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Economic Leapovers

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Economic Leapovers: Some Theory and Case Studies

Introduction:

This paper examines the phenomenon of economic leapovers in technology. Leapovers are defined and placed in historical context, with some examples from telecommunications and case settings from Russia and China. In particular, the socioeconomic factors behind leapovers are noted and analyzed in light of several classical economic doctrines of Adam Smith, David Ricardo, Thomas Malthus, and Karl Marx. The potential for other leapovers is also examined as an extension.

Thesis Statement:

Political instability, along with other socioeconomic factors, is necessary for leapovers to occur. To understand the thesis, first the definition of a leapover must be clarified. A leapover occurs when a country or individual bypasses current technology in anticipation of better technology in the future. This process creates a jump in technology from sub-par to more advanced technology, so that the country or individual leaps over others who are better established in the older technology. This process is also known as leapfrogging.

There are multiple examples of leapovers in the world today. Cell phone usage in the Philippines and Zimbabwe is a case in point. In the Philippines during 2000, about 8.01% of the population had a cell phones and 3.82% of the population had landlines. This is a 2 to 1 ratio. In 2010, 79.89% of the population owned a cell phone and 6.79% of the population had landlines. This ratio is increased to 11.78, a

change of 461.76%. Zimbabwe went through a similar technological leap-over. The country's cellphone usage went from 3.01% in 2003 to 65.83% in 2009, while the landline usage of 2.39% of the population grew of a mere .94% to 3.33%.

Table 1 – Cell Phones/Landlines per capita

Cell Phone/ Landline to Population									
Country	Population	Year	# of Cell Phone Users	% of Population	Population	Year	# of Landlines	% of Population	Tenative Cell Phone/Landline Comparison
Philippines	81,159,650	2000	6,500,000	8.01%	81,159,650	2000	3,100,000	3.82%	2.10
Zimbabwe	12,576,740	2003	379,100	3.01%	12,576,740	2003	300,900	2.39%	1.26

According to Alan Yu of NPR, developing African countries have experienced "leapfrogging." Cell phone use has jumped over other forms of technology becoming the predominate form of communications. Yu states "65 percent of people in Africa have cellphones, but only 42 percent have electricity." (NPR) This leap in technology from inferior telecommunications to prevalent cellphone use presents some interesting questions, one of which is as follows:

Why did the countries choose to adopt this specific technology and which socioeconomic factors were present to create a favorable environment leading to a leapover?

Two countries in particular present a unique perspective in regards to the posed questions, China and Russia. These two countries, while having a significant difference in cultures, have many similarities that have led to both experiencing significant leapovers.

Theory:

Further discussion of leapovers requires a firm foundation in key economic theories. Economists have provided insight on the economic conditions that foster jumps in technology. Four major economists are Adam Smith, David Ricardo, Thomas Malthus, and Karl Marx.

Adam Smith was the father of Capitalism. He presented the concept of laissez-faire economics in his book *The Wealth of Nations.* This work served as the basis for most theories of free markets. Laissez-faire economics is the concept that the government should have little involvement in business [Buccholz (2007)]. Smith notes that mankind has a natural tendency to trade. He wrote, "a certain propensity in human nature [is]... to truck, barter, and exchange one thing for another.... it is common to all men." [Smith (1776)] Even from an early age, children begin performing trades with one another, like a stick of gum for a baseball card. Smith stated, "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest." One would not devote time to his/her passions or hobbies if adequate compensation could not be forthcoming [Buccholz (2007)]. In fact, a man would be considered foolish to think otherwise. It is purely self-interest that motivates one to perform a task.

A major component of Adam Smiths' theory is division of labor. Specializing and dividing tasks between employees to increase efficiency revolutionized the

business world. Smith described three steps by which division of labor increases efficiency [Buccholz (2007)]:

- First: Division of labor increases specific skills for a worker performing a specific task.
- Second: Usage of time becomes more efficient because workers can focus on one task instead of switching from task to task.
- Third: By specializing in a task, it is more likely that machinery will be developed to help complete the task.

New technology being driven by workers can lead to leapovers. However, this brings these questions to mind:

When is the optimal time to invest in new technologies?

Are there first and second mover advantages?

When does current technology become obsolete?

These questions are addressed in Horton and Wolf (2014) in which game theory is used to characterize the economic benefits of entering a new market and to determine optimal switching points between technologies.

David Ricardo was greatly influenced by Adam Smith's philosophies. His book, *The Principles of Political Economy and Taxation*, is today considered a major classic work. He believed that there should not be any barrier to trade between nations. This practice is commonly known as **free trade**. However, many politicians and philosophers of his time were trending away from free trade. To illustrate the benefits of free trade, David Ricardo posed the concept of *comparative advantage* as opposed to absolute advantage. The theory of absolute advantage states that a nation should produce these goods or services at which it is most

efficient. Comparative advantage states that a nation should focus on producing products or services at which it is *relatively* more efficient in producing while abandoning products or services at which it is *relatively* less efficient. By doing so, countries can further increase productivity in their areas of strongest advantage.

For an illustration of the implications of Ricardo's idea of comparative advantage, consider two countries, the U.S. and China. If each uses all its productive resources in producing either auto parts or corn (maize), Table 2 is used to represent their production possibilities (these results may be shown to hold for an arbitrary number of goods and/or countries, shown in Carbaugh (2004), pp. 48-49).

Table 2 – Example of Comparative Advantage

Production Possibilities if all resources are fully employed		
Country/Product	*Auto Parts*	*Corn (maize)*
United States	500 gigatons	400 macrobushels
China	300 gigatons	200 macrobushels

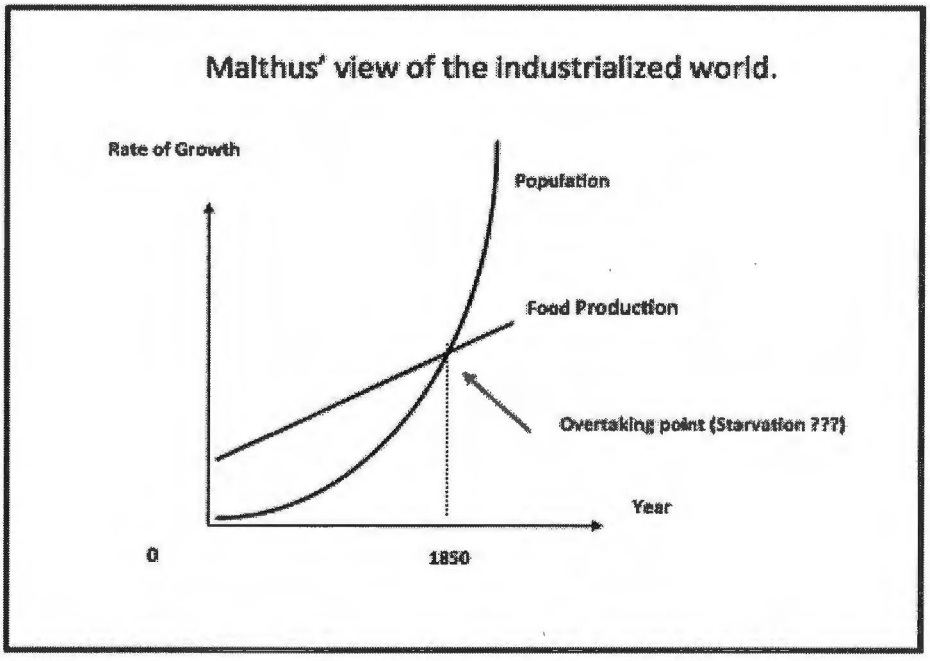
As depicted above, the United States has an absolute advantage in both auto parts and corn; however it has a comparative advantage only in corn and China has a comparative advantage in auto parts. This is determined by the ratios of the U.S. to China in auto parts production and in corn production (500 to 300, or 5 to 3, for auto parts and 400 to 200, or 2 to 1, for corn). Following the guidelines presented by Ricardo's doctrine of comparative advantage; the United States should produce

corn and not auto parts. This will allow the U.S. to focus its resources on corn, increasing its productivity through specialization. Likewise, China should focus on producing auto parts. The United States will trade with China in order to obtain auto parts. This can be done either by exchanging a good for a good (corn for auto parts) or with the use of currency (much more efficient).

It should be noted that every country has a comparative advantage in *something,* even if it is simply something it is less bad at doing. While this example focuses only on production, not demand, it communicates Ricardo's basic message: every country has value to some other country as a trading partner, and no country can go it alone and be economically efficient.

In contrast to Ricardo's free-market optimism, his friend Thomas R. Malthus, also known as the Prophet of Economic Doom and Population Boom, predicted that the earths population would out grow the food supply and experience mass famines [Buccholz (2007)]. In his book, *Essay on the Principle of Population*, Malthus stated that the world's population increases at an exponential rate while the food supply increases at a linear rate. This is shown in Figure 1 below.

Figure 1 – The Malthusian Premise



In order to combat impending famines, Malthus hinted that the government might need to limit the number of children per household. [Malthus (1958) cut-right-to-the-chase in his *Introduction*] This idea, of course, did not result in public abstinence from sex (even Mr. Malthus eventually married and sired several daughters), but later on was used by China to control its population. As terrifying as the implications of Malthus's theory seem, the concept is flawed. Malthus did not adequately take technology into consideration. Technology grows at an exponential rate, thus allowing advancements in food supply production. It is plausible that leapovers in technology have allowed the food supply to keep pace with the ever-growing population. This is not to say there are not famines in the world, for transportation issues along with other complications do not allow for proper

nourishment in all corners of the world. It is rather to state that food production is at its highest point in history. *Will population exceed productivity*? Perhaps it is a possibility, but with technology doubling every two years, the threshold could be in the distant future.

In his book *The Communist Manifesto*, Karl Marx proclaimed the fall of capitalism. He stated that capitalism would eventually be taken by greed and collapse upon itself, resulting in violent protests. The outcome of the violent revolts would be a socialized state, known as "the dictatorship at the proletariat." Before continuing it, is important to note that Marxism is a political implication of an economic concept. Marx did not invent socialism; rather he popularized it, bringing its concepts into social acceptability. In his manifesto, Marx made it clear that only labor has value. The mantra of Marxism became "to each according to his ability to each according to his need."

Marx's political theories have been implemented with little success by many countries around the world. Most notably among these are Russia and China. Marxism in Russia has proven to be unsustainable. This is due to one key aspect of human nature, to improve one's position in life. Marxism adheres to the idea of redistributing the wealth; however this has negative impacts upon productivity. Without an incentive to work, a human will revert to slovenliness. After all, who would put in the extra effort when adequate compensation cannot be acquired?

Case Study - Russia:

A brief history:

1917- Bolshevik Revolution; Russian Soviet Socialist Republic established
1918- Red purge; Communism Party creates a socialized economy
1921- New Economic Policy
1922- U.S.S.R formed
1924- Stalin; Five-Year Plan; famine returns
1936- Great Purge
1941- World War II
1945- World War II ends; Super-powers develop; Cold War
1949- Soviets detonate Nuclear Bomb
1953- Stalin Dies; change of power (Khrushchev)
1956- Khrushchev denounces Stalin's policies
1961- Soviet launch first manned shuttle into space
1962- Cuban Missile Crisis
1964- Coup in Communist Party; Khrushchev falls from power
1969- Border disputes with China
1972-Arms Controls Treaty
1978-1982- Soviets invade Afghanistan
1985-1991- Gorbachev attempts to boost U.S.S.R's failing economy
1991- U.S.S.R disintegrates
1992- Community party dissolves; Capitalism introduced
-Massive corruption: social & political instability
1998- economy collapse
1999- Putin becomes President of Russia
2000-2003- Religious, social, political suppression
2004- Putin reelected; Terrorist seize school
2008- Medvedev elected President

Source: http://www.infoplease.com/spot/russiatime3.html

Summary:

Russia has had an interesting history, sometimes being at the peak of civilization and other times struggling for existence. Over the past 100 years, Russia has been predominantly communist and only in recent years has it practiced Capitalism. Communism, however, is not implemented or enforced peacefully.

Marx' vaunted *dictatorship of the proletariat*, or common people, has somehow never materialized without bloodshed. A glance through the timeline prescribed above makes this apparent. The Red Purge in 1918, the Great Purge in 1936, and the use of the Komitet Gosudarstvennoy Bezopasnosti (KGB) are all tragic examples of the abuses that Communist inflicts. Capitalism is not without fault, either. After the fall of the Berlin Wall and the collapse of the U.S.S.R., Russia made an economic switch to Capitalism. For the first time since the erection of the Iron curtain, trade with Eastern Europe was open to the Western World. Initially, Russia struggled with government greed and corruption, which led to economic collapse in 1998. Since then, Russians have struggled with high inflation rates and many other socioeconomic issues.

Analysis:

There are a few core socioeconomic conditions that were present in Russia and their presence created an environment favorable for a technological leapover. In this case, the leapover occurred in cellular technology.

The first socioeconomic factor that was vital for Russia to make a technological jump was political turmoil. Political turmoil is characterized by: inconsistent laws, undefined or unfavorable business conditions, dynamic technological environments, and unstable regimes. These create the need to adapt to a constantly changing environment. Thus when political/social turmoil are present, there is a need created for better technology, technology that allows for people to react to stressful situations. A system of landlines, the dominant existing

technology, was unsuitable for this task and hence a new technology was sought. Russia quickly adapted cell phones because they are versatile. Political turmoil however only serves as a catalyst for technological leapovers. Countries other than Russia have experienced political turmoil without having a leapover. Other economic conditions must be present for leapover to occur.

High inflation rates in Russia were another socioeconomic condition that a leapover seems to require. High inflation rates cripple an economy. During such conditions, currency is devalued while the cost of product increases. This situation creates economic inequities and uncertainties. One direct effect is a decline in switching costs. Switching costs are the material and immaterial costs of transitioning from a current technology to differing technology. Shapiro and Varian (1998) emphasized the need for understanding switching costs between forms of technology in mapping out business strategy. The new technology of cell phones was much cheaper to install than it was to update landlines. Much of this is in direct material and labor costs. Landlines must be dug, miles and miles of cable must be strung, and installation must be completed and tested. Cellular technologies, however, require only a singular tower that serves as a connection for satellites. It is faster to install and much cheaper, thus becoming the most attractive option for a country in Russia's situation.

The third condition that was present in Russia and was conducive to an economic leapover is poor infrastructure. This can be a byproduct of political turmoil or political suppression but may also occur for other reasons. In Russia, a poor infrastructure was caused by many years of political turmoil and by the

infamous "Russian winters" that paralyzed both Hitler and Napoleon. With regime changes and terrorist attacks, Russia still struggles to provide adequate infrastructure to those outside of major cities. This is apparent in the analysis of water supply, road systems, educational institutions, and communication technologies. It is common knowledge in Russia that one does not drink the water from the tap, instead one purchases bottled water. This, coupled with only 25% of the population having the antecedent dominate form of communication, a landline, in 2002, indicates that Russia in fact did have a poor infrastructure. Russian infrastructure, as late as the late 2000's, was geared towards 1940's socialistic conditions and not for a vibrant expert economy of consumers and commercial producers.

To summarize the socioeconomic factors that contributed to an economic leapover, Russia had political turmoil, social suppression, poor infrastructure, and a high inflation rate. Since its leapover(s) Russia has approached the U.S. in its technological sophistication, particularly in the area of consumer goods.

Case Study - China

A brief history:

1912- Republic of China established
1913- The first and only democratic election occurs in China
1914-1918- World War I; Japan has political/social control in China
- 1915- Japan's "Twenty-One Demands"

1917-1927- Warlords fight for control over China "Warlord Decade"
1921- Chinese Communist Party (CCP)
1927- Second Revolution in China (Nationals)
-Northern Expedition (KMT attempt to purge China of CCP)
1927-1937- Nationals (KMT) control government
- 1934- The Long March

1937-1945- War of Resistance against Japan
1946-1949- Civil War (CCP vs. KMT)
1949- Establishment of People's Republic of China
1956- Hundred Flower Campaign- promoted criticism of the government
1957- Anti Rightist Campaign
1958- Great Leap Forward
-Famine kills 30 million people
1962- Socialist Education System
1966-1970- Cultural Revolution
1978- Democracy Wall
1989- Tiananmen Square
1997- Hong Kong returns to China's control
2001- China enters World Trade Organization
2008- China hosts Olympics

Source: http://www.indiana.edu/~e232/Time2.html

Summary:

China's history has been plagued with political turmoil. Warlords, political parties, and even other countries have fought for control, a trend that continued into the 20th century with the Boxer Rebellion and the more recent Japanese invasion of Manchuria. During the 1940s, two groups fought for control of China, the Nationalists (KMT) and the Communists. The power struggle resulted in bloody

conflict and genocide. Socially, the environment was not much better than the politics, with the resulting Mao regime characterized by drab smocks and institutionalized deprivation. Failed reforms and suppression have been the norms for China's population for a very long time.

Analysis:

China has had multiple socioeconomic factors that created an environment favorable for a leapover, the first of which was political turmoil. Covering a vast amount of land, China consists of many people groups that speak a multitude of languages. These formidable physical and social barriers encouraged conflict between rival groups, resulting in violent government transitions. Civil War and occupying countries have dictated political terms causing nearly continuous political changes. These changes have not always been implemented peacefully. The government has used physical force to suppress religious, social, and business groups.

Political and social suppression/persecution has been a second socioeconomic condition that has shaped the technological environment in China [Morrison (2014)]. Persecution and suppression negatively affect economic progress in countries where the government tightly controls the population. This can limit educational opportunities and cause the quality of school systems to diminish. The Anti Rightists Campaign and the Tiananmen Square incident are two of the most obvious examples of social suppression in China. In the 1989

Tiananmen Square incident, the Communist government resorted to military action to dissolve unarmed protests.

When a government closes trade with the outside world, as seen with communist China, technology and other aspects of the economy become sub par. This creates a need for newer better technologies. Without the flow of new ideas and products, social conditions worsen, and infrastructure declines.

Poor infrastructure was the third socioeconomic condition that prepared China for a technological leapover. A combination of social suppression, political turmoil, and a closed economy were the prohibiting factors to the formation of a sturdy infrastructure. China did attempt to improve the educations system with socialist education system, but little progress was made. Civil war and occupation by outer entities, Japan and Britain, prevented the formation of physical infrastructure. As late as 2001, only 10% of China had landlines.

Interestingly, in the case of Russia and China, as cell phone usage increases so does the number of roadways (see Table 3 below). Though it is not possible to show causality between the two, there is some room for speculation. Multiple causes could result in an increase of this vital infrastructure. Perhaps the government is building the roadways to install cellular towers. Another hypothesis is with the increased capital that a more open market procures, the government or perhaps private citizens are using excess funds to improve the infrastructure (for a sanguine evaluation of China's latest technological progress, see Shukman (2011)).

Table 3 – Roadways in China and Russia from 2000 to 2009

Roadways	2000	2009
China	1,402,698	3,860,800
Russia	532,393	982,000

Source: http://www.indexmundi.com

Table 4

Cell Phone/ Landline to Population									
Country	*Population*	*Year*	*# of Cell Phone Users*	*% of Population*	*Population*	*Year*	*# of Landlines*	*% of Population*	*Tenative Cell Phone/Landline Comparison*
Philippines	81,159,650	2000	6,500,000	*8.01%*	81,159,650	2000	3,100,000	*3.82%*	2.10
Zimbabwe	12,576,740	2003	379,100	*3.01%*	12,576,740	2003	300,900	*2.39%*	1.26
United States	275,850,000	1998	69,209,000	*25.09%*	279,040,000	1999	178,000,000	*63.79%*	0.39
China	1,273,111,000	2001	65,000,000	*5.11%*	1,261,832,000	2000	135,000,000	*10.70%*	0.48
Russia	144,978,600	2002	17,608,800	*12.15%*	144,978,600	2002	35,500,000	*24.49%*	0.50
Country	*Population*	*Year*	*# of Cell Phone Users*	*% of Population*	*Population*	*Year*	*# of Landlines*	*% of Population*	*Tenative Cell Phone/Landline Comparison*
Philippines	99,900,180	2010	79,896,000	*79.98%*	99,900,180	2010	6,783,000	*6.79%*	11.78
Zimbabwee	11,392,630	2009	7,500,000	*65.83%*	11,392,630	2009	379,000	*3.33%*	19.79
United States	307,212,100	2009	279,000,000	*90.82%*	307,212,100	2009	151,000,000	*49.15%*	1.85
China	1,336,718,000	2011	986,253,000	*73.78%*	1,336,718,000	2011	285,115,000	*21.33%*	3.46
Russia	140,041,200	2009	238,000,000	*169.95%*	140,041,200	2009	44,959,000	*32.10%*	5.29

Table 5

ΔTc/LC Over Time						
Country	P (initial)	Years	P (Final)	Difference Δ	% Change	Avg. Change per Year
Philippines	2.10	10	11.78	9.68	**461.76%**	**46.18%**
Zimbabwe	1.26	6	19.79	18.53	**1470.69%**	**245.11%**
United States	0.39	≈10	1.85	1.46	**375.21%**	**37.52%**
China	0.48	≈10	3.46	2.98	**618.44%**	**61.84%**
Russia	0.50	7	5.29	4.80	**967.23%**	**138.18%**

Note about use of tabular data:

Because data from CIA fact sources was incomplete and often had years missing, it was imperative to make the data comparable. To do so, the difference between the ratio of tentative cell phones to landlines was divided by X, where X is the range of years that the data spans. After configurations, the data could be compared to the Philippines. Upon review of the data, it became apparent that Russia, China, and Zimbabwe all had experienced leapovers.

The charts above depict cellular usage and landlines in five countries. The United States serves as a control group as it is where cellular technology was originally developed. This is important because the definition of a leapover is when a country or individual bypasses current technology in anticipation of better technology in the future. This process creates a jump in technology from sub-par to more advanced technology, so that the country or individual leaps over others who are better established in the older technology. Thus the countries must exhibit a greater adoption rate than the United States to have experienced a leapover. The Philippines serves as a marker to indicate if a leapover occurred, because it is known that a technological leapover has occurred in the Philippines. By comparing usage data of a known to an unknown, it is possible to determine if a leapover occurred in the counties is substantial. Zimbabwe, China, and Russia were all selected for study because they exhibit the necessary socioeconomic conditions that are necessary for a leapover to occur.

Extension:

Leapovers may be pursued practically in the business world both as a business venture and an as a means to improve economic conditions in developing countries. When entering into a new market, companies bring with them the technology required to perform in their industry. Local laws vary from country to country, however it is normal for countries to require companies to employ a certain percent of their workforce from the local population. Countries such as Japan require foreign companies to divulge blueprints and schematics of the product to be manufactured. When this occurs the standard of living increases in developing countries because of new technology and increased cash flow.

Lord Bauer argued in his book *Equality, the Third World, and Economic Delusion* that trade is more beneficial than aid. Funds and charity help but only for a limited time. Charity is not effective because many times money is swindled from the funds by the local governments or the governments lack the ability to us them effectively. To make a significant difference in a country's economy, it requires new technology, the creation of jobs, trading, and a steady flow of cash. This concept is akin to the old saying "Give a man a fish, you feed him for a day. Teach a man to fish, you feed him for a lifetime."

Investing in foreign countries does not need to be purely socially-minded. Bauer's work would seem to imply that *perhaps it would be better for it not to be socially-minded at all.* There are perfectly sound reasons for outsourcing. Outsourcing is a viable option for business wishing to cut costs. The cost of labor is cheaper in less developed countries and there are many tax breaks offered for

companies willing to take the risk of international investments. Countries have a major question that it must ask when looking at developing a partnership:

When is the optimal time to invest in new technologies and when will the technology become obsolete?

It would not do to invest in a current technology and find it obsolete in just a few years (maybe even months). A country should examine the industry of the prospective company and determine if it first of all would be beneficial for the economy and remain beneficial for years to come. Companies looking to invest have a major question to ask before pursing technological investments in a developing country:

Are there first or second mover advantages?

In other words, is it of greater benefit to capture the initial market or to let a competitor create a stable environment? Many times the first mover must install the infrastructure required for business entry, maneuvering through political hoops and tedious technicalities, and operating in a riskier environment.

Future Application:

The possibility of countries experiencing leapovers is intriguing. Two countries in particular are primed to experience one: Columbia and Cuba. Though neither one will experience a leapover in its current state, a change in economic conditions could open the door of new companies to enter into trade.

Columbia has the second largest population in South America and boosts vast amounts of natural resources. Low wages and taxes would make it a favorable

location for companies looking to outsource. However, not many companies are willing to risk the turbulent environment created by the drug cartels. Too many risks currently exist for a company to invest wisely in Columbia. The risk would significantly decease either if the government could manage the cartels or if the cartels gained control and set up their own government, stabilizing the political system. This said, I am not advocating the success of the cartel but merely directing attention to the concept that a stable government and willingness to trade make a country more favorable for investors. The optimal economic situation from a U.S. perspective is that the government disbands the cartels and opens the country to free trade.

Cuba is in a similar position to Columbia except it lacks much of the natural resources. However, Cuba is in close proximity to the United States, making trade convenient. Both Columbia and Cuba have many of the socioeconomic conditions discussed earlier in the paper with the potential to attract investors. Of course, this is all speculative and consistent data, currently an unreachable luxury, would be necessary to yield conclusive evidence.

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