2009.

Because I am particularly interested in the share of output that does not come from a country's natural endowment, I use additional data from the World Bank to discount the percentage of GDP that derives from resource rents. These include oil, gas, coal, forests, and minerals.

My explanatory variables are based on geography, legal systems, and cultural norms. Some of these variables come from the Global Development Network Growth Database compiled by William Easterly at the World Bank in 2001. They include a composite measure of a country's latitude (which I use to measure distance from the equator), a dummy variable for being landlocked, and a series of other dummy variables for having a legal system of British, French, German, Scandinavian, or state-socialist origin.

To these I add each country's average annual temperature and dummy variables for unusually low or high annual rainfall, all from the website Weatherbase by Canty and Associates. The final variable is the only cultural one: the Gender Inequality Index (GII) published by the United Nations

Development Program in 2011 using data from 2010. Higher values of the index denote less equality between the sexes in health, education, and labor force participation.

3. Results

Table 1 summarizes the results of the regressions using first just the geographical variables, then adding the variables for legal systems and gender inequality. Table 2 shows the seven countries with the highest and lowest residuals from the regression, together representing 10 percent of the sample. I use the same sample in each regression to aid in the interpretation of the results; versions of the first two regressions with unconstrained samples (the GII is the limiting variable) are in the Appendix.

In the first regression, half of variation in log standards of living is explained by just five variables describing geography and climate, two of which are based on rainfall. This improves to about 55 percent of variation with the addition of the dummy variables for legal system, with state-socialist as the omitted category. Including the GII makes a much bigger difference, increasing the explanatory power of the third regression to a startling 80 percent, still with just 10 explanatory variables, four of which are dummies for legal foundations. The inclusion of the GII also reduces the coefficients for being landlocked and for distance from the equator.

Table 1: Regression of log per capita gross domestic product at purchasing power parity (boldface signifies coefficient is significant at 95% confidence)

Specification:	I	II	III
N	142	142	142
F	27.77	18.14	51.89
R^2	0.505	0.553	0.798
Latitude degrees from equator	0.045 (0.011)	0.047 (0.010)	0.015 (0.007)
Landlocked?	-1.059 (0.198)	-1.005 (0.196)	-0.499 (0.138)
Average annual temperature (°F)	-0.005 (0.013)	-0.012 (0.013)	0.003 (0.009)
Average annual rainfall $< \mu - \sigma$	-0.306 (0.237)	-0.285 (0.231)	0.081 (0.158)
Average annual rainfall $> \mu + \sigma$	0.004 (0.309)	-0.016 (0.304)	-0.216 (0.206)
British legal foundations?		0.770 (0.277)	0.757 (0.187)
French legal foundations?		0.568 (0.264)	0.666 (0.178)
German legal foundations?		1.370 (0.446)	0.466 (0.309)
Scandic legal foundations?		0.144 (0.465)	-0.076 (0.313)
Gender Inequality Index			-5.592 (0.443)

Table 2: Countries with the biggest residuals from regressions of log gross domestic product per capita at purchasing power parity

Specification:	I	II	III
Positive residuals (biggest first)	Singapore Qatar Brunei D. Macao Luxembourg Seychelles U.A.E.	Singapore Qatar Macao Seychelles Brunei D. Eq. Guinea Luxembourg	Qatar Botswana Panama Saudi Arabia Luxembourg United States Hungary
Negative residuals (biggest last)	Burundi Tanzania Benin Uzbekistan Estonia Papua N.G. Albania	Cameroon Germany Mongolia Benin Russia Moldova Burundi	Haiti Mauritania Liberia Mozambique Iraq D.R. Congo Burundi

4. Discussion

The question of causality is somewhat simplified when dealing with deep factors that may affect living standards. Though some countries' borders have been determined relatively recently, in general geography is not a result of changes in living standards. By the same token, if the colonizing powers of previous centuries were all seeking economic benefits, then there is no reason to suppose that future changes in living standards differentially affected their choice of which lands to invade.

Causality is a somewhat more nettlesome question for gender inequality. I use it as an explanatory variable because it may be related to longstanding aspects of countries' cultures. Of course, gender inequality has changed

greatly within many countries in just the past few decades, and some of those changes may have been related to growth in living standards. But big differences in gender inequality persist among countries at all levels of living standards, and the biggest differences at each level – say, between Qatar (GII = 0.549) and the Norway (GII = 0.075), or Rwanda (GII = 0.453) and Afghanistan (GII = 0.707) – are undoubtedly related to cultural norms that date back centuries.

In any event, determining causality among the independent variables is not the main point of this research. The central question here is how, having controlled for the effects of these variables, to explain the residuals from the regressions.

In the third regression, with the full complement of independent variables, only 20 percent of the variation in log living standards is left in the residuals. The countries with the biggest positive residuals are (in order) Qatar, Botswana, Panama, Saudi Arabia, Luxembourg, United States, and Hungary.

Finding hints for these residuals is relatively straightforward, starting with Qatar and Saudi Arabia, two of the world's biggest exporters of natural gas and oil, respectively. The regression equation predicts per capita purchasing power of about \$4,200 for Qatar after subtracting natural resource rents, when the value for 2010 is actually \$55,800. Part of the difference stems from an underestimate of the importance of natural resource rents in Qatar's gross domestic product. Though the World Bank estimates the share of rents at 28 percent, others put the share almost twice as high. Changing the value of the variable to 52 percent, a recent estimate from Qatar National Bank Capital (Qatar News Agency, 2011), leads to a much smaller, but still significant residual of about \$33,000. Qatar may still be an overachiever, but not by as much as the residual would suggest. Saudi Arabia's petroleum sector may

also raise its living standards in ways not captured by the World Bank's data, though the bank's estimate of the sector's contribution to gross domestic product is similar to official statistics [Organization of the Petroleum Exporting Countries, 2012].

Botswana and Panama are simpler cases. Botswana receives enormous rents from diamonds, which are not included in the World Bank's measure (only tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate are included). In fact, the World Bank's own report on Botswana suggests mining accounted for about 28 percent of gross domestic product in 2009, though the rents figure in its database is only 4 percent [Lewin, 2011]. Adjusting the data in the third regression reduces Botswana's residual to \$6,800 from \$10,200.

Similarly, Panama also garners rents from a quirk of geographical and colonialist fate – its location and selection for the transoceanic canal. Revenues from the canal contribute about 8 percent of gross domestic product directly [Xinhua, 2012], but the presence of the canal may have contributed in many other ways to Panama's development. Finally, Luxembourg's high residual likely results, at least in part, from a different kind of rent – its position as a financial paradise.

The two countries with the next-biggest residuals are the United States and Hungary. For the United States, the predicted per capita purchasing power is \$18,000 versus the actual value of \$46,100. It is possible that the importance of natural resource wealth has also been underestimated here. Moreover, natural resources were once a much more important part of the American economy, and so their contribution to living standards today may be underrated by the current measure of non-oil per capita purchasing power.

But even a century ago, the United States was a far more diversified economy than any of those discussed above. It seems likely that the residual here, more than in the other cases, represents what the people of the United States have been able to add to their living standards through their own ingenuity and the openness of their economy. To be sure, this interpretation of the residual is a sum total of progress over time, rather than a measure of the American economy's current capacity for innovation. But it suggests that the United States has indeed pushed much further than one might have expected given its starting point.

It is worth noting that the residual for the United States would disappear completely if its 0.237 value for the GII – which is higher than for any other country with non-oil per capita purchasing power above \$30,000 except for the Bahamas and Qatar – were changed to Austria's value of 0.136. To the extent that the GII is a subjective measure, the residual may be subjective as well. Yet one might revise the statement above to say that the United States has achieved much more than expected given its cultural forces diminishing the equality of women.

Hungary also scores poorly on the GII, at least relative to its fellow former socialist members of the European Union. It overachieves with non-oil purchasing power per capita of \$20,600 versus a predicted \$8,800. Replacing its GII of 0.237 with the Czech Republic's value of 0.136 would reduce the gap to \$5,200. Perhaps unsurprisingly, the Czech and Slovak Republics – also landlocked, also formerly socialist – have fairly large residuals as well. What allowed these countries, and most of all Hungary, to overachieve? Perhaps Hungary and the former Czechoslovakia maintained more of an independent spirit during the state-socialist years; after all, both revolted against Soviet power. Arguably, they also had cultural traditions more reminiscent of those in Western Europe.

At the other end of the spectrum, the seven countries with the biggest negative residuals are not exactly a mysterious bunch, either. The five at the absolute bottom all suffered from years of destructive civil conflict in the recent past: Burundi (1993-2005), the Democratic Republic of the Congo (on and off since 1996), Iraq (2003 to the present), Mozambique (1977-1992), and Liberia (two long wars between 1989 and 2003). Another one of the seven, Haiti, had a particularly cruel and extractive dictatorship for three decades, then bouts of political instability that continued until it lost roughly 5 percent of gross domestic product in the earthquake of 2010. The last one, Mauritania, has been called “slavery’s last stronghold” [Sutter, 2012]; as much as 20 percent of the population may still be enslaved, despite its official abolition in 1981 [U.S. State Department, 2011]. Two decades of dictatorship that included a massive nationalization of privately held land, followed by two coups, have also retarded economic progress.

Because civil conflict can be a product of longstanding cultural and political forces, such as ethnic differences and borders drawn by foreign powers, it may qualify as a proxy for deep factors as well. Yet civil wars are difficult to quantify with just one variable. For example, looking at the years of conflict within a given period, say the past five decades, would miss any differences in intensity; Colombia has arguably been in a continual state of war since the 1960s, but its war has been far less devastating than many of the civil conflicts in Sub-Saharan Africa, or the current conflict in Syria. In any event, a composite variable might explain more of the variation, especially among the underachievers.

This discussion of residuals has been heuristic and imprecise, to be sure, but so are the relationships between deep factors and living standards. Countless

other factors affect living standards, and it would be unreasonable to expect a regression – or any other method – to explain 100 percent of the variation.

5. Conclusion

Every country is a special case in terms of economic development. Still, some factors determined long ago – geographic, institutional, cultural – are powerful enough to affect the fortunes of people around the world in similar ways. A small assortment of these factors can account for 80 percent of the variation in living standards between countries today.

A large part of the other 20 percent may also be somewhat predetermined, whether by a treasure trove of diamonds, borders badly drawn, or a handy location for international shipping. As a result, perhaps just 10 percent of what economically separates a Norwegian from a Nigerien may result from the sum total of human innovation in technology, policy, and the other products of an organized society. As economists we must direct our focus to this 10 percent and pay special attention to the success of the overachievers. Yet we should not assume that bridging the other 90 percent of the gap might ever be easy.

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Appendix

Table A1: Regression of log per capita gross domestic product at purchasing power parity, full sample (boldface signifies coefficient is significant at 95% confidence)

Specification:	I	II
N	177	177
F	25.37	16.98
R^2	0.426	0.478
Latitude degrees from equator	0.038 (0.010)	0.040 (0.010)
Landlocked?	-1.080 (0.202)	-1.020 (0.199)
Average annual temperature (°F)	-0.013 (0.012)	-0.021 (0.013)
Average annual rainfall $< \mu - \sigma$	-0.374 (0.224)	-0.313 (0.220)
Average annual rainfall $> \mu + \sigma$	0.171 (0.238)	-0.137 (0.233)
British legal foundations?		0.878 (0.276)
French legal foundations?		0.546 (0.263)
German legal foundations?		1.393 (0.467)
Scandic legal foundations?		0.201 (1.027)

Table A2: Countries with the biggest residuals from regressions of log gross domestic product per capita at purchasing power parity, full sample

Specification:	I	II
Positive residuals (biggest first)	Singapore Qatar Luxembourg Macao U.A.E. Brunei D. Seychelles	Singapore Qatar Macao Seychelles Luxembourg Brunei D. U.A.E.
Negative residuals (biggest last)	Guinea Madagascar Eritrea Iraq Mozambique Sao Tome and P. Liberia	Bangladesh Eritrea Mozambique Sierra Leone Iraq Sao Tome and P. Liberia