Reconciling Acemoglu and Sachs: geography, institutions and technology

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1 September 2010

RECONCILING ACEMOGLU AND SACHS: GEOGRAPHY, INSTITUTIONS AND TECHNOLOGY

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This paper attempts to reconcile two models for sustainable economic growth in developing countries. I develop an empirical and theoretical case for how the geographic landscape of a country determines the ease with which it can assimilate foreign technologies and establish institutions favorable to economic growth. I explore the threshold between the seemingly conflicting geographic (Sachs et al.) and institutional (Acemoglu et al.) theories, and economic growth. I do this by developing a technologically determinant, intermediate bifurcation where growth shifts from being geographically to institutionally driven after enough technology has been assimilated. My analysis finds that the rate of technological assimilation is determined by the landscape of a country. As the technology level increases, income level converges toward the level of developed countries. After reaching a certain threshold, however, the primary driver of economic growth appears to shift from geography to institutions.

The goal of economic development is to ensure that people enjoy prosperity and opportunity, leading productive lives without worrying about survival. Once-poor countries that experienced economic growth were those that successfully assimilated and incorporated technology into their economies.[1] This is because an economy that effectively utilizes computer, mechanical and other technologies is better positioned to have a competitive advantage. Technology is a predominately non-excludable good that helps workers become more productive. Given two workers with the same human and physical capital allocations, the worker with better access to technology should be more productive. As demonstrated by American economist and Nobel Laureate Robert Solow, economic growth cannot

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Acknowledgments: Veiseh is grateful to Professor Jeffrey D. Sachs of the Earth Institute at Columbia University, and Professor Pierre-Andre Chiappori in the Economics Department at Columbia University, for their review. He is also thankful to Professor Xavier Sala-i-Martin, Professor Satyajit Bose and two anonymous referees for their comments.

Journal of International Affairs, Fall/Winter 2010, Vol. 64, No. 1.

be achieved purely by an influx of physical capital because of the diminishing returns of capital toward income. Solow insists that technology is the means to raise the permanent income level of an economy.[2] Robert Barro and Xavier Sala-i-Martin found that most of the technology that helps developing countries converge to the income level of developed countries is technology created in the developed world and then diffused into the developing world.[3] With these two themes in mind, the general question of "Why do some countries develop faster to enjoy higher levels of income?" becomes "What helps a country adopt technology faster than others, thus stimulating growth?"

> The general question of "Why do some countries develop faster to enjoy higher levels of income?" becomes "What may help a country adopt technology faster than others, thus stimulating growth?"

While the technology level of a country can be an endogenous factor, explaining why some countries converge more quickly than others, the theories of Solow, Barro and Sala-i-Martin provide no clear explanation as to *why* certain countries acquire technology and put it to use in their economies faster than others.

Two existing theories may provide an explanation: the institutional theory, broadly associated with Daron Acemoglu, Simon Johnson and James Robinson, and the geographic theory, broadly associated with Jeffrey Sachs and John McArthur. The institutional theory attributes economic growth to the legal and economic institutions already established within a country.[4] Conversely, the geographic theory, while acknowledging the important role played by institutions, asserts that the geography of a country (e.g., resource endowment and climate) is the direct, dominant factor in its development.[5] While on the surface the two theories appear conflicting, they are not incompatible. The empirical analysis below demonstrates a bifurcation between the two theories, wherein a country develops and economic growth goes from being largely driven by geographical factors to being largely driven by institutional factors. This dynamic threshold, incorporating both Acemoglu and Sachs, corresponds to a switching model that I explore in this paper.

What role do institutional and geographic theories play in the assimilation of technology for the sake of economic growth? As mentioned, the ability of a developing country to converge with its developed counterparts is largely a function of how well it can assimilate technology. I assert that the rate at which technology is assimilated is determined by the landscape of the country: the more geographically disadvantaged the country's landscape, the more difficult it is to bring in new technologies and the less likely it is to develop quickly. As the technology level increases within a country, the income level converges toward the level of developed countries.[6] However, after reaching a certain threshold, economic growth appears to shift from being geographically driven to institutionally driven.

Background

There is little debate that good governance and the rule of law are key to maintaining a prosperous economy. Fair institutions are essential to the management of a thriving economy.[7] As Acemoglu states, "good economic institutions provide 'secure property rights' for a broad cross-section of society."[8] Proponents of the institutional theory assert that institutions established during the colonial era are largely responsible for the current plight of many countries and that these effects dominate geographic factors.[9] Places that were not conducive to settlement did not accumulate large enough amounts of human capital to establish healthy institutions. However, the institutional theory of growth attempts to draw direct linkages between economic growth and institutions established nearly two hundred years ago and may discount the current importance of geographic factors. On the contrary, the geographic theory asserts that geographic factors are the direct linkage to economic growth and dominate institutional factors in its promotion or limitation.[10]

However, neither the institutional theory nor the geographic theory appear complete. The geographic theory does not explain the recent economic prosperity experienced by areas that previously suffered from what were considered geographic disadvantages such as land-locked Botswana and desert economies like Dubai. Likewise, Acemoglu admits that even the institutional theory lacks "crucial comparative static results" to explain why equilibrium economic institutions differ.[11]

Although geography may not directly determine aggregate economic level, it may set the tipping point for when an economy will transform from an agrarian economy to a sustainable manufacturing and service-based one. This is because geography can dictate the level of difficulty associated with incorporating technology into the economy. Examining this tipping point—if one exists—may provide

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a quantifiable threshold at which economic systems go from unfavorable to favorable behavior or, in this case, from stagnant to positive growth. Such a threshold could have significant policy implications, which will be discussed later.

This paper explores when and how an economy uses technology to transition from a developing country to one with a standard of living and life expectancy largely indistinguishable from wealthier, more developed countries.

How can a city in the middle of a desert, such as Dubai, rise from the sands to become an economic epicenter?

Historical Analysis and Linkages

Countries that used to be geographically and/or institutionally disadvantaged have risen to the path of sustainable growth despite their historical endowments. I will explore two examples to illustrate the case.

The first question is, how does a land-locked country such as Botswana overcome its geographical disadvantage and reach a path to sustainable growth? Second, how can a city in the middle of a desert, such as Dubai, rise from the sands to become an economic epicenter? In each case, investment in technology helped overcome geographical challenges.

The geography of a territory or, more specifically, the landscape of a territory, is a key factor in determining how quickly healthy institutions are likely to be established for economic growth. Geographic landscape is defined as the terrain of the territory that can be characterized by exogenous factors such as access to waterways and coastline. However, my analysis shows that after a certain threshold of development, countries previously dependent on geographic factors to explain income level shift to a model of income growth that is primarily determined by institutions.

I argue that the tipping point is determined by how easily the landscape of the territory allows for the assimilation and utilization of technology. As technology is adopted in a territory, factors such as lower transportation costs and higher industrial productivity increase the competitive advantage of the region. Institutions for the maintenance of urbanization and commerce then organically develop to help elevate the economy to a higher steady state level. In other words, as a country rises in aggregate income level, institutional factors begin to play a larger role than geographic factors in explaining the income level.

The facilitator of this transition is the technology level of a country. The difficulty in transferring and assimilating technology due to geographic factors offers one explanation for the link between the geography of a territory and the type of institutions that thrive. Institutions may work more effectively depending on the level of technology in a region. To give one example, tasks such as keeping and processing records can be done more efficiently with computer technology. Without technology, this task would require mounds of paper records and a specialized staff to maintain them. As a second example, a region with technological infrastructure such as power lines and roads finds it easier to establish institutions governing that territory and economy because technological infrastructure is the foundation for further technological innovation—for instance telegraph lines and railroads. A treacherous landscape may hinder the assimilation of technologies that can lead to advanced institutions.

In the case of a land-locked country like Botswana, airplanes, an extensive highway system and other transport technology have helped lower the costs of doing business, rendering Botswana's economy more competitive. Despite lacking a coast, its landscape is quite conducive to technology transfer. It is a flat, semi-arid country roughly the size of Texas that is mostly covered by the Kalahari Desert and whose landscape consists of desert and savanna.[12]

Our second case study, Dubai, was a relatively small port before 1990 that flourished into a modern metropolis in the desert with an unprecedented number of skyscrapers.[13] This transformation would not have been possible without advances in available construction technologies, making building in a desert location like Dubai possible. Though Dubai has benefited from a certain geographical advantage with its access to the Persian Gulf, the financial institutions that make it the financial epicenter in the region today did not fully develop until the import of technology and the development of the infrastructure required to support those technologies.

Although it is true that Botswana and Dubai utilized their natural resources as a source of investment, this paper assumes that the source of the investment is largely exogenous to growth. While investment can theoretically originate from oil revenue, diamond revenue or even World Bank loans, the way investment is used to help a country assimilate new technologies is what is actually crucial to development and growth.

Lastly, countries afflicted with malaria were considered largely unsuitable for development until the discovery of quinine as a remedy. Quinine is an example of a technology that, once assimilated into an afflicted region, relieved the geographic disadvantage and removed a barrier to development.[14]

Data, Empirical Strategy and Assumptions

The empirical challenge of this study is to find indicators reflecting four different stages of advancement toward sustainable growth, as defined in Tables 1

Table 1: Each Theory is the Predominant Force Behind Each Stage of Development

Theory Type	*Stage -1*	*Stage 0*	*Stage 1*	*Stage 2*
Economic Development Stage	Agricultural, rural economy	Bifurcation Threshold	Manufacturing, urbanized economy	Self-sustained economic development
Theory Type	Geographic Theory		Institutional Theory	Research and development-based economy

Below is a table illustrating the missing causal link between the two theories. On either side of the tipping point, either factor may be the most significant in explaining the aggregate wealth level of a country.

Table 2: How the Geographic and Institutional Theories Are Reconciled through the Tipping Point

Theory Type	*Stage -1*	*Stage 0*	*Stage 1*	*Stage 2*
Institutional Theory	Geography determined which colonial institutions were established.		Colonial institutions have perpetuated until today.	Economic growth determined by these institutions.
Geographic Theory	The geography of a region is the predominant factor.			Economic stagnation/ growth determined by geography.
Bifurcation Causality	The geography of a region is the predominant factor.	Geography of a region determines how easy it is to transfer technology.	Technology transferability to a region, as determined by its geography, is the determinant of what kind of institutions were established.	The subsequently established institutions are the determining factor in today's economic growth.

and 2. This issue is addressed by examining existing data and extracting different indicators that can be used to create composite metrics reflective of the unique states we are quantifying.

Four types of indicators are used to evaluate a given territory at each of those four different stages. These four indicators were chosen after conducting a factor analysis of sixty-one geographical, technological, institutional and economic indicators. The rationale for the final eight indicators chosen is described in this section.

First, indicators are required to measure how viable a territory is for technology transfer. For a territory to be favorable to technology transfer, it must have several properties. The two primary properties are the ability to easily navigate by land or water as well as the ability to install infrastructure for supporting development. Three indicators signal how conducive a territory is to technology transfer: ratio of water area to land area, ratio of coastline length to total area and ratio of waterways to land area. Each indicator is exogenous and reflects the state of the territory as it is in its steady state.

Each of the three geographic-landscape indicators offers an important measure. First, the ratio of water area to land area indicates how plentiful water supplies are in proportion to the land area. The higher the ratio, the more water is available for key industrial processes and societal uses. Second, the ratio of waterways to land area indicates how much access the internal area of a region has to navigable waterways. Navigable waterways are important for transportation of both raw materials and finished goods. Third, the ratio of coastline length to land area indicates how much access the land territory has to the coast. A high ratio of coastline will make it easier to transport technologies and goods via the sea to the territory in question.

Also needed is an indicator measuring the level of technology transferred into the territory. My primary indicator of measuring technology assimilation and usage is the number of mobile phone subscribers per hundred people. Previous work by Easterly and Levine using a similar indicator supports this as an adequate measure of technology level.[15] I assume that the more technology utilized by a population, the higher its technology level.

A variable measuring how institutions have developed in a territory is also required. This is clearly a challenge because institutional and infrastructure indicators are certainly endogenous. Instead, I use indicators to measure how progressive the institutions are. I assume that institutional progress can be seen in several ways. For example, female participation in government could indicate how progressive government institutions are.[16] Likewise, the rule of law and protection of property rights are viewed positively by those seeking to conduct commerce.[17]

Three variables are used to measure institutional progress. The first is the number of days required to start a business. If a country has functioning institutions, then starting a business should be a relatively smooth process; anyone with motivation, capital and a good idea should be able to do business. Starting a business is a function not only of the competence of the people working at the institution, but also of how effective communication is among the institutions required to start the business. I assume that it takes more than one institution to start a business and that the time it takes to start the business is ultimately a function of the quality of the institution's workers and competence.

Second, I use the Rule of Law indicator created by Freedom House, which evaluates on a 1 to 16 scale—1 representing least rule of law, and 16 being most stable rule of law.[18] The measure is based on four factors: independence of the judiciary, primary rule of law in civil and criminal matters, accountability of security forces and military to civilian authorities, and equal treatment under the law. This indicator helps us gauge the strength of the judiciary and rule of law in a given territory. I assume that a strong and fair rule of law is a consequence of healthy institutions.

Lastly, the percentage of seats in parliament held by females is an indicator of the heterogeneity and the progressive nature of institutions governing a territory. This paper assumes, based on work by Esther Duflo, that heterogeneity is a positive indicator of institutional progress due to the resulting diversity of ideas and citizens working within that institution.[19] As a corollary, I also assume that the proportion of females in parliament is correlated with gender diversity in other institutions within the country.

The Basic Model

The basic model is composed of two sets of variables. Each set is meant to describe a factor that may contribute to economic growth, i.e., geographic (βs) and institutional (δs) variables, so that we can examine if a bifurcation exists between our two different sets of indicators:

$$Y_i = \alpha_0 + \sum \beta_i X_i + \sum \delta_j X_j + \varepsilon_i$$

In this case, the geographic variables—ratio of water area to land area, ratio of coastline length to total area, ratio of waterways to land area—are represented by the β_i coefficients, while the δ_j coefficients represent the institutional variables—number of days to start a business, rule of law and percentage of seats in parliament held by females. The six indicators illustrated in the previous section are chosen out of a total of sixty-one unique indicators that endogenously and exogenously describe the condition of a country.

The basic model takes the following form, with definitions of the terms below:

$$Y_i = \alpha_0 + \beta_1 * \ln(X_1) + \beta_2 * \ln(X_2) + \beta_3 * \ln(X_3) + \delta_4 * \ln(X_4) + \delta_5 * (X_5) + \delta_6 * (X_6) + \varepsilon_i$$

Y_i: Dependent variable is the natural log of income per capita. Since this variable exhibits skewness, I took the log of the dependent variable.

α_0: Constant is the natural log of income for countries in the sample, which represents what remains if all other indicators are set to zero and their impacts are removed from the model.

β_1: Coefficient for waterway density—square kilometers of waterway per square kilometer of land area. I took the natural log of this indicator because of its skewed nature as a ratio. I then normalized the log such that the minimum value was zero.

β_2: Coefficient for coastline density—kilometers of coastline per square kilometer of total area. I took the natural log of this indicator because of its skewed nature as a ratio. I normalized the log such that the minimum value was zero.

β_3: Coefficient for water area to land area density—square kilometers of water area per square kilometer of land area. I took the natural log of this indicator because of its skewed nature as a ratio. I normalized the log such that the minimum value was zero.

δ_4: Coefficient for average time to start a business in days. I took the natural log of this indicator because of its skewed nature.

δ_5: Coefficient for the rule of law, as gauged by Freedom House.

δ_6: Coefficient for percentage of parliamentary seats held by females.

Results

I ran six models to examine which variables best explain the income per capita of a country. In Model 1, I examine how the primary indicators—three geographic and three institutional—explain the variance in per capita income level for all countries. I found that all six variables are significant at the 15 percent level, with four of six statistically significant at the 5 percent level.

Table 3: Results

Dependent Variable: Natural Log of Income		***Model 1***	***Model 2***	***Model 3***	***Model 4***	***Model 5***	***Model 6***
Specification:		All Countries	Excluding top 20% in wealth (only countries with < $10,000 per capita income)	Excluding bottom 20% in wealth (only in countries with > $1,000 per capita income)	All countries, excluding OPEC countries	Excluding top 20% in wealth and OPEC countries	Excluding bottom 20% in wealth and OPEC countries
Natural Log of Ratio of Waterways to Total Area		0.0628 (0.135)	0.0744 (0.062)*	0.00694 (0.858)	0.0735 (0.064)*	0.0727 (0.072)*	0.02612 (0.430)
Natural Log of Ratio of Water to Land Area		-0.0807 (0.139)	-0.0851 (0.084)*	0.0423 (0.429)	-0.0221 (0.676)	-0.0826 (0.104)	0.1197 (0.016)**
Natural Log of Ratio of Coastline to Land Area		0.1064 (0.003) **	0.1018 (0.003)***	0.0138 (0.680)	0.0479 (0.007)***	0.0976 (0.005)***	0.0021 (0.941)
Natural Log of Average Time to Register Business		-0.4783 (0.000)***	-0.2426 (0.073)*	-0.3932 (0.001)***	-0.4512 (0.000)***	-0.2684 (0.052)*	-0.3505 (0.001)***
Rule of Law	0.1508 (0.000)***	0.0741 (0.014)**	0.0977 (0.000)***	0.1753 (0.000)***		0.0791 (0.010)**	0.1217 (0.000)***
Percentage of Parliament Seats held by Females	0.0241 (0.024)**	-0.0010 (0.321)	0.0310 (0.002)***	-0.0109 (0.019)**		0.00951 (0.392)	0.0324 (0.000)***
Constant	7.4309 (0.000)	7.0098 (0.000)	8.3073 (0.000)	6.8704 (0.000)		7.0800 (0.000)	7.5458 (0.000)
R-Squared Value	0.505	0.278	0.516	0.574		0.292	0.656
Number of Observations		141	111	97	133	106	90

* = 10 percent significance level; ** = 5 percent significance level; *** = 1 percent significance level.

In Model 2, by reducing the sample to countries with less than \$10,000 income per capita, all three geographic factors are significant at the 10 percent level, while only two of the institutional factors are.[20] This illustrates that, in the initial gestation of an economy, both geographic and institutional makeup are important in explaining the variance in income.

In Model 3, when I reduce the sample by excluding very poor countries—where income is smaller than \$1,000 per year—all three institutional indicators are significant while none of the geographic indicators are statistically significant.[21] I interpret this to mean that countries that have assimilated enough technology and created infrastructure will experience low enough transportation costs and high enough industrialization levels such that geographic boundaries will not stand in the way of achieving a higher comparative advantage.

In Models 4 through 6, I re-ran the regressions by excluding members of the Organization of the Petroleum Exporting Countries (OPEC), whose endowment of natural resources tend to be larger and not reflective of the landscape of the country. Excluding OPEC countries from our sample helps to remove outliers that are physically advantaged not by their surface geography, but by the assets they hold underground. Even while excluding them from the model, the story is still consistent with the description of Models 1 through 3.

Interaction between Geographic and Institutional Variables

For robustness, this section explores the interaction of the geographic variables with the institutional factors.

The following specification is designed to examine whether there is significant interaction between the geographic and the institutional indicators. This is done by creating a dummy variable from a geographical indicator such as coastline density. The dummy variable has a value of one when a country is considered to be dense with coastline and zero if a country is considered to be less dense with coastline. All countries that are in the top 50 percent of coastline density are assigned the value of one; otherwise countries receive a value of zero. Let X_7 represent the dummy variable, and μ represent the coefficient on the interaction term.

The general form of the second specification appears as follows, where I run the regression against each of the three institutional indicators. The example below shows how X_3 has been transformed into the geographic dummy variable X_7 and an interaction term is created with the institutional variable X_4:

$$Y_i = \alpha_0 + \beta_1{*}\ln(X_1) + \beta_2{*}\ln(X_2) + \beta_3{*}(X_7) + \delta_4{*}\ln(X_4) + \delta_5{*}(X_5) + \delta_6{*}(X_6) + \mu_7{*}(X_4)(X_7) + \varepsilon_i$$

The goal is to see whether the geographic variables exhibit a critical threshold against the institutional variables.

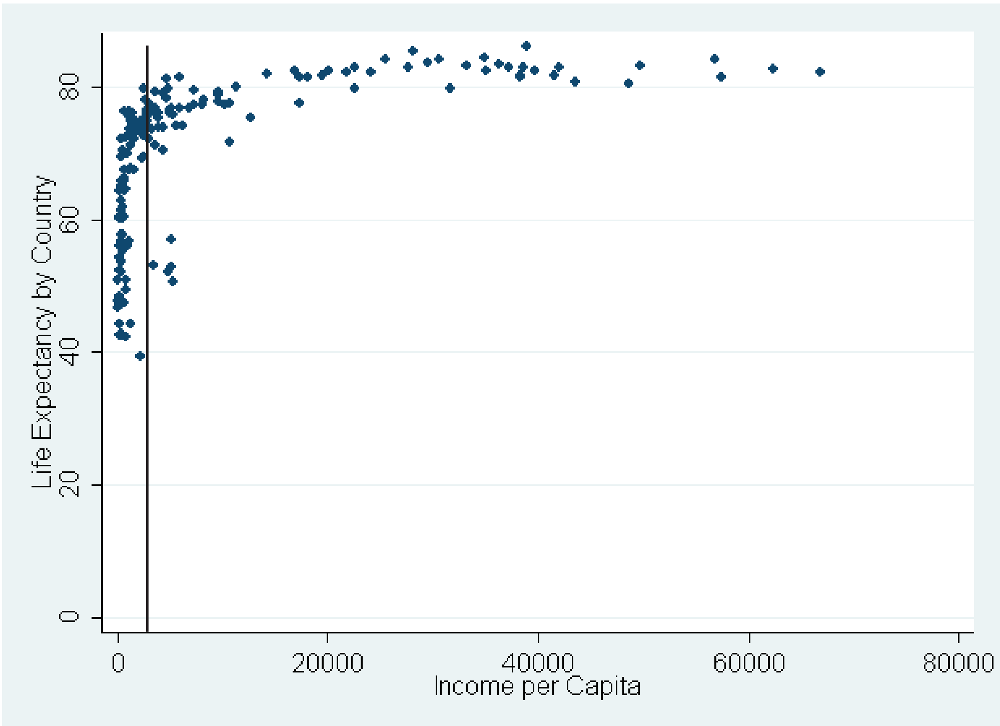
The regressions provide three important findings. First, while testing the interaction of coastline density against the three institutional variables, coastline density shows a significant correlation with the institutional indicator of how long it should take to start a business.[22] This means that countries with greater access to the coastline are more likely to have institutions that allow individuals to create businesses without significant delays.

Extending this further, testing the interaction of the ratio of water area to land area against the three institutional variables, there is a significant correlation with the rule of law.[23] Simply put, countries with more access to water may be more conducive to political stability. If citizens are not short on basic necessities like water, they may be less likely to fight.[24]

Finally, when testing the interaction of the ratio of waterways to land area against the three institutional variables, we see that the interaction terms are only significantly correlated to the rule of law and female participation.[25]

The above interactions and the following analysis reinforce our choice of geographic and institutional variables, and the existence of a critical threshold.

Figure 1: Life Expectancy as a Function of Income Level



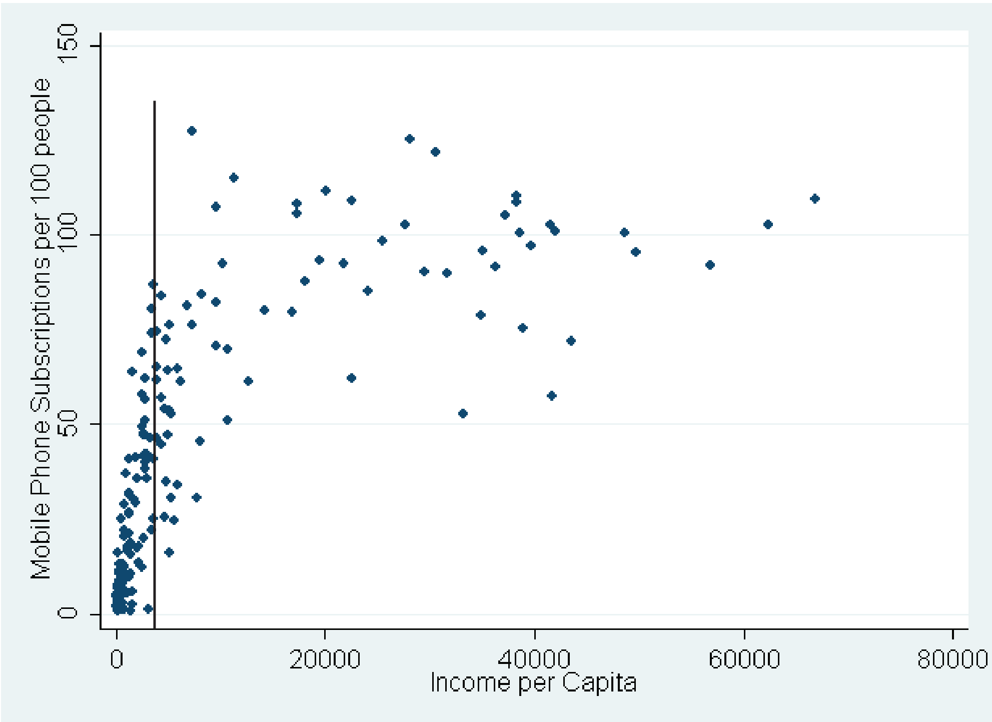
Source: World Bank 2005; World Bank 2007.

Existence of a Threshold

By examining the dynamics of the regressions, we see that there exists a tipping point where the model is able to explain part of the variance in income level per capita with either geographic or institutional factors. When I constrain my sample to non-OPEC countries with incomes greater than $3,400 (see appendix) all of the geographic indicators become insignificant at the 5 percent confidence level, with only water per land area significant at the 10 percent level.

This threshold appears arbitrary until we examine indicators that reflect the progress of society as a function of income level, i.e., its ability to adopt technology. Initially, we see that life expectancy plateaus at the same levels we see in most developed countries once a country surpasses an income level of $3,400.

Figure 2: Mobile Phone Subscriptions as a Function of Income Level



Source: World Bank 2005; World Bank 2006.

After a country surpasses an income level of $3,400 per capita, the life expectancy and basic technology level are comparable with more developed countries. The income level that marks the transition from lower life expectancy and basic technology usage to the same levels enjoyed by wealthier, developed countries is the same income threshold that marks the transition of the significance of geographic factors explaining income level to institutional factors.

Policy Implications and Conclusions

Typical geographic barriers, such as being landlocked, disease burdened, far from markets, or possessing deficient soils actually do not determine a country's economic destiny. We have seen that, as the acquisition and use of technology advance, these problems can be overcome. The cases of Botswana and Dubai show that a country's territory need not be endowed with resources for it to achieve sustainable growth.

A country need not be endowed with resources to achieve sustainable growth.

The acquisition of technology and eventual establishment of healthy institutions should be a focus for any policymaker seeking economic growth in a developing country. Policymakers should not, however, discount the importance of the geographic landscape as a challenge not only to overall development, but also to how easy it is to assimilate technology into the country. Policymakers, economic or otherwise, should have a firm understanding of technology and the role it plays in the economy. In addition, they must understand that the assimilation of technology may not be automatic and factors like geography may pose their own challenges.

As seen, while geography may not directly determine the aggregate economic level—e.g., for Botswana and Dubai—it can set the tipping point for when an economy will transform from agrarian to a sustainable manufacturing and service system. This tipping point is determined by whether the geography of the territory makes it easier or harder to assimilate technology and conduct commerce. As technology advances in a territory, institutions for the maintenance of urbanization and commerce (i.e., sanitation infrastructure and institutions that help support business, respectively) will help to elevate the economy to a higher steady state level.

Appendix: Further Analysis

I would like to note several areas for further exploration. First, the effects of climate on the economy, which have been a part of the studies conducted by both Acemoglu and Sachs, were not accounted for in this study. Moreover, finding truly exogenous indications of institutional development was not within the scope of this project. Lastly, data about income levels do not take into account two important issues: poor countries tend to have incomplete data, and countries with forbidding geography—such as mountain or deserts—may have an informal economy that is not captured by World Bank income numbers.

Table 4: Data

Variables	*# of Obs.*	*Mean*	*Std.Dev.*	*Min.*	*Max.*	*Source*
Dependent variable: log of income	179	7.971	1.618	4.605	11.110	World Bank Online (Atlas Method), 2007.
Log of ratio of waterways to total area	184	2.823	2.583	0	8.289	CIA Factbook, 2005.
Log of ratio of water to land area	200	3.096	32.393	0	12.547	CIA Factbook, 2005.
Log of ratio of coastline to land area	198	5.531	3.470	0	13.234	CIA Factbook, 2005.
Log of average time to register business	172	3.553	0.845	0.693	6.542	World Bank Online (Atlas Method), 2007.
Rule of law	172	8.872	4.423	1	16	Freedom House Institute, 2008.
Percentage of parliament seats held by females	178	16.687	9.687	0	48.8	World Bank Online, 2007.

NOTES

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5 John W. McArthur and Jeffrey D. Sachs, "Institutions and Geography: Comment on Acemoglu, Johnson and Robinson (2000)" (National Bureau of Economic Research (NBER) Working Paper 8114, February 2001), 1.

6 Per Solow, Barro and Sala-i-Martin's explanations as noted above.

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8 Acemoglu, 1370.

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[16] Esther Duflo and Raghabendra Chattopadhyay, "Women as Policy Makers: Evidence from a Randomized Policy Experiment in India," *Econometrica* 72, no. 5 (2004), 1431.

[17] North, 3.

[18] Freedom House is an independent watchdog organization that supports the expansion of freedom around the world. Freedom House supports democratic change, monitors freedom and advocates for democracy and human rights. See www.freedomhouse.org.

[19] Duflo, 1434.

[20] This paper defines high-income countries as countries with incomes greater than $10,000 per capita and very poor countries as countries with incomes less than $1,000 per capita. While this definition is largely arbitrary, it originates from the definitions provided by the World Bank and allows us to exclude wealthy countries and very poor countries, while maintaining a significant sample size. See http://data.worldbank.org/about/country-classifications.

[21] Ibid.

[22] Auxilary regression results yield: coefficient value for Coastline Density to be 2.309 with a P-value of 0.010; coefficient value for Average Number of Days to Start Business to be -0.223 with a P-value of 0.210; and coefficient value for the Interaction Term to be -0.504 with a P-value of 0.037.

[23] Auxilary regression results yield: coefficient value for Water-to-Land Area Ratio to be -1.360 with a P-value of 0.003; coefficient value for Rule of Law to be 0.093 with a P-value of 0.010; and coefficient value for the Interaction Term to be 0.124 with a P-value of 0.010.

[24] Irna van der Molen and Antoinette Hildering, "Water: Cause for Conflict or Co-operation?" *ISYP Journal on Science and World Affairs* 1, no. 2 (2005), 133–43.

[25] Auxilary regression results yield: coefficient value for Density of Waterways to be -0.465 with a P-value of 0.285; coefficient value for Rule of Law to be 0.0911 with a P-value of 0.017; and coefficient value for the Interaction Term to be 0.109 with a P-value of 0.018. Auxillary regression results for Female Participation yield: coefficient value for Density of Waterways to be -0.442 with a P-value of 0.229; coefficient value for Female Participation to be -0.007 with a P-value of 0.612; and coefficient value for the Interaction Term to be 0.055 with a P-value of 0.004.