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DEPARTMENT OF SUPPLY CHAIN & INFORMATION SYSTEMS

THE ROLE OF TRANSPORTATION INFRASTRUCTURE IN ECONOMIC DEVELOPMENT- AFRICA'S DEVELOPMENT

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ABSTRACT

This thesis was completed in response to a submission from the Dow Chemical Company to the Penn State Center for Supply Chain Research in the Smeal College of Business. Dow is interested in global trends in transportation, specifically in the continent of Africa. This thesis examines the historical impact of transportation infrastructure on a country's economic development and analyzes historical data for China and the United States in terms of transportation infrastructure development and GDP growth. Utilizing the U.S. and China as benchmarks, this thesis examines investment in Africa, the current issues of African transportation networks, and consumer spending growth in order to provide Dow and other companies with a complete overview of the logistical landscape of the continent.

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Introduction

Transportation infrastructure allows for the movement of people, goods, and ideas. Without adequate transportation networks and policies, can developing countries compete in the global market? Does gross domestic product (GDP) growth drive infrastructure development? Or does improvements in transportation infrastructure jumpstart economic development? This thesis will analyze the role of transportation infrastructure development in driving a country's economic growth. In particular, it will analyze the current state of transportation across the continent of Africa including physical structures such as kilometers of roadway as well as political concerns such as a country's customs policy. It will provide businesses with recommendations for moving forward in terms of the logistics of doing business in Africa from the sole perspective of transportation.

Research Methodology

The main context of this thesis comes from a literature review. Chapter one looks at the role of transportation from a historical perspective and how transportation infrastructure stimulates a nation's economy. The literature focuses mainly on the role of transportation in the United States during the time period of 1800 to1900. Chapter two provides another case example of transportation fostering economic development through a literature review of China's economic transformation over the past thirty years. The following chapter provides a data analysis of transportation infrastructure and economic indicators in order to understand the correlation between the two. After China's own transformation, chapter four analyzes Chinese investment in African infrastructure. Then, Chapter five outlines the current state of transportation in Africa and highlights the deficits. Chapter six provides an outlook for consumer spending growth in Africa, a key consideration for businesses deciding whether or not to invest. Finally, chapter seven provides a conclusion as well as business recommendations for supply chain investment in Africa.

Chapter 1

Historical Perspective of Transportation in Social, Political, & Economic Development

Historically, the development of transportation networks has significantly bolstered the growth of civilizations in terms of social/cultural, political, and most importantly economic foundations. For example, the Egyptians located their civilization near the Nile River (Locklin, 1972). In turn, the river allowed citizens to communicate, soldiers to defend the society, and goods to be traded amongst consumers and suppliers. Moving forward in time, in the United States, prior to the invention of the steam engine, water was the most efficient and lowest cost mode of transportation for transporting goods to consumers (Locklin, 1972). Strong economic cities were built around ports to ship and receive goods around the world, similar to the Egyptian civilization several centuries earlier. Transporting goods west of the Mississippi River required heavy investment and took significant lead time (Locklin, 1972). In the 18th century, the development of the steam engine contributed to the significant economic developments of the 19th and 20th centuries (Locklin, 1972). In 1807, the steam engine allowed for decreased costs in water transportation as well as reductions in transportation time (Locklin, 1972). However, the invention of the steam locomotive in 1829 gave rise to the railroad industry that fueled revolutionary economic development, a cultural revolution, and increased political activity throughout the United States (Locklin 1972).

Social Impacts of Transportation

Transportation not only allows for the movement of goods, but also the movement of people. Through this flow, transportation networks allow for social changes including increased exchange of ideas, more access to education, trends of rapid urbanization, and movement of healthcare options (Locklin, 1972). As citizens can now more freely travel the world, ideas spread faster and cultures and societies can come together. The merging of societies allows citizens to learn from individuals with different backgrounds, religions, and beliefs. Furthermore, transportation networks allow for an increase in education as knowledge spreads faster; ideas can be shared face to face and imported from other towns and cities (Locklin, 1972). With more modes of transportation as well as more efficient transportation, students can travel more easily and therefore can enroll in more educational institutions. Moreover, in terms of urbanization, transportation networks allow for goods to be transported longer distances and more efficiently allowing citizens the option to live further away from the supply of certain goods or raw materials (Locklin, 1972). Large scale production encourages the concentration of manufacturing in key cities and towns. Thus, workers and their families develop the area to fit their desired lifestyle. Developments in transportation networks have had a positive stimulus on urbanization (Locklin, 1972). For example the development of railroad systems in the United States led to more cities in the Midwest (Locklin, 1972). The concentration of people no longer had to be around ports and rivers. Finally, increased options in transportation networks allow for improvements in healthcare delivery (Locklin, 1972). If networks exist, medicine, supplies, and personnel can reach afflicted areas. For

example, underdeveloped transportation networks in Africa made it difficult for supplies to reach the famine afflicted areas. Relief efforts were complicated by the logistics of transporting the products from the ports to the inland areas (Locklin, 1972).

Political Significance

The significance of transportation development on a country's political environment stems from the government's role in its development. In the majority of countries, transportation development and maintenance comes from government investment and planning. Government intervention is necessary to design efficient routes, cover capital expenditure for large-scale public works, and regulate the efficiency and safety of the system (Coyle, 2011). Furthermore, the political importance of transportation networks depends on the military's role in transportation for national defense. As an example, the Roman Empire built a vast network of roads initially for military purposes, even though it ultimately had a more important impact on trade and commerce (Coyle, 2011). These roads allowed the empire to transport soldiers to protect its citizens from intruders. Furthermore, Sir Winston Churchill stated, "Transportation was the underlying basis for all that could be accomplished in effectively fighting a war" (Coyle, 2011). However, one of the key drawbacks of government involvement in transportation development is the right of eminent domain (Coyle, 2011). In the United States, this law allows the government to require citizens to sell their land for public use (Coyle, 2011). The government acts in the best interest of the community, but this may not please all citizens.

Economic Significance

The most important impact of transportation development is economic growth; it allows for increased transportation of goods and services in the market place. In terms of economics, transportation increases the availability of goods, equalizes prices, reduces costs, creates central markets, and boosts the area of profitable production (Coyle, 2011). In turn, transportation improvements reduce costs to consumers by decreasing transportation costs from production to market and transportation expenses of raw materials necessary for manufacturing (Coyle, 2011).

Increases the Availability of Goods

Development of transportation networks as well as improvements in these networks allows communities to purchase goods from a variety of locations. Towns and cities no longer have to be self-sufficient and produce all of their own products. Consumers can purchase goods from around the world (Coyle, 2011). Furthermore, geographic locations are no longer restricted by climatic conditions and available resources in determining what products they can buy and sell. Transportation allows an outlet for goods from various areas to become commonplace in a community that otherwise would have no means of production (Locklin, 1972).

Increases the Value of Goods

Transportation also plays a role in determining the economic value and utility of products and services. It bolsters place, time, and quantity utility of a good (Coyle, 2011).

Place utility is defined as the usefulness of a good or service as a function of the location for which it is made available (Coyle, 2011). For example, ski coats have more place utility in Denver, CO than Miami, FL. Without reductions in transportation costs and increases in efficiency, a good could not be sold at a different location at market price. When the factor of transportation expense is reduced, goods can be bought from farther away at a cheaper price and consumers do not have to rely on local products that may be more expensive (Coyle, 2011). Dionysius Lardner, an early transportation economist, developed the Law of Squares which states that "an increase in the distance over which a given amount will cover the transport of goods will increase the market area of the produce in even greater ratio" (Coyle, 2011).

In terms of time utility, transportation improvements help alleviate the burden of this economic concept (Coyle, 2011). Certain products carry no economic value if they arrive at the market during a period of no demand (Coyle, 2011). These products may have a very short window to meet demand. For example, Easter eggs have limited demand if bought after the Easter season. Reliable and efficient transportation networks allow these products to be shipped at a reasonable cost to meet the demand window. In addition, this utility not only refers to the finished product, but also to raw materials needing to arrive during a specific time period. Otherwise, they have no value and the shipment may be denied. Effective transportation can ensure time utility. As far as Lardner's Law, the speed of transportation is a governing factor for perishable goods (Coyle, 2011). These goods lose all economic value if they arrive after the shelf life; transportation improvements can support time utility.

Transportation not only helps to ensure place and time utility, but also supports quantity utility (Coyle, 2011). Quantity utility ensures that products arrive in the right quantity and condition (Coyle, 2011). As the increasing trend of minimizing safety stocks for both shippers and receivers has become more important and valuable, transportation has helped to ensure this utility (Coyle, 2011). Transportation ensures that the quantity demanded is the same quantity delivered. Furthermore, this utility increases as the value of goods increase due to the relation to inventory-carrying costs and stock out costs (Coyle, 2011).

Geographic Specialization & Large Scale Production

Transportation development leads to both geographic specialization and large-scale production (Coyle, 2011). Consumers can trade and have the networks to transport goods; geographic specialization allows each nation or community to produce the products and services with their own raw materials, capital, and labor (Coyle, 2011). Transportation is essential for individuals to trade the products that they can produce most efficiently. Through the theory of comparative or absolute advantage, an area will specialize in the production of goods for which they have the greatest advantage or the least comparative advantage (Locklin, 1972). As each area specializes in certain products, the trends of geographic specialization tie into economies of scale (Locklin, 1972). More efficient transportation allows for the development of larger scale production facilities. The unit cost for producing each item falls as more units are produced. However, efficient transportation must exist for this to happen because either the raw materials or finished products must be transported long distances because of the economies of scale

(Coyle, 2011). For example, transportation growth allowed the meat-packing industry in Chicago to exist. Without it, they would have to rely on local supply that could not provide the cattle in the quantity, quality, and cost necessary for market growth (Locklin, 1972).

Equalized Prices

If a community cannot trade, the citizens must rely on the product that they can produce locally (Locklin, 1972). Therefore, they are also dependent on the conditions of the area. Weather and natural disasters can hurt the crops for the entire community. However, if an efficient transportation network exists, crop failures are much less harmful to the town. It may hurt the farmers and producers, but the consumers can still purchase goods from other areas. Furthermore, a community is no longer as fearful and cognizant of oversupply. If local demand decreases, the abundant supply can be transported and sold to other areas (Locklin, 1972). This allows for a reduction in local prices. Transportation networks and developments also help to increase competition and therefore further equalize prices (Locklin, 1972). Without these networks, communities would rely on the local suppliers who may charge unfair prices and produce goods inefficiently.

Reductions in Cost of Goods

Transportation development and increased efficiency reduces the price of goods for consumers through reductions in the cost of production; freight rates can be considered a production cost if every other input remains relatively the same (Locklin,

1972). Reductions in freight costs reduce prices by decreasing the cost from production to market as well as the cost of shipping raw materials required for manufacturing (Locklin, 1972). As freight rates decline, the cost to ship a product to the market decreases and vice versa. For example, in U.S. History, the settlers in the interior had to pay higher costs for commodities due to extremely high freight rates from inefficient and underdeveloped transportation (Locklin, 1972). Furthermore, especially when utilizing economies of scale, raw materials may need to be shipped from a variety of different locations. The cost of goods can be reduced if the cost of production is reduced. Therefore, if freight rates decline, the cost of supplying raw materials can be reduced and the cost of goods ultimately decrease (Locklin, 1972). Industries sometimes move closer to sources of raw materials to reduce shipping costs, but if multiple inputs come from a variety of different distances and locations this is not feasible. In these cases, production facilities may be moved closer to the input with the highest cost (Locklin, 1972). Nevertheless, the other inputs will have to be shipped longer distances and the end product may travel further distances to market. Any reduction in freight costs will then reduce costs to the end consumers by reducing production costs.

Establishment of Central Markets

When transportation networks exist, local economies can become even more interconnected. Transportation leads to the establishment of central markets; supply comes from many sources and then flows to demand of consumers in a wide variety of locations (Locklin, 1972). Central markets help to reduce wide price fluctuations that can exist when goods are sold only in a local market (Locklin, 1972). Commodity markets

can then be established world-wide as products travel great distances to reach the areas of demand. It helps to stabilize commodity prices as the producing price in local areas fluctuates with the world price (Locklin, 1972). Prices now only vary mainly with fluctuations in transportation costs.

Increased Area of Profitable Production

Transportation networks increase the area of profitable production. Essentially, as transportation becomes less expensive and more efficient, goods can reach distant locations more easily (Locklin, 1972). For example, grain could only be transported 250 miles by railcar at one point in U.S. History (Locklin, 1972). Therefore, it could only be sold to people within that circumference (Locklin, 1972). As transportation improved, the areas that could produce became more profitable. Farms could be located in areas of more arable land, while the population could live in another location. In turn, transportation also helped to increase land rents and values in remote regions. Land west of the Allegheny Mountains had little to no value before the advancement of rail transportation as it was very expensive to ships goods to and from this area (Locklin, 1972). As transportation networks developed, the land value increased. Nevertheless, this also decreases the land value for areas closer to the market. Transportation can cause increased air and noise pollution making certain areas close to transportation networks less valuable (Coyle, 2011).

Chapter 2

China's Infrastructure Development in Transportation

In the past thirty years, the Chinese economy has developed as seen in Figure 1. GDP has grown almost seventy times between 1978 and 2007. The infrastructure growth and development over these past thirty years has reached incredible levels. The transformation in infrastructure in many ways is a guideline and model for other developing nations.

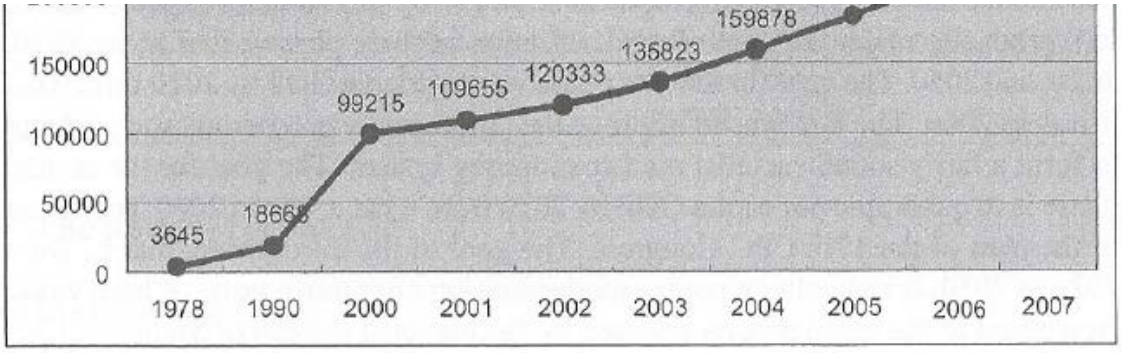

Figure 1.1 GDP growth

Note: The unit is RMB 100 million yuan.

Figure 1:China's GDP Growth (The unit is RMB 100 million Yuan) (Mengkui, 2012)

The United States serves as a comparable country to analyze Chinese infrastructure in part because they have similarities in terms of the complexity and efficiency of their transportation systems. In addition, these nations are similar in size

and the differences in previous political and economic practices highlight the challenges of investment and development under Communism in China (Mengkui, 2012). In 1978, at the start of the period of political and economic reform known as the "Opening Up Period", China had 51,700km of operational railroads (Mengkui, 2012). This was only 15.6 percent of the U.S. rail system (Mengkui, 2012). Furthermore, railroad density was only 15.2 percent of that of the U.S. at 53.9km per every 10,000square kilometer range (Mengkui, 2012). Highways were 14.4 percent of those in the U.S. with a total of 89,200km (Mengkui, 2012). Roadway network density was 927km per every 10,000 square kilometer area (Mengkui, 2012).

One of the main difficulties of developing transportation and other fixed asset investments in China was the fact that the government was "highly centralized" and "excessively monolithic" (Mengkui, 2012). Until this time period, the government was the most important body investing in infrastructure with control over every industry and sector. In addition, enterprises were not independent from the state and therefore could not freely invest in infrastructure. Until 1980, the state owned eighty percent of all enterprises (Mengkui, 2012). Furthermore, all investment came from the state's public finance budget that required distribution to be allocated by department and geographic location (Mengkui, 2012). Unlike loans and other investments, the financing from the state required no return compensation (Mengkui, 2012). In addition, the extremely complex review and approval process made it difficult for any development plans to be passed. Extraordinary time and energy was required to receive approval for a project. Loans from international finance institutions and foreign governments were mandated to abide by the state's planning processes (Mengkui, 2012). These challenges limited the

markets' role in development and lead to underdeveloped and inefficient infrastructure prior to the 1980s.

Accomplishments

Dramatic Growth in Investment

Between 1978 and 2007, investment in transportation in China increased from 6.41 billion RMB to 1.2503 trillion RMB (Mengkui, 2012). This figure includes all fixed-asset investments in railroads, roads, public transport, water transport, and aviation. Investment in railroads rose from 3.34 billion RMB to over 235 billion RMB (Mengkui, 2012). Railroad investment increased even more dramatically from 990 million RMB to over 690 billion RMB during this same time period (Mengkui, 2012). Overall, investment increased by twenty percent per year, roughly equivalent to the rate at which overall investment in all fixed assets developed during this same period (Mengkui, 2012).

Improvements in Capacity

Not only did increased investment support economic growth and infrastructure development, but also throughput capacity of basic infrastructure saw significant improvement during this time period (Mengkui, 2012). Currently, roughly twice the mileage of railroads is being built every year than was built in total at the start of the reform period (Mengkui, 2012). In terms of highways, the additional mileage built every year is roughly nine times the amounts of roads developed each year in the early years of the restructuring process (Mengkui, 2012). The capacity to develop new infrastructure

has continued to improve. Not just the capacity to build the infrastructure, but also the overall capacity of transportation has improved. Today, China has roughly fifty-six percent of the mileage of roads that exist in the U.S. (Mengkui, 2012). As started earlier, in 1978 that number was 14.4 percent (Mengkui, 2012). In just thirty years, the capacity of highways relative to the U.S. has increased by forty percent. Furthermore, China is expected to reach the level of the U.S. fairly soon. With 54,000km of expressways currently and a development rate of 5,000km each year, China is predicted to match the U.S. total (90,00km) in the next few years (Mengkui, 2012). In addition, the kilometers of railroads in operation increased by over fifty-one percent and airport runways increased by 14.7 percent (Mengkui, 2012).

Forces Behind Development

One of the primary forces driving development stemmed from the overall process of reform and the liberalization of the market. Historically, any areas in which political and economic reform are particularly forceful will see accelerated development of infrastructure (Mengkui, 2012). Furthermore, demand was a significant factor driving infrastructure development. The economic growth of China required basic infrastructure to support it, especially in terms of logistical transport for the increased movement of goods (Mengkui, 2012). With an average growth rate of roughly ten percent per year, China has experienced continuous supply chain bottlenecks due to inefficiency in transportation infrastructure (Mengkui, 2012). In addition, improvements in the standard of living also played a role in infrastructure development (Mengkui, 2012). In certain

situations, structural changes in consumption have surpassed demand from enterprises for increased transportation. For example, as the personal use of automobiles increases, the demand for roadways also increases. Finally, a fundamental breakthrough in the process of investment as well as in the management of infrastructure has bolstered infrastructure development.

Sources of Investment

Throughout the past thirty years the types of investment has dramatically changed. As mentioned earlier, investment and funding was strictly monitored and controlled by the central government hindering the development of infrastructure. Overall, the development of transportation has been possible from an increased focus on local governments, more control allocated to enterprises, increased acceptance of foreign investment, and additional innovations to support infrastructure development (Mengkui, 2012).

Role of Local Governments

Throughout the period of "Opening Up," amendments applied to the process of approval and review allowed for an increased involvement by local governments. Prior to 1984, any investment in infrastructure over 10 million RMB had to receive approval from the State Planning Commission (Mengkui, 2012). Reforms in 1984 raised the level to 30 million RMB and then additional reforms in 1987 raised the level again to 50 million RMB (Mengkui, 2012). Furthermore, reforms in 1988 and 1993, established that the

central government would handle key national projects, but local governments could have authority for infrastructure development in their regions (Mengkui, 2012). This transfer of power that granted more authority to local governments has been an extremely powerful force behind economic growth and infrastructure development. In 2007, eleven percent of all investment in fixed assets in urban areas came from the central government (Mengkui, 2012). The other eighty-nine percent came from local sources (Mengkui, 2012).

Enterprises' Role in Investment

As more companies were privatized and even certain entities still state-owned, the pressure from the government was relaxed. These institutions were now allowed more freedom to make decisions in terms of construction and growth. By 1995, the percentage of government investment in basic construction projects for enterprises declined to 6.8 percent from the level of seventy-eight percent in 1978 (Mengkui, 2012). Furthermore, in 2005, the State Council created a positive environment for the non-public sector to enter such transportation industries as railroads and civil aviation (Mengkui, 2012).

Foreign Investment

Historically, foreign investment has existed in China, but it was centrally managed, strictly controlled, and limited to small scale loans from foreign governments or international financial institutions (Mengkui, 2012). The expansion and increased openness to foreign investment supported the overall process of opening up the markets. In 1981, foreign investment in fixed assets only accounted for 3.6 billion RMB, but in

2007 it exceeded 513 billion RMB (Mengkui, 2012). Foreign direct investment (FDI) not only supplemented insufficient funds, but also brought new technologies and business practices to China (Mengkui, 2012). For example, the World Bank had been an important investor in China's railways. Between 1992 and 1995, China borrowed over $885 million for several key railroad projects (Mengkui, 2012). In 1993, China sought foreign direct investment for the first time (Mengkui, 2012). The government signed a joint-venture with a Japanese investment group in order to build a $2 billion bullet train (Mengkui, 2012). Around this same time, several rail lines were selected as pilot projects for a share-holding company laying the foundation for foreign investment (Mengkui, 2012). Foreign investment for roadways began in the 1980s. Between 1985 and 1993, China completed 7,000km of road with loans from international financial institutions or bilateral government agreements (Mengkui, 2012). The World Bank had been one of these main providers for roadways as well as for rail. Additionally, FDI helped fund 1,700km of roadway of which 370km are expressway during this same time period (Mengkui, 2012). The interest from international institutions resulted from the high return on these projects. For example, daily revenue on the Guangshou-Fushan expressway is 250,000 Yuan (U.S. $41,667) calculated with an average flow of 40,000 vehicles per day (Mengkui, 2012).

Infrastructure Innovation

The government focused on almost all forms of investment and funding to increase the development of infrastructure. Toll roads were one of the earliest sources of funding for maintenance and new construction (Mengkui, 2012). In addition, they became one of the most innovative, influential, and successful. Commencing in 1984, the government allowed loans to build roadways and to be paid back by the collected tolls

(Mengkui, 2012). By the end of 2003, China had built 150,000km of toll roads, seventy percent of all toll roadways in the world (Mengkui, 2012). Next, a percentage of fees charged for transport or a portion of the ticket price charged for civil transportation supported additional infrastructure development (Mengkui, 2012). This source of funding was extremely important in China as it is a stable source of funds (Mengkui, 2012). Furthermore, China also allowed for equity financing, bond financing, and project financing. Today, over forty companies listed on the domestic exchange are funding transportation projects (Mengkui, 2012). Railroad bonds were the largest share of all bonds in the transport sector, equating to roughly 100 billion RMB (Mengkui, 2012).

Chapter 3

Importance of Transportation Infrastructure in Economic Development

The figures below show the trends from both the development of the United States and China from economic, population, and infrastructure development. Data collected from the United States Census Bureau as well the All China Data Center through the University of Michigan is analyzed in order to track the growth and development of these countries (All China Data, 2012). Figure 2 shows the upward trend of Gross Domestic Product for the United States. From 1960 and1990, there was a sharp trend upwards that has since risen more gradually. In Figure 3, the population trend has a much more steady increase than the steeper curve in GDP growth trends. The graph in Figure 4 portrays a vast increase in public infrastructure spending that more closely matches the trends in Exhibit 2 than Exhibit 3. Exhibits 5 and 6 indicate the drastic increases in roadway and highway development. The spending on highway development parallels the GDP growth around the 1960s and 1970s as viewed in Exhibits 2 and 6. Overall, the increase in infrastructure development and increased public infrastructure spending at the federal, state, and local levels helped drive growth in the United State's GDP. Furthermore, the data indicates that infrastructure development is more important than population growth in spurring a nation's economic growth.

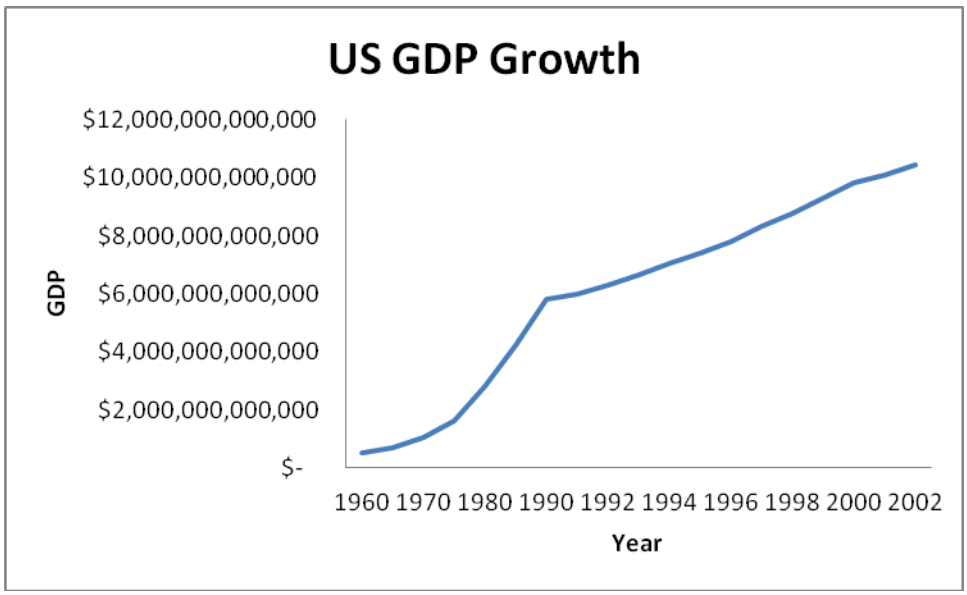

Figure 2 United States GDP Growth (1960-2002) (National Data, 2003)

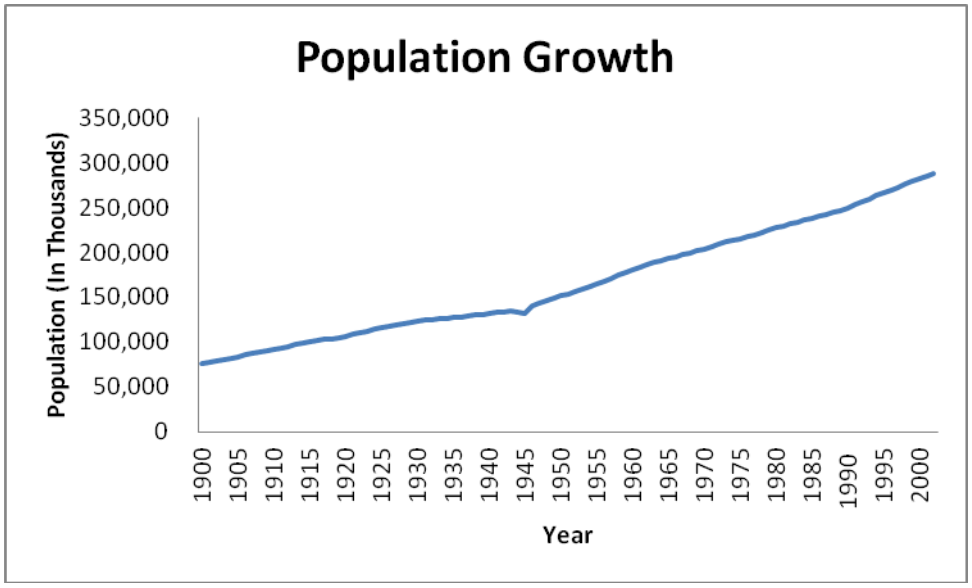

Figure 3 U.S. Population Growth (1900-2000) (Statistical Abstract, 2003)

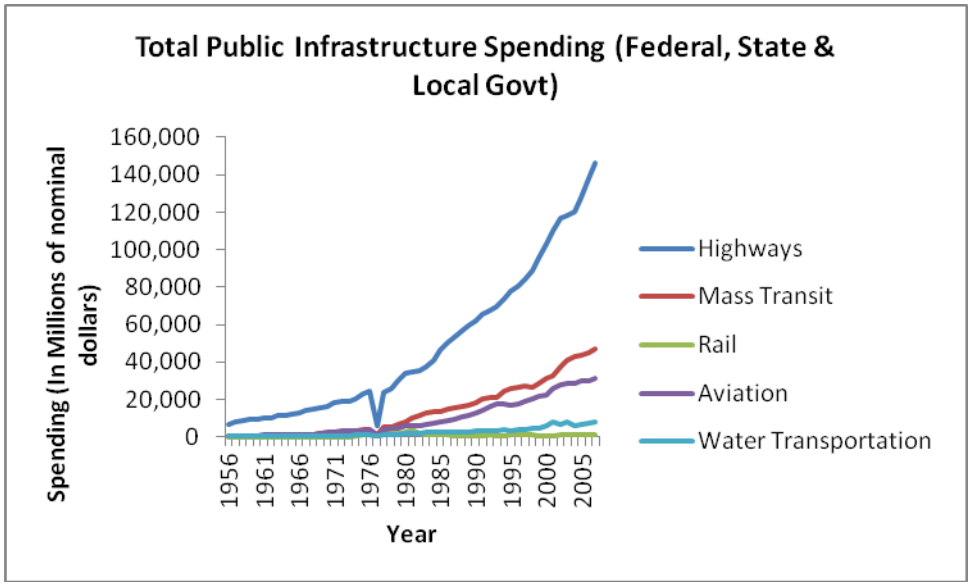

Figure 4 Total US Public Infrastructure Spending (1956-2005) (Detailed Data, 2009)

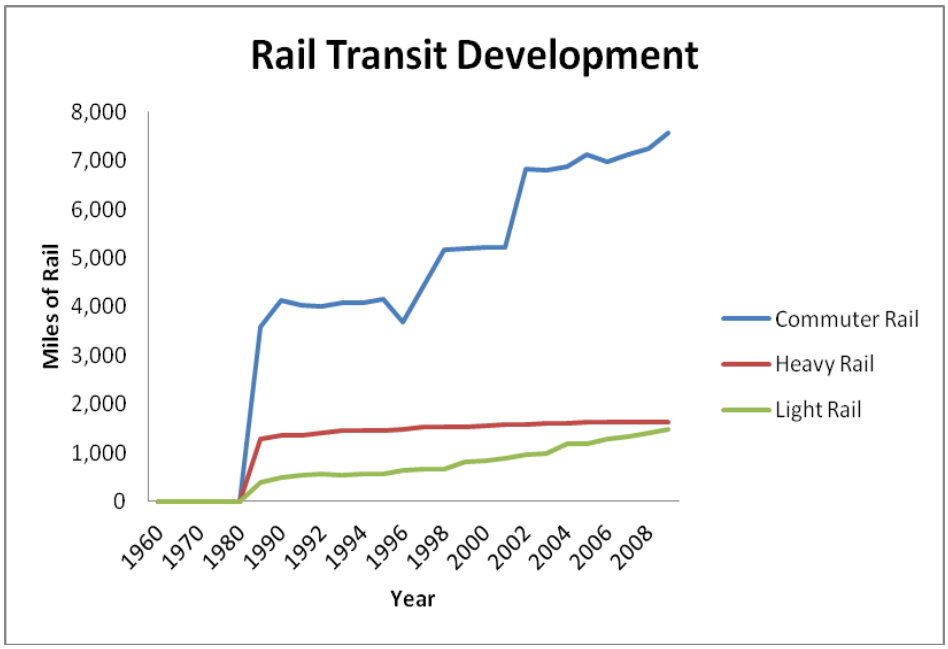

Figure 5 American Rail Transit Development (Table 1-1, 2010)

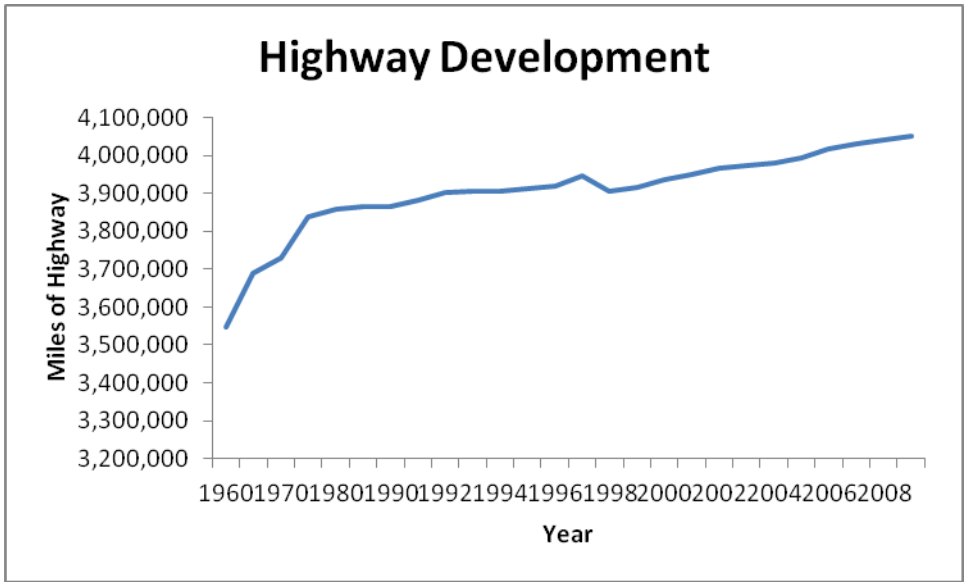

Figure 6 American Highway Development (Table 1-1, 2010)

China has seen rapid economic development over the past thirty years, similar to what the United States experienced in previous years. As seen in the Figure 7, China's economy has experienced drastic improvement in GDP over the past thirty years. While population has been growing, as seen in Figure 8, the incline is not nearly as steep. Figure 9 and Figure 10 indicate that infrastructure development continues to drive economic development more so than population growth; the trend lines are much closer in nature between Figure 7 and Figures 9 and 10 than between Figures 7 and 8. Infrastructure development is more important to the growth of a country's economy than the manpower (the country's population). Development of highways and railways has continued to fuel China's rapid economic growth allowing for the movement of people, materials, and products throughout the country.

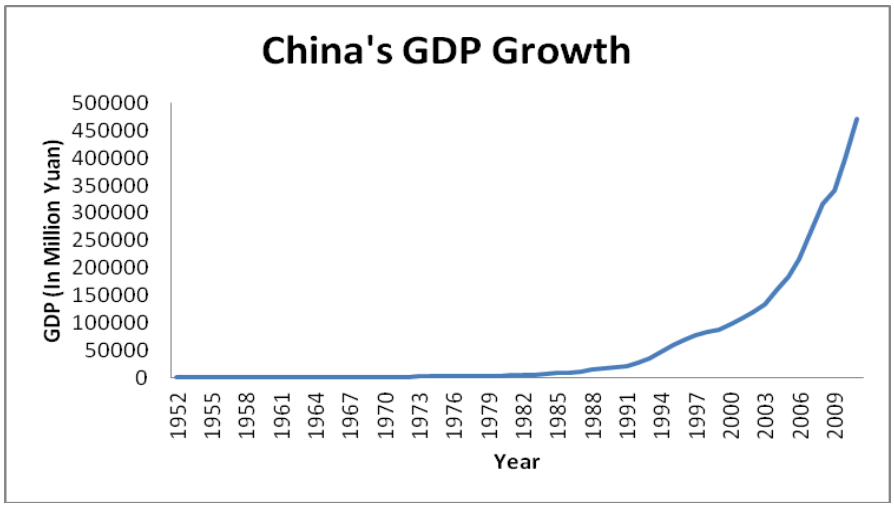

Figure 7 China's Gross Domestic Product Growth (1952-2009) (All China Data, 2012)

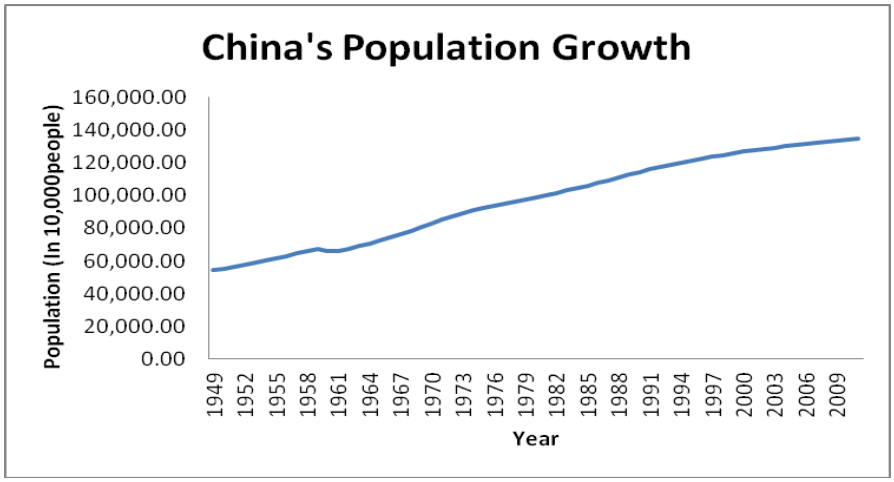

Figure 8 China's Population Growth (1949-2009) (All China Data, 2012)

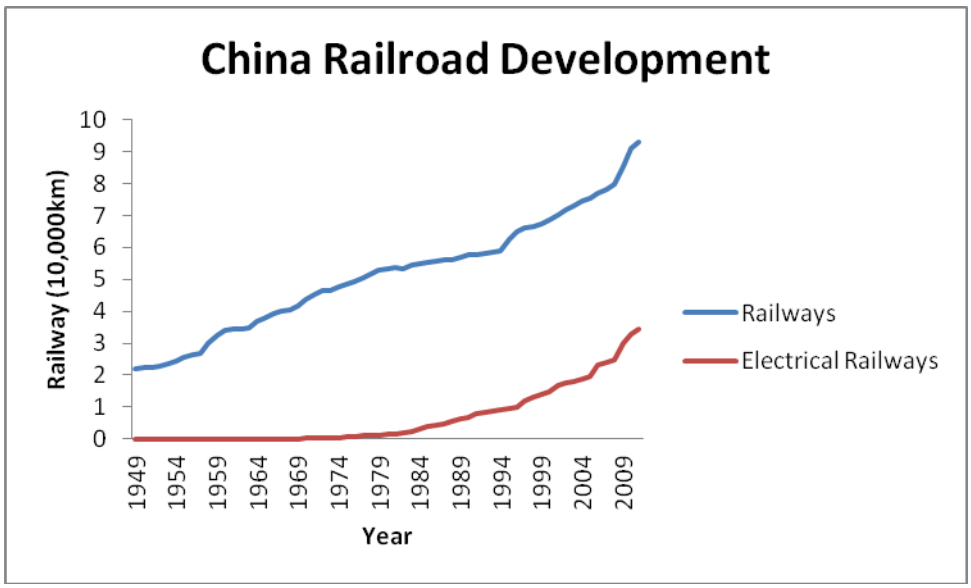

Figure 9 Railroad Development in China (All China Data, 2012)

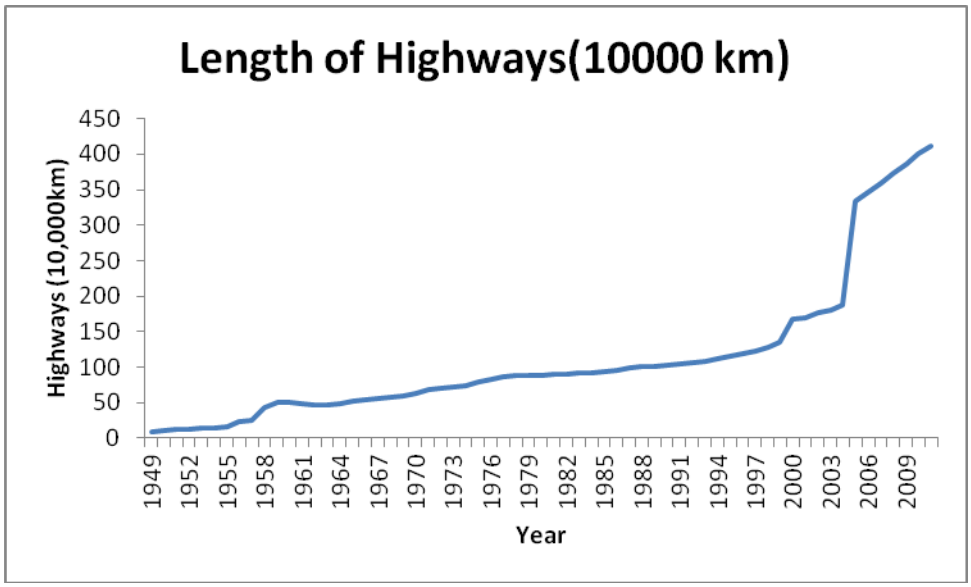

Figure 10 Highway Development in China (All China Data, 2012)

From the trends, one can conclude that infrastructure development is tightly tied to gross domestic product growth as well as population growth. Transportation infrastructure helps fuel a country's economic growth and therefore also drives trends in terms of social and population growth. Developing and financing infrastructure is

essential to the development of a country's economy. These networks allow for the movement of goods and people both domestically and globally.

Appendix A provides a comparison of the infrastructure in China, the United States, and several African Countries with data from the World Factbook and the Global Edge Database through Michigan State University (The World Fact, 2013) (Get Insights, 2013). The countries were selected based on input from the Dow Chemical Company as well as through an analysis of growth trends in Africa. These nations have some of the strongest economic development across the continent of Africa. The data continues to support the hypothesis that infrastructure development drives economic development. Furthermore, the data highlights the deficits in infrastructure levels when these African countries are compared to the benchmark nations (the U.S. and China). For example, South Africa, the most developed market in the region with the largest GDP, does not even compare to the United States. In terms of roadways, South Africa has roughly five percent of the kilometers as the United States. Railways are slightly higher with approximately nine percent the length of track as found in the United States. Airports are almost insignificant as they represent fewer than four percent the number in the United States. Furthermore, while many of these nations have higher GDP growth rates than the United States, the infrastructure deficit needs to be addressed in order to maintain this positive trend. China's GDP is 9.2 percent, higher than almost all the African Nation's listed, but the nation also has infrastructure development more comparable to the United States than any African Nation.

Chapter 4

China's Investment in Africa

After its profound economic growth, China looked for newer areas of investment. In need of natural resources to support a growing manufacturing industry, Chinese investment turned to Africa. The combined resource flows from China to Africa are comparable to those of a traditional Official Development Assistances (ODA) under the Organizations for Economic Co-operation and Development (OECD) (Foster, 2009). Nevertheless, the partnership and opportunities did not start in the early 2000s. Historically, the Sino-Africa trade dates back to the days of the Silk Road (Foster, 2009). Contemporary investment started in the 1960s, but the majority of this investment did not support infrastructure needs in Africa (Foster, 2009). The only exception was the construction of the Tanzania-Zambara Railway (Taraza) completed in 1976 (Foster, 2009).

Motivation

For China, the opportunities in Africa stem from a need for natural resources, specifically petroleum and minerals. The Chinese economy needs these resources to support its increasingly growing manufacturing sectors. For Africa, there exists an enormous deficit for infrastructure, as well as a funding gap for these associated large investments (Foster, 2009). Sub-Saharan Africa lags behind most nations in infrastructure

needs, especially transportation and energy. The infrastructure deficit may be costing Africa's nations up to one percent of per capita GDP per year (Foster, 2009). In addition, trucking costs in Africa are two to four times higher than in the United States; travel times along key export corridors are two to three times as high as those in Asia (Foster, 2009).

These two significant requirements created principles of mutual benefit and reciprocity for these two areas. China found a source of natural resources to bolster their economic development; African nations found an investment source to support the infrastructure requirements of the country (Foster, 2009). In 2006, the Chinese government coined it the "Year of Africa" highlighting the campaign with several diplomatic trips to Africa. Furthermore, China's construction sector has had an annual growth of twenty percent per year making it the largest construction market in the global economy with the capability and expertise to develop the infrastructure throughout Asia (Foster, 2009). China's finance investments are on a large enough scale to make a material contribution toward reaching the needs of Africa's vast infrastructure challenges.

Areas of Development

China has invested in at least thirty-five African countries on infrastructure and finance deals (Foster, 2009). The largest investments are in Nigeria, Angola, Ethiopia, and Sudan (Foster, 2009). Almost seventy percent of total Chinese investment in Africa is supporting these four countries (Foster, 2009). Nevertheless, roughly half of the confirmed projects involving Chinese commitments in Africa are much smaller, receiving

less than U.S. $50 million (Foster, 2009). In addition, the major sectors of investment are hydropower and rail. Recent investment in the railways resulted in U.S. $4 billion to rehabilitate more than 1,350km and create 1,600 new kilometers of rail. In perspective, the entire African Railway is about 50,000km (Foster, 2009).

Types of Negotiations

Unlike the typical resource flows to Africa, China is on complementary terms (Foster, 2009). The financing comes through the China Export-Import (Ex-Im) Bank with the terms marginally concessional (Foster, 2009). Concessional agreements stem from regulations in the OECD-ECA (Export Credit Agreement) and state that the terms must have an equivalent grant element of thirty-five percent or more comparative to those found on the market (Foster, 2009). The Ex-IM Bank has the specific mission to promote trade and economic development. Unlike other support to Africa, Chinese investment has mutual benefit, reciprocity, and is complementary. Coined the "Angola Mode" or "Resources for Infrastructure," these repayments of loans for infrastructure development are made in terms of natural resources (Foster, 2009). Many of these countries do not have sufficient funds to show credibility to proving adequate financial guarantees in order to take loans for long-term infrastructure investment. China is extremely interested in the natural resources and therefore will use them as collateral to back these infrastructure loans. Furthermore, the majority of these "loans" from China have an interest rate of 3.1 percent, a grace period for four years, and a maturity of thirteen years (Foster, 2009).

By the Numbers

Since 2001, Chinese investment in Sub-Saharan Africa has seen an upward climb. Between 2001 and 2003, it only accounted for about U.S. $0.5billion (Foster, 2009). By 2004, investment increased by $1 billion. In 2006, this number took a significant increase to $7 billion, but fell off slightly in 2007 to $4.5 billion (U.S.) (Foster, 2009). In Africa, the infrastructure needs are roughly U.S. $22billion per year with a $10 billion funding gap per year (Foster, 2009). Nevertheless, the continuously growing Chinese financing could potentially make a significant improvement to close the gap. Comparatively, in 2006, the countries of the Organisation for Economic Co-operation and Development (OECD) attributed U.S. $5 billion to support infrastructure projects (Foster, 2009). China, as one economic unit, contributed relatively the same amount that year.

Chapter 5

Current Issues with African Transportation

As seen through the data analysis, transportation infrastructure is a key driver of economic development. Infrastructure development has caused more than half Africa's recent economic growth, and studies predict that additional investment in infrastructure could continue to fuel faster economic growth (Foster, 2010). Structural policies only contributed sixty-eight basis points per capita in economic growth, while infrastructure development contributed ninety-nine basis points between 1990 and 2005 (Foster, 2010). Nevertheless, as seen in Appendix A, all of the countries lack development in roadways, highways, airports, and ports. Current capacity levels are nowhere near those of developed countries such as China and the United States. The estimated cost to decrease the infrastructure deficiency is around $93 billion U.S. per year with about one third needed for maintenance (Foster, 2010).

Intraregional Concerns

Intermodal and intraregional gaps constitute one of the most significant issues for the continental state of transportation. Links do not exist between modes, making it difficult to transport goods to and from the ports (Foster, 2010). International trade is hindered by the lack of continuity and cooperation between countries. Many impediments exist at the point of interchange as the countries lack automation in customs practices

(Foster, 2010). These interchanges open the doors for issues of corruption as well as restrictions on imports hindering logistics, increasing transportation times, and escalating freight costs. Queues at borders can be ten to thirty percent higher than in other regions of the world (Foster, 2010). Furthermore, the unreliability of the customs borders adds time to transportation, and thus additional freight costs. Trucks can expect an additional four days for imports and nine days for exports when delivering products to a country in the interior (Foster, 2010).

Furthermore, with many landlocked countries, the connection between port and rail remains a continuous issue for international trade. The transition between port and rails lacks integration hindering the efficiency of trade between countries and around the world (Foster, 2010). While containers are unpacked at the ports, they cannot be easily moved to railways or motor carriers to bring the goods to the interior nations.

In order to oversee the operation of these intermodal changes, businesses also look to the efficiency of logistics providers. Third party logistics providers are underdeveloped and in many parts of Africa unavailable (Foster, 2010). Figure 11 below

shows the global results for the Logistics Performance Index from 2007 (Foster, 2010).

1 <= LPI <= 2.29 2.53 <= LPI <= 3.14 2.29 <= LPI <= 2.53 3.14 <= LPI <= 5 no data

Figure 11 Logistics Performance Index from 2007 (Foster, 2010)

Except for South Africa, African countries scored extremely low in terms of logistics performance. This index measured not only infrastructure quality, but also competency handling logistical issues such as tracking orders, efficiency and ease of border customs, ease of arranging international shipments (Foster, 2010).

Roadways

Currently, roughly eighty percent of main road networks in Africa are in good or fair condition (Foster, 2010). However, the road density is significantly lower than other developing regions. The density is thirty percent less than the South-Asian Region, the next lowest region (Foster, 2010). The world average is 944km per 1,000km^2, with more than half paved; Africa is 204km per 1,000km^2 and only one quarter is paved (Foster,

2010). As seen from the low roadway density, a large majority of the population does not have access to the main networks (Foster, 2010). Although agriculture is viewed as an engine for economic growth and it constitutes roughly one third of the continents GDP, only one third of the rural population live within two kilometers of an all-season road (Calvo, 1998). Furthermore, these main networks have issues connecting between countries and regions. The completion of an intercontinental highway is a distant reality, requiring an additional 60,000-100,000km of roadway (Foster, 2010). In addition, current networks suffer from capacity constraints, low vehicle mileage, absence of service lanes, deteriorating pavement, and minimal street lighting (Foster, 2010). For the road construction that is occurring, escalating unit costs are causing even more hardships for African countries. Rising road construction input costs, such as oil prices, have caused project expenditures to increase thirty percent in 2005 and more than sixty percent in 2007 (Foster, 2010). Another cause of inflationary construction expenses is the lack of competition between construction companies.

Furthermore, freight rates are excessively high due to restrictive regulation and weak competition (Foster, 2010). A combination of self-regulation and national protection causes unnecessarily high prices. While increased competition with a combination of freedom of entry and market pricing would decrease this cost for businesses, a coalition of interest groups exists that is limiting the feasibility of this occurring (Foster, 2010). These groups are concerned with a drop in trucking employment and profits for their own businesses. The majority of the bottleneck issues for the freight industry involve inefficiencies at border crossings causing the transit velocity to be less than 10km/hr (Foster, 2010).

Another concern for companies involves road safety. Currently, there is a lack of statistics on road accidents as well as a lack of a reliable road accident collection agency. Nevertheless, researchers indicate that the continent would benefit from legislation to enforce speed limits, encourage motorcyclists to wear safety helmets, regulate the use of mobile phones by drivers, and implement laws against driving under the influence of alcohol (Foster, 2010). In addition, either new agencies need to be formed or current agencies need to be given the task of implementing and regulating laws that will help to eliminate corruption in licensing, enforce proper road procedure and behavior, and improve the inspection and control of vehicle conditions (Foster, 2010). Furthermore, the region would benefit from improvements in pre-hospital emergency services.

In order to alleviate the disparity between road networks, researchers indicate that it will cost the continent of Africa about U.S. $9.6 billion a year (Foster, 2010). This amount constitutes 1.5 percent of GDP for the entire region with 0.6 percent of regional GDP supporting road maintenance (Foster, 2010). However, this is a significant burden for some of the lower-income states, in upwards of seven percent of GDP (Foster, 2010). Currently, funding is around U.S. $6.9 billion and the fragile states are only spending about one tenth of the requirement (Foster, 2010).

Railways

During the 1980's, the African railways carried a large share of the country's passenger and freight traffic (Foster, 2010). At the time, road transport was poor or strictly regulated. Today, most railways have been liberalized and fallen into disrepair;

they only serve small markets and other than the ones used for mineral lines, they are inessential to the economy. Warfare and conflicts have made several sections unusable. Furthermore, most of the rails are relatively isolated heading inland from a port to a trading center.

Most of the tracks have relatively low traffic density. Railway networks spatial density compares track mileage with the size of a country. Most African countries fall in the range of one to six, and thirteen countries have no operating railway at all (Foster, 2010). Furthermore, in terms of network density per million habitants, most African countries fall into the range of 30-50 compared to 200-1000 in Europe (Foster, 2010). As the data indicates, Africa lacks a significant amount of track, but even the ones that do exist still cause significant infrastructure problems. Of the 69,000km of existing track, only 55,000km are currently operated (Foster, 2010). Almost all are single track and where the service is poor, speed restrictions are necessary, resulting in lower railway competitiveness and rolling stock productivity (Foster, 2010). The majority of the tracks face complications from age/ wear, insufficient ballast, deteriorating earthworks, decrepit structures, and poor rail signaling (Foster, 2010). Locomotives and freight wagons are nearly twice the age of the international best practice at twenty-five to thirty years old (Foster, 2010). Furthermore, in most nations, signaling relies on manual systems leading to major safety concerns caused by human errors. Even for the regions with power signaling, short circuits, lack of electricity, and failing cable networks cause the risk of injuries and accidents from signaling errors.

One of the other major concerns for rail transportation is border crossing. Due to an absence of reliable interconnection services, trains cannot cross borders and must be

unloaded and reloaded at national borders causing significant delays. On average, each delay costs companies $200 per railcar, per day (Foster, 2010). For example, a train from Kolwezi, Democratic Republic of Congo to Durban, South Africa takes thirty-eight days at an average speed of 4km/hr (Foster, 2010). Of those thirty-eight days, only nine days are spent traveling; the other twenty-nine days are spent loading and unloading freight at interchanges (Foster, 2010).

Ports and Waterways

Ports

While general cargo volume has grown around 6.6 percent and container shipments have experience growth around 7.2 percent, African ports suffer from several key issues including high fees, low capacity, and inefficiency (Foster, 2010). One of the main causes of additional fees stems from a cycle of high tariffs that further increase costs. Delays can be particularly costly. In 2006, a one day delay cost shippers U.S. $35,000 (Foster, 2010). In order to alleviate some of these issues, ports began charging congestion fees ranging anywhere from $35-$425 per container, per day (Foster, 2010). Normal port charges, excluding the additional costs for delays tend to be at least twice the cost of other parts of the world, and the costs for handling and offloading the cargo tends to be forty percent above the global rates (Foster, 2010).

Many of the African ports are only operating around eighty percent capacity (Foster, 2010). However, this capacity could be improved with increased focus on operational efficiency. The international norm for crane moves per hour is around

twenty-five to thirty while the average for African countries is only seventeen (Foster, 2010). Furthermore, cargo handling is also much lower than the international standards operating around seven to twenty-five tons per crane hour compared with more than thirty tons in developed nations around the world (Foster, 2010). An efficient truck cycle is around one hour. However, African standards are much lower. Eastern Africa is around five to six hours, Southern African ports are around four hours, and Western African ports are the highest averaging around ten hours (Foster, 2010). In addition, these capacity constraints increase terminal congestion resulting in terminal dwell times of almost thirty days in certain locations, much higher than the international standard of seven days or less (Foster, 2010).

Finally, African ports are not flexible in order to handle the changes in the global shipping industry. For example, Asian shippers use vessels in the 8,000-11,000 TEU, but most African ports cannot handle any vessels above 2,000 TEU (Foster, 2010).

Inland Waterways

Throughout Africa, inland waterways are underutilized and poorly developed. For example, the Congo Basin has a network of 12,000km covering nearly four million square kilometers and servicing nine countries (Foster, 2010). With this vast network of natural transportation, the rivers could be an extremely valuable resource for businesses to transport goods throughout the inland African countries. In addition, the waterways could be particularly beneficial due to low transport costs; it would cost $0.10 less per ton/km than roadway or railway freight (Foster, 2010). However, the Congo Basin as well as many of the other inland waterways is neglected and overlooked due to outdated,

insufficient infrastructure, lack of adequate channel markings, weak regulations, and poor maintenance.

Airports

While the air transport sector has seen growth of about six percent per year from 1997-2006, this particular mode still has significant concerns (Foster, 2010). Safety practices and records remain a significant issue for investors. Even with only 4.5 percent of global flights, African airlines recorded twenty-two percent of all accidents in 2004 (Foster, 2010). Furthermore, the world average in 2006 for lost aircraft per million departures was 0.65 (Foster, 2010). Africa's record was 4.31 aircraft per million departures (Foster, 2010). Research on the accident records first pointed to the operation of Western built aircraft. However, this information was inaccurate. The operation of Soviet- built aircraft resulted in equally high accident rates. Therefore, researchers indicate that poor safety standards across the board and lax supervision cause poor air traffic records (Foster, 2010).

In terms of infrastructure, almost all African airports, outside of war torn areas have at least one paved runway (Foster, 2010). Most airports do not currently experience runway capacity constraints. However, there are constraints in other areas such as taxiways and jetways. Runways in sub-Saharan Africa are much worse than those in Northern Africa; ninety-six percent of Northern African runways are in excellent or very good condition compared to less than fifty percent in Southern Africa (Foster, 2010). The largest deficiency in air traffic infrastructure revolves around air traffic control. Many of

the air traffic control towers have fallen into disrepair, hindering the safety and efficiency of air travel. Limitations on radar capability force more time between aircraft landings. This inefficiency also hinders communication between pilots and operators on the ground. In certain cases, pilots may go an hour without any contact with operators on the ground (Foster, 2010). Furthermore, these air traffic control towers lack adequate information on weather patterns, increasing the risk of crashes due to inclement weather. Finally, the deficiency in air traffic control hinders search and rescue missions.

Chapter 6

Consumer Spending Growth in Africa

Over the past decade, African nations have experienced GDP growth exceeding five percent and are continued to see high levels of growth in the near future (African Consumer, 2012). In turn, consumer spending is also expected to grow. Table 1 below shows consumer spending data from 2010 as well as predictions for spending in 2020 (African Consumer, 2012). Research indicates that consumer spending would grow more than thirty-five percent if Africa experiences a 4.5 percent per capita GDP growth annually through 2015 (African Consumer, 2012).

Africa's emerging consumer markets

EAC & COMESA	Population (2009)	2010 Consumer spending[§]	2020 Consumer Spending[§a]
Kenya	40m	$23bn	$37bn
Ethiopia	83m	$20bn	$43bn
Uganda	33m	$15bn	$30bn
ECOWAS			
Nigeria	151m	$115bn	$167bn
Ghana	24m	$15bn	$29bn
Senegal	13m	$10bn	$16bn
SADC			
South Africa	49m	$215bn	$315bn
Angola	19m	$14bn	$18bn
Zambia	13m	$10bn	$23bn

Source: Euromonitor Africa Consumer Spending 2010

[§]\In constant 2010 prices [a]\Projections

Table 1 African's Emerging Consumer Markets (African Consumer, 2012)

Factors for Consumer Growth

The first predictor of consumer spending growth is economic growth. Africa has experienced a decade of real GDP growth of five percent and economists believe that African nations will continue to experience steady GDP growth (African Consumer, 2012). Next, population growth drives consumer spending growth. The continent's population is growing at two percent per annum (African Consumer, 2012). Total population is expected to double from one billion to two billion by 2060 (African Consumer, 2012). Partially tied to population growth, rapid urbanization is also increasing the number of consumers in the African market. In 2009, thirty-seven percent of Africans lived in cities (African Consumer, 2012). This number is projected to hit fifty percent by 2030 (African Consumer, 2012). Consumer spending is also growing due to significant efforts to reduce poverty and in turn providing households with more money to spend on consumer goods. Researchers predict that the poverty level for Africa will decline from forty-eight percent in 2008 to twenty percent in 2020 (African Consumer, 2012). As poverty declines, a growing middle class is also emerging in Africa. In 2010, roughly 300 million Africans were considered middle class (people earning roughly between U.S. $2 and U.S. $20 a day) (African Consumer, 2012). The middle class is expected to triple to over one billion people by 2060 (African Consumer, 2012). Furthermore, African governments are improving the business climate and many of them have also become politically more stable. These two factors will hopefully attract more investors to improve the African markets. Reductions in trade barriers will also potentially reduce costs of doing business and therefore attract additional investors to

boost economic growth and consumer spending. Finally, a technology boom across Africa will help improve consumer spending. As more Africans own cellular devices, businesses will have more outlets for marketing and promotions. Projections indicate that almost all Africans will own a mobile phone by 2060 (African Consumer, 2012). Cellular devices will also boost virtual banking, especially in rural areas and thus heighten consumer spending.

Challenges for Consumer Growth

One of the most significant challenges for African business is the market structure. With multiple nations, each one has varying income levels, cultures, and languages (African Consumer, 2012). These markets are also highly segmented and heterogeneous. Consumer behavior and spending can be drastically different; companies may need to cater to a multitude of market segments. Next, the challenges of poor distribution channels and underdeveloped transportation networks that were highlighted in the previous chapter also challenge businesses entering the African markets. Companies may need innovative distribution systems to reach consumers and continue to fuel consumer spending. Finally, qualified employees are hard to find. Individuals who can market to consumers are difficult to train.

Chapter 7

Conclusion & Business Recommendations

Transportation infrastructure is essential to economic development. As seen through the data analysis and the historical perspective of China and the United States, infrastructure development drives economic growth. Africa's infrastructure deficit poses a hindrance to economic development for the country. Investment from countries such as China has prevented the gap from widening, but it did not begin to close it. Nationally, African nations need to invest significantly more to compete globally, especially in roadway maintenance. Improvements need to be made to alleviate the barriers of trading between nations as queue time at borders significantly increases time and money for supply chain operations. Overall the improvements are both political and economic such as working with trade coalitions and investing in transportation infrastructure. Changes also need to be made that are physical and structural in order to improve the logistics operations in Africa. While significant challenges exist to business in Africa, opportunities also abound.

Growing Market

Businesses cannot simply overlook the continent of Africa because of the vast deficiencies in the transportation network and the hidden challenges of doing business. Africa's economy is growing and consumer spending is growing in turn. With a growing

population expected to reach 1.3 billion people by 2020, companies cannot afford to ignore the market (A Continent, 2012).

Global Sourcing

In most developing countries, global transportation and logistics is commonly impeded by customs and regulatory policies (Bookbinder, 2013). To overcome these obstacles and make the network more efficient, supply chains should consider employing custom-house brokers and focus on shipments with Incoterms (Bookbinder, 2013). Custom-house brokers are familiar with the regulatory regimes of countries. These individuals have an understanding of commodity class descriptions in a country and therefore can assist a supply chain in identifying the most favorable duties and tariffs (Bookbinder, 2013). Supply chains can also look at duty drawbacks. Duty drawbacks were originally passed by the United States Congress as the Tariff Act in 1789; they allow organizations to collect tariffs paid on imported goods if they are an input to a finished product that will subsequently be exported outside the U.S. (Bookbinder, 2013). In addition, Inco terms, formulated by the International Chamber of Commerce, state the terms of shipment and transfer of ownership in international purchases (Bookbinder, 2013).

Appendix A

Infrastructure Data for Select African Countries

Country	GDP	Highways (In km)	Railways (In Km)	Airports (Total Number)	Population	GDP Growth Rate	Distribution of Family Index-Gini Index
United States	$ 15,080,000,000,000	6,506,204	224,792	15,079	313,847,465	1.80%	45%
China	$ 11,300,000,000,000	3,860,800	86,000	497	1,343,239,923	9.20%	48%
South African Region							
South Africa	$ 555,000,000,000	362,099	20,192	567	48,810,427	3.10%	65%
Angola	$ 116,300,000,000	51,429	2,764	176	18,056,072	3.90%	N/A
Nambia	$ 15,930,000,000	64,189	2,626	112	2,165,828	4.90%	70.70%
Botswana	$ 29,850,000,000	888	25,798	76	2,098,018	5.10%	63%
West African Region							
Ghana	$ 75,660,000,000	62,221	947	10	24,652,402	14.40%	39.40%
Nigeria	$ 414,000,000,000	193,200	3,505	53	170,123,740	7.40%	43.70%
Togo	$ 6,460,000,000	7,520	568	8	6,961,049	4.90%	N/A
Benin	$ 14,750,000,000	16,000	438	5	9,598,787	3.50%	36.50%
East Africa Region							
Tanzania	$ 67,900,000,000	91,049	3,689	106	46,912,768	6.40%	37.60%
Kenya	$ 71,210,000,000	160,886	2,066	194	43,013,341	4.40%	42.50%
Uganda	$ 47,780,000,000	70,746	1,244	46	33,640,833	5.10%	44.30%
Ethiopia	$ 94,850,000,000	36,469	681	58	91,195,675	7.50%	30%
North African Region							
Libya	$ 38,980,000,000	100,024	N/A	144	5,613,380	-59.70%	N/A
Egypt	$ 519,000,000,000	65,050	5,083	84	83,688,164	1.80%	34.40%
Maghreb Region							
Tunisia	$ 100,000,000,000	19,232	2,165	29	10,732,900	-1.80%	40%
Algeria	$ 263,300,000,000	113,655	3,973	142	37,367,226	2.40%	35.30%
Morocco	$ 163,500,000,000	58,256	2,067	56	32,309,239	4.90%	40.90%

(Get Insights, 2013) (World Fact book, 2013)

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