TRANSPORTATION CONTEXT
OF LATIN AMERICAN LOGISTICS

by

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ABSTRACT

Through increasing globalization and trade liberalization, many third-world and developing countries are experiencing levels of growth that are quickly shifting the world's balance of political and economic power. China and India have dominated the global discussion of emerging economies, but other regions that have received much less attention hold attractive potential as well from the perspective of United States companies – in particular, Latin America.

Domestic companies going international for the first time or even just into a type of foreign market that is very different from previous experience can find the learning curve steep and their once-reliable intuition no longer useful. Penetrating such a market requires a taut supply chain and while there are many facets to any supply chain, we here focus on the transportation aspect and build the Latin American context surrounding it and affecting logistical decisions and paradigms. By exploring the unsuccessful and ongoing attempts at regional integration, the policies that shape the business environment, the barriers and opportunities presented by a unique geography, and the underdeveloped infrastructure, we build the context necessary to develop a holistic understanding of Latin America and its diverse member nations. Using this context, we explore a way to compare the new environment to old experiences and to provide knowledge required to plan supply chain networks in the region.

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Dr. Cindy Barnhart is also deserving of many thanks for providing me with the funding that made this possible and for the general advising that she gave while I was here at MIT trying to uncover the path that was right for me and my goals. As I traversed that path I also met some wonderful friends who were always encouraging while at the same time tried to keep me from graduating by dragging me out to have fun.

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"The United States has a vital interest in that part of the country."

– referring to Latin America,
commonly attributed to former
United States Vice-President Dan Quayle

Figure 1-1. Map of current-day political boundaries for Latin America
Source: CIA 2008

1.1   PURPOSE AND MOTIVATION

Supply chain strategies are increasingly needed on the international and global level with the slow but steady economic homogenization occurring in today's world. As the United States dollar weakens and other countries continue to make political and economic strides, the BRIMC countries (Brazil, Russia, India, Mexico, and China) continue their growth while others only slightly farther on the horizon begin to prepare for a place on the world stage.

Whether or not the introductory quote was actually one of Dan Quayle's many misstatements (I could find no reliable source and he has been misquoted before), it still speaks humorously and accurately to Americans' lack of understanding of our southern neighbors despite their proximity and potential influence. Much of the focus of today's supply chain literature, when discussing emerging markets, is on China – for good reason. Unfortunately, this results in relative neglect of other regions with interesting challenges and economic potential – one of which is Latin America (though the region's economic powerhouses of Mexico and Brazil do garner some attention as members of BRIMC). From a United States perspective, Latin America is more geographically accessible and culturally similar than Asia. China's closest urban center, Shanghai, is farther from Los Angeles than Latin America's farthest Pacific coast urban center, Santiago, Chile. London is 70% further from New York than Baranquilla, Colombia. Panama is also a crucial country to international trade and the United States Navy, not necessarily because of their economy, but rather because of the Panama Canal. The Canal requires costly maintenance and upgrades to keep up with global trade growth, which should encourage the international community to ensure that Panama keeps pace with global economic development. In many ways, Latin America may be more attractive to business than some BRIMC countries from an institutional perspective. Chinese markets are overextended and supported by the government while its regulations and human rights policies are increasingly in the international spotlight. Nearby, Russia's future economic growth potential is becoming more and more circumspect due to an increasingly stymied "democracy", heavy-handed state control of the media, and

overt high-level corruption. These reasons, along with a simple personal interest and appreciation for the region, are what motivate my focus on Latin America.

In researching the area, no comprehensive perspective could be found on the region as a whole and information proved to be scarce and difficult to find in many cases. There are excellent sources addressing very specific elements of Latin America but lack a greater context. Others paint broad strokes across each of its larger countries while failing to present the details necessary for more than a surface understanding. Among them are interesting reports on logistics performance, global competitiveness, investment attractiveness, and corruption. However, the dimensionless indices they often produce, sometimes with questionable methodologies, are merely instant gratification and oversimplifications unless one commits to understanding and analyzing each contributing variable and then placing this information within a larger topical, regional, and sometimes global context.

Americans have been notorious for trying to move into foreign markets with our domestically-driven perceptions and understandings of operations and behavior. A fortunate result of globalization has been an improvement of American savvy in this regard and this thesis is meant for those looking for insights into Latin America and the logistical context in which the region operates, particularly as concerns transportation.

The remainder of this chapter will cover basic information on the region. The next chapter focuses on regional integration efforts and other policies and influencers of the supply chain. Chapter three quickly covers the most notable natural challenges to Latin American supply chains, followed by a thorough treatment of regional infrastructure in chapter four. Chapter five then brings all of the previously discussed supply chain factors together to discuss hemispheric network implications for various product types. The included "future research" section describes some other ideas that could easily stem from the information and insights within this thesis.

1.2   BASIC DEMOGRAPHICS AND ECONOMIC DATA

To better facilitate our understanding of the region, let us make some high-level comparisons along the lines of demographics and the size of the economies that make it up.   Using the map below as a reference, we will frequently categorize Mexico in with Central America, though you will see later that this is not a perfect pairing.   Therefore, in our discussions, the region from Panama to Mexico (with the exception of Belize) will be Central America.   All of the landmass south of and including Colombia we will consider South America (with the exception of the Guyanas, which are the three small territories of Guyana, Suriname, and French Guiana).

In terms of population, Brazil makes up over half of South America with almost 200 million people.   Mexico is also a regional juggernaut with over 100 million, dwarfing the rest of Central America which cumulatively can only claim 40 million.   Generally speaking, population correlates to land area with the exceptions of Bolivia which has a much lower and El Salvador which has a much higher population density.
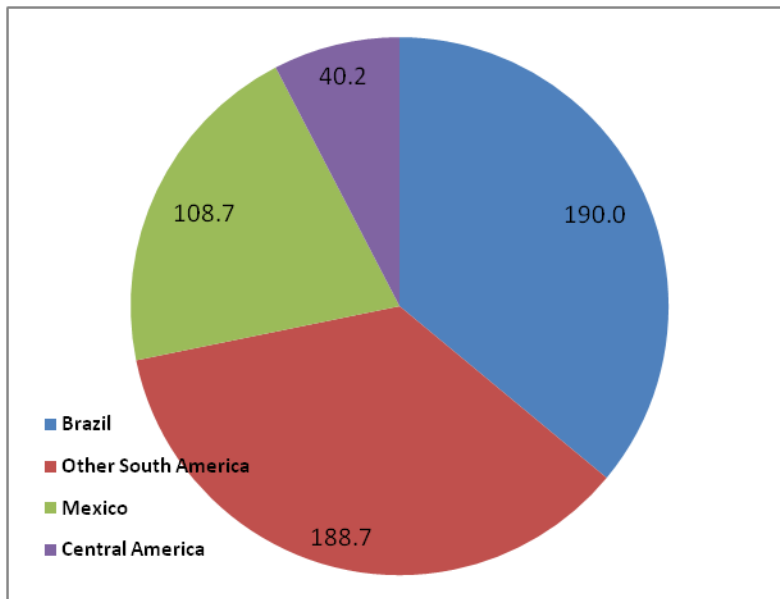
Figure 1-2. Population of Latin America (millions)
Source: CIA World Factbook 2008
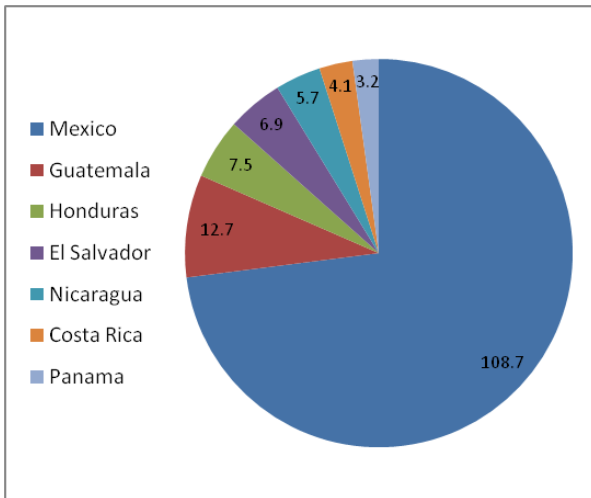
Figure 1-3. Population of Central America (millions)
Source: CIA World Factbook 2008
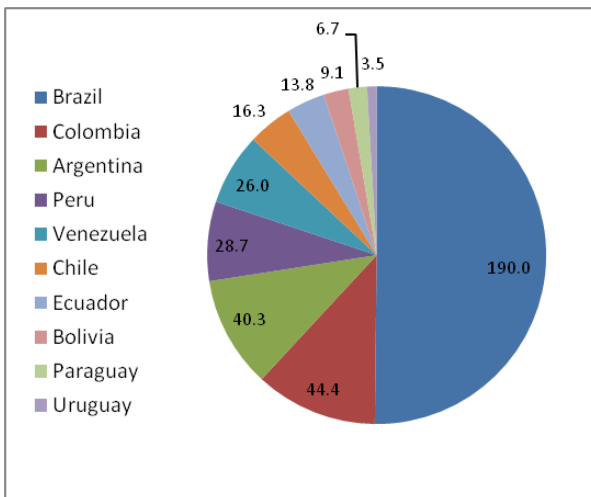
Figure 1-4. Population of South America (millions)
Source: CIA World Factbook 2008

The size of the population surely impacts the size of the economy, but only to the degree that a country maintains a strong currency and high levels of trade and production. Figure 1-5 presents 2007 Gross Domestic Product (GDP) through purchasing power parity (PPP). The countries are listed in order of population size so that correlative inconsistencies are evident. A table of other countries is also provided for benchmarking purposes.
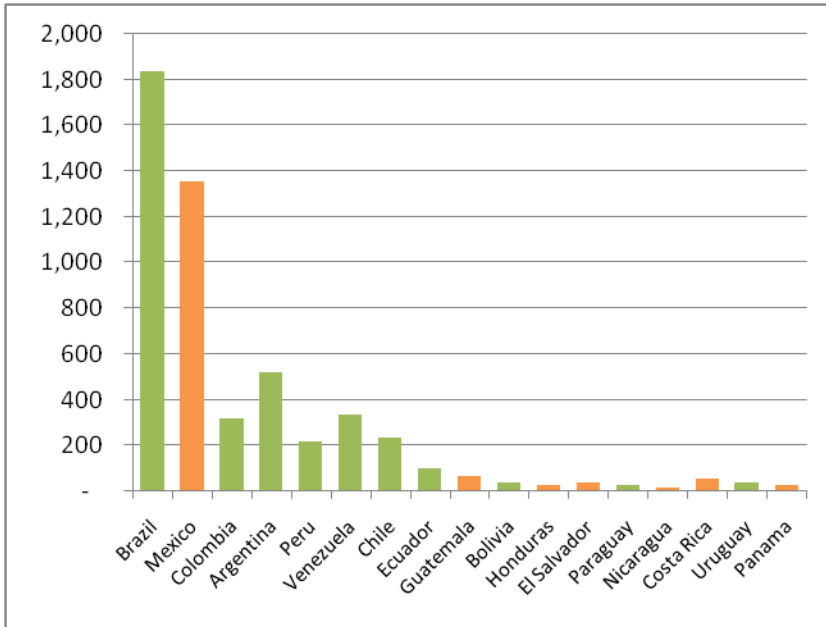
Figure 1-5. GDP purchasing power parity of Latin America (USD billions)
Source: CIA World Factbook 2008

US	13,860
China	7,043
UK	2,147
South Africa	468
Hong Kong	293
Portugal	232
Sudan	108

Table 1-1. GDP purchasing power parity of select non-Latin American countries (USD billions)
Source: CIA World Factbook 2008

GDP is a snapshot indicator of a single country's impact on the global economy and the influence that country holds. To better understand the economic situation of the people of a country, it is important to determine the GDP per capita. Figure 1-6 provides this data with the countries again listed in order of population.

Per capita GDP is necessarily an average. In order to better capture the distribution of income within a country we turn to the Gini Index. A perfectly even distribution of income in a country would create a linear cumulative diagram. Of course no society looks like this and instead curves fall underneath this benchmark with general concavity. The Gini index measures the difference between a country's cumulative income curve and the perfectly linear benchmark line. The index is simply the percentage of the area under the benchmark line that is captured by this

gap. Therefore, higher indices tell of higher income disparities within a country. Latin America scores exceptionally poorly on this metric. Of the 126 countries that the UN's Human Development Report gives a Gini index for, Latin American countries fall between the ranks of 81 (Nicaragua) and 121 (Bolivia), most falling below 100.
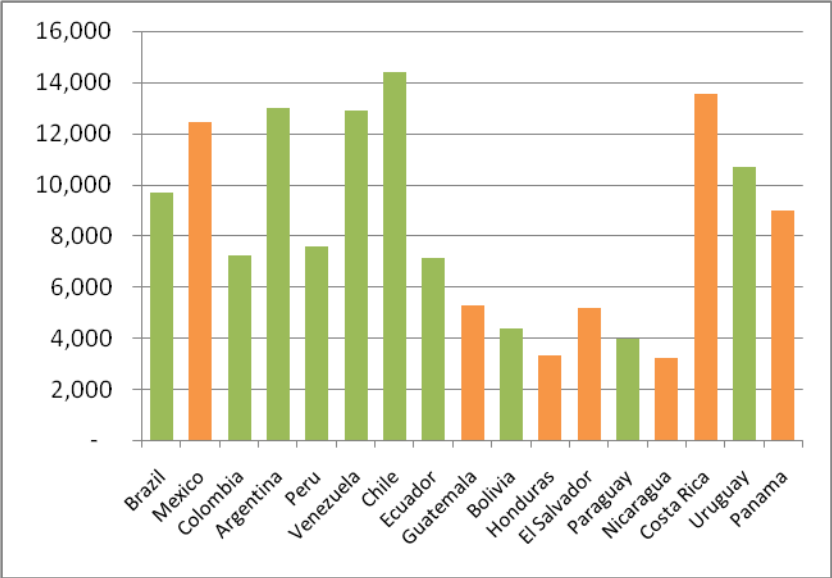
Figure 1-6. GDP purchasing power parity per capita (USD)
Source: CIA World Factbook 2008

1.3   MAJOR DATA SOURCES AND INDEXES

In this thesis there are a number of indices, reports, and data sources used. The major ones that are constantly used and referred to are in Table 1-2 for quick reference.

Acronym	Name	Creating Organization
---	CIA World Factbook	US Central Intelligence Agency
BPI	Bribe Payers Index	Transparency International
CPI	Corruption Perceptions Index	Transparency International
GCI	Global Competitiveness Index	World Economic Forum
IGQI	Infrastructure Gap Quality Index	World Economic Forum
IPIAI	Infrastructure Private Investment Attractiveness Index	World Economic Forum
LPI	Logistics Performance Index	World Bank

Table 1-2. Major data sources and indexes used

2 INSTITUTIONAL AND POLICY ENVIRONMENT

International supply chains are strongly affected by relationships and agreements between countries as well as the various domestic economic policies and business environments. While the social norms and basic culture of Latin America are much more similar to the United States than one might encounter in other regions of the world such as China, similar advantages are not necessarily as easy to come by in the administrative realm.
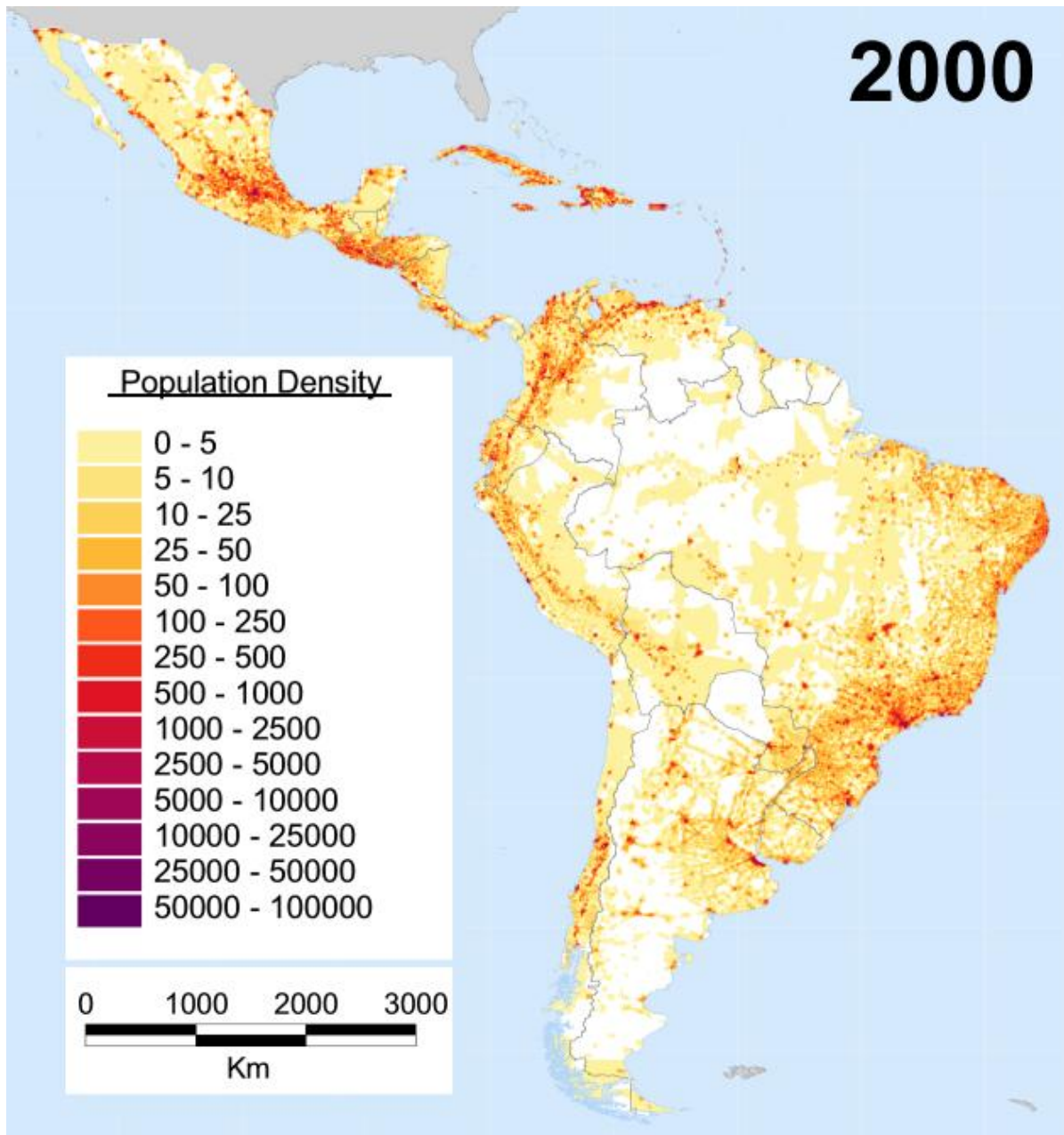
Figure 2-1. Map of population densities in Latin America (2000)
Source: CIAT 2005

2.1   REGIONAL INTEGRATION EFFORTS

When concerning oneself with supply chains in a global context, international politics, policies, and regional and free trade agreements are major factors to consider. Consequences of international policies range from understandable, such as companies being driven to postpone production into Brazil due to their labor protection taxes, to the absurd, such as companies finding it cheaper to send domestic product outside and then back in to China before selling it domestically.[1] The second half of the twentieth century witnessed widespread and sometimes successful efforts to liberalize and reduce international barriers to trade around the world and in Latin America.

This thesis refrains from delving into the macroeconomic theory and implications behind international trade agreements, but understanding their influence on supply chain considerations and having an historical perspective are important. There are different types and levels of trade agreements, however, so we will take just a moment to define important vocabularies.

Bela Balassa of Johns Hopkins University laid much of the framework for understanding economic integration in his text The Theory of Economic Integration. He described five successive stages of economic integration.

1. *Free Trade Area*

    This refers to a group of countries that have eliminated trade quotas and tariffs among themselves. Some mistakenly use the term Free Trade Zone (FTZ) synonymously with Free Trade Area.   An FTZ is a specially exempt zone within a country (Shanghai's FTZ in Pudong, for example) that enjoys trade-based and bureaucratic exemptions, often with the intention of attracting foreign investment.   Another complication is that a Free Trade Area is often referred to as a

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[1] Source: Blanco 2008

Preferential Trade Area (PTA) where the quota and tariff barriers are only reduced or only apply to a small subset of goods.

2. *Customs Union*

As with each successive stage, a customs union includes the elements of the previous stage (in this case the Free Trade Area). In addition, a customs union adds the requirement that all participating countries maintain the same common economic tariffs (CET) and regulations on imports from countries outside the union.

3. *Common Market*

This is a customs union with free movement of people, capital, and goods between countries.

4. *Economic Union*

The economic union adds the harmonization of key economy-affecting policies, such as safety regulations or even a shared currency.

5. *Complete Economic Integration*

This is the final stage, sometimes dubbed a *political union*, since this stage is achieved when a supranational body is created to control economic and monetary policy.[1]

The stages mentioned above are based on conventional theory and when applied to reality, are often less than perfect. Nevertheless, they provide a useful foundation with which to begin describing the basics of Free Trade Agreements (FTAs) and more comprehensive trading blocs. It is also worth mentioning that Balassa believed that in order to achieve higher levels of economic integration, deeper social and cultural integration is necessary.

Latin American countries have had their eye on economic integration for two-hundred years, but the efforts were not attempted in earnest until the 1950s and 60s.[2] The result of their efforts thus far is a slew of acronyms, ever-shifting allegiances, and

[1] Source: Harri 2003

[2] Source: Meléndez O. 2001

only mixed progress. Rather than cover each country's or agreement's story independently, it is more useful to briefly address the topic from a temporal perspective. Caribbean developments are mentioned in passing because of the Caribbean's geographic proximity and minor economic influence on our definition of Latin America. Table 2-1 is a list of acronyms provided for quick reference.

Acronym	Name	Comment
ALADI	The Spanish derived acronym for LAIA	
ALBA	Bolivarian Alternative for the Americas	Comprised of the most Leftist Latin American countries
AP	Andean Pact	
CACM	Central American Common Market	
CAFTA	Central American Free Trade Agreement	
CAN	Andean Community of Nations	Also commonly just called the Andean Community
CARICOM	Caribbean Community	
CARIFTA	Caribbean Free Trade Association	
DR-CAFTA	Dominican Republic - Central American Free Trade Agreement	
G3	Group of Three	The three originally being Mexico, Colombia, and Venezuela
LAFTA	Latin American Free Trade Association	
LAIA	Latin American Integration Association	Frequently refered to by its spanish name as well, ALADI
MERCOSUR	Southern Common Market	Deriving from the Spanish: Mercado Comun del Sur
NAFTA	North American Free Trade Agreement	
UNASUR	Union of South American Nations	Also called UNASUL from the Portugese

Table 2-1. List of regional association acronyms

2.1.1 THE 1950S & '60S

The first truly meaningful integration efforts were made in the late 1950s and early 1960s. In 1958, the West Indies Federation was created. (At the same time the most basic framework of what is today the European Union went into effect with the Treaties of Rome.) The West Indies Federation, a plan for political union comprised solely of British Caribbean colonies, was a short-lived precursor to later economic relationships.[1] Only two years later, in 1960, Central American Common Market (CACM) was formed and Latin American Free Trade Association (LAFTA) was signed. CACM began with Guatemala, El Salvador, Honduras, and Nicaragua having the obvious goal of achieving at least a common market and, more ambitiously, a full political union.[2] LAFTA began as Argentina, Brazil, Chile, Mexico, Paraguay, Peru, Uruguay, Colombia, and Ecuador signing the Treaty of Montevideo. (Sources cannot agree on when Colombia, Ecuador, Bolivia, or

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[1] Source: CARICOM 2008

[2] Source: Meléndez O. 2001

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Venezuela joined LAFTA, but generally it appears that Colombia and Ecuador joined in the early 1960s and Bolivia and Venezuela in the late 1960s.) Both agreements successfully came into effect over the following years. It is important to realize that in the 1950s and 60s, regional trade agreements were undertaken with protectionism in mind, rather than greater global economic involvement as is the case today. This was aligned with ECLAC's model for the region (the UN's Economic Commission for Latin America and the Caribbean).

Figure 2-2. Map of regional association memberships (1963)

A few years after LAFTA regulations started in 1962, the West Indies Federation dissolved.[1] The next year, Costa Rica joined CACM. Picking up where the West Indies Federation ended, CARIFTA (later to become CARICOM) was formed in 1965 to maintain ties between Caribbean countries. The Caribbean Free Trade Association initially included only three countries, one of which was Guyana. In 1968, as

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[1] Source: CARICOM 2008

CARIFTA came into effect, eight more Caribbean countries joined. CARIFTA was formed as no more than a limited free trade area.[1]

Over barely a half-dozen years, CACM had become a huge success. Tariffs had been eliminated for 95% of intraregional trade and the common external tariff was applied to 90% of imports. These numbers themselves mean nothing until one also realizes that trade was also booming. (By 1970, trade had grown eight-fold within the region.)[2] LAFTA, meanwhile, was failing. One of the strengths of CACM was the relative economic parity of the member countries; LAFTA economies were highly disparate. The result was more trade diversion (to the larger, more developed economies of Brazil, Mexico, and Argentina) than trade creation. Another stymie of success was the simple fact that the group failed to execute its policies because countries were using every exception they could to maintain tariffs.[3] In recognition of the failure of LAFTA, some of the Andean countries decided to band together to both strengthen their collective position against the larger economies as well as to create a more liberal and successful trade bloc. Thus, in May of 1969, Chile, Colombia, Peru, Ecuador, and Bolivia signed the Cartagena Agreement and created the Andean Pact (also sometimes called the Andean Group, Andean Community, or ANCOM). The stated goal of the organization was to achieve an economic union.[4]

Less than two months after the Andean Pact was created to strengthen South American trade, Central America found itself in crisis. To oversimplify things, immigration disagreements in July 1969 erupted into the short Fútbol War between Honduras and El Salvador. Honduras withdrew from CACM and although the bloc continued, its momentum was gone and trade logistics complicated.

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[1] Source: Merrill 1992

[2] Source: Merrill 1993

[3] Source: Beaulac 1980

[4] Source: Choi 1998

2.1.2 THE 1970S & '80S

Through the 1970s, CACM trade continued to grow, but at a much slower clip than it had over the wildly successful '60s (three times increase compared to eight).[1] A significant weakness of CACM had been exposed: there was no efficient and accepted way for the bloc to handle trade disputes. It also began to suffer from the economic imbalance problems (seen earlier in LAFTA) and Nicaragua's increasing instability.[2] Most consider CACM to have been dormant for all practical purposes over these next two decades.[3]

Figure 2-3. Map of regional association memberships (1971)

In 1971, CARIFTA added Belize to its ranks. CARIFTA was not particularly successful, however, so two years later it became CARICOM (the Caribbean

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[1] Source: Leitmann 1995

[2] Source: Merrill 1993

[3] Source: Urquidi 1993

Community).[1] This change was based on the intent to further liberalize the bloc and form a common market. Also in 1973, Venezuela joined the Andean Pact. Meanwhile, Chile was crumbling under the weight of economic depression, exploding inflation, and eventually a political coup by Pinochet. Pinochet's new government withdrew Chile from the Andean Pact in 1976 (becoming an observer only) as a shift in economic strategy, emphasizing bi-lateral FTAs and less protectionism.

Figure 2-4. Map of regional association memberships (1980)

The 1980s ushered a regional depression unto Latin America, called the Lost Decade.[2] This, in conjunction with Nicaragua's Contra War, caused CACM to disintegrate completely and intraregional trade plummeted from United States$1,100M in 1980 to United States$420M in six short years.[3]

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[1] Source: Leitmann 1995

[2] Source: Bernanke 2005

[3] Source: Merrill 1993

By 1980, LAFTA also came to terms with its own failure and attempted to breathe life back into the huge bloc. The result was ALADI (Latin American Integration Association, sometimes referred to as LAIA). ALADI was a step backwards[1], however, because it promoted bi-lateral agreements rather than uniform trade reduction and offered immense flexibility for member states to make separate agreements and set different tariffs for non-member countries.[2] The bi-lateral agreement reached in 1986 by Brazil and Argentina through the ALADI process would eventually evolve into MERCOSUR (Mercado Comun del Sur, translates to Southern Common Market).[3] The decade ended with the United States and Canada entering into the bi-lateral FTA that would eventually become NAFTA.

2.1.3 THE 1990S

In 1991, the Treaty of Asuncion was signed by Brazil, Argentina, Paraguay, and Uruguay to form MERCOSUR. MERCOSUR's goal, like so many trade blocs before it, was a common market or even economic union.[4] That same year, Central America finally recovered itself enough to reinstate CACM, this time with limited inclusion of Panama along with a few more acronym-driven institutions. In 1992, NAFTA was signed, bringing together the United States, Canada, and Mexico. One year later, the free trade area went into full effect for the Andean Pact (excluding Peru) and CACM was pursuing expanded relations with most of the other trade organizations of Latin America.[5] In 1994, NAFTA went into effect and United States-led discussions began in Miami about the FTAA (Free Trade Area of the Americas) whose purpose would be to achieve free trade across the entire Western Hemisphere.

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[1] Source: Urquidi 1993

[2] Source: Inter-American Development Bank 1998

[3] Source: International Labour Office 1999

[4] Source: International Labour Office 1999

[5] Source: Merrill 1993
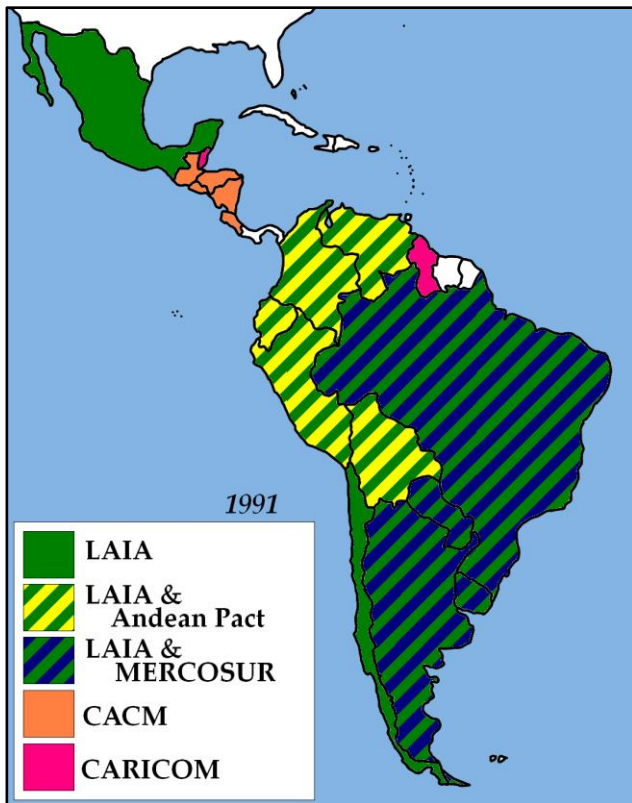
Figure 2-5. Map of regional association memberships (1991)

Halfway through the decade, Suriname joined CARICOM. CARICOM entertained, though never completed, thoughts of developing a bi-lateral FTA with Chile, Latin America's healthiest economy at this point due to its willingness to accept foreign investment. Furthermore, CET's went into effect for both MERCOSUR and a subset of the Andean Pact (Colombia, Venezuela, and Ecuador).[1] Mexico, Venezuela, and Colombia also began the G3 trading bloc. The year 1996 saw the Andean Pact become the Andean Community of Nations (CAN in Spanish) with a series of reforms that further integrated the bloc.[2]

Throughout the trade liberalization process during the '80s and '90s, many Latin American countries implemented reactionary increases to their tariffs in response to

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[1] Source: Choi 1998

[2] Source: Salazar-Xirinachs and Robert 2001

domestic economic problems. This limited the success of all trade blocs within the region, notably the resurgent efforts of CACM and MERCOSUR in the mid '90s.[1]

One can easily see the South American dichotomy created by the CAN (Andean Pact) and MERCOSUR from Figure 2-5. With the hope of uniting all of South America, the two groups began talks of a merger in 1999. (Such negotiations were yet another indication of the failure of ALADI.) This was also the year that Cuba joined the floundering ALADI and Hugo Chavez, who would have significant influence on future Latin American integration efforts, began his rocky and controversial presidency of Venezuela.

2.1.4   THE 2000S

The presidents of the twelve countries of South America, soon to be UNASUR, met in Brasilia in mid 2000.[2] This meeting yielded Initiative for the Integration of the Regional Infrastructure of South America (IIRSA) an ambitious, large-scale initiative funded by three global financial institutions and with the intent to improve infrastructure throughout South America. The April 2001 Summit of the Americas in Canada witnessed large protests of the FTAA (and would be seen again in 2003). In 2001, the Puebla-Panama Plan (PPP) was another of the first projects like IIRSA to seriously address the infrastructure issues (discussed later) that were contributing to the lack of Latin American integration despite the continued political and economic efforts. This program was created to finance mostly transportation and electrical infrastructure projects connecting southern Mexico to Colombia.

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[1] Source: Choi 1998

[2] Source: IIRSA 2008
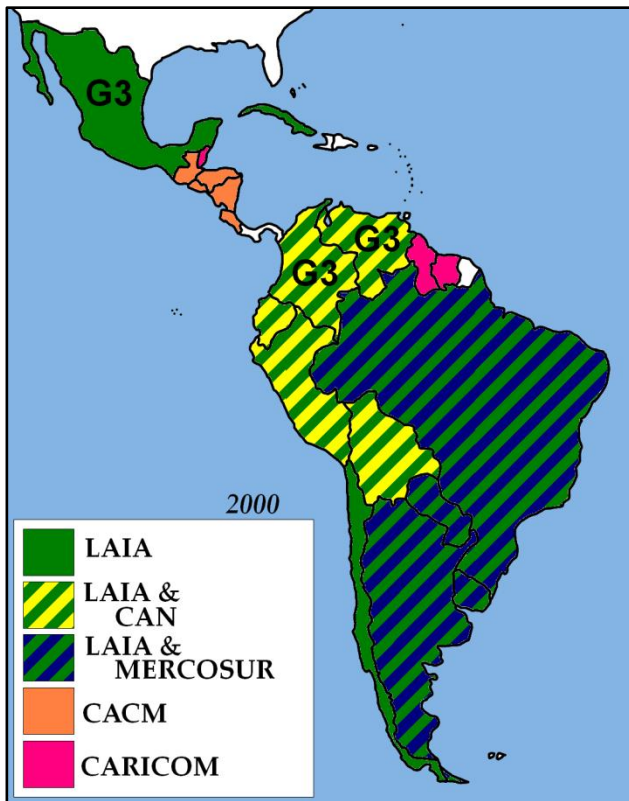
Figure 2-6. Map of regional association memberships (2000)

A big year for trade agreements was 2004. The CAN-MERCOSUR integration efforts (initially dubbed SAFTA), achieved a middling milestone with the signing of the Cuzco Declaration stating their intention to create UNASUR (the Union of South American Nations). DR-CAFTA (Dominican Republic—Central American FTA) was also signed between all of the CACM nations, the United States, and the Dominican Republic. Also in 2004, Cuba agreed to exchange medicines, doctors, and other medical services for Venezuelan oil. This was the beginning of ALBA (Bolivarian Alternative for the People of Our America), pushed by Chavez as an alternative for Latin America to the FTAA proposal being spearheaded by the United States. The emphasis of ALBA is for social as well as economic integration. ALBA was the formal manifestation of an ideological shift that has been slowly building in Latin America. For all practical purposes led by Chavez, it is ideologically and vehemently opposed to the free trade continually proffered by the United States, and instead

simply seeks cooperative relationships as an alternative to these "neoliberal" international trade policies.[1]

July 2005 saw a further baby step in making UNASUR a reality when the member countries of both CAN and MERCOSUR became associate members of the opposite bloc.[2] Venezuela's Chavez complicated integration efforts the very next year, however, by withdrawing from CAN because of Colombia and Peru's recent FTAs with the United States[3] and also from the G3. He immediately applied to gain membership in MERCOSUR, which is still technically pending due to some opposition in Brazil and Paraguay's congresses at least partly because of concern about Chavez's incessant confrontation with the United States, though it is generally referred to as a member.[4] UNASUR took further structural form when, in December 2007, it declared the creation of the Bank of the South and one month later determined that a formal treaty should be ready to sign by June 2008. Another supranational bank, the Bank of ALBA, was founded on January 27, 2008.

ALBA has grown to include Nicaragua and Bolivia and clearly represents some of the most leftist countries of Latin America. ALBA's growth has been analogous with Chavez's increasing influence over the region which is slowly following his anti-free trade, anti-United States lead. MERCOSUR, in particular, has been flirting with a shift from free trade policies, which is interesting since MERCOSUR has consistently failed at implementing free trade in the first place. Like all of the other blocs, it has employed reactionary tariffs in response to domestic economic problems, but MERCOSUR more than other blocs (with the exception of CACM in the late '60s) has witnessed immense politicization of its organization. Internally, member countries of MERCOSUR have been in constant contention over various disputes, most recently the Argentina-Uruguay conflict over a paper pulp mill installation[5], and

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[1] Source: Márquez 2007

[2] Source: Decision 613 of the Andean Community 2005

[3] Source: Kennedy 2007

[4] Source: El Universal 2008

[5] Source: Osava 2008

before that quite a bit of tit-for-tat policies between Brazil and Argentina. Externally, MERCOSUR seems to be shifting away from trade and more into a political association, again in line with Chavez's increasing involvement in the bloc.[1]
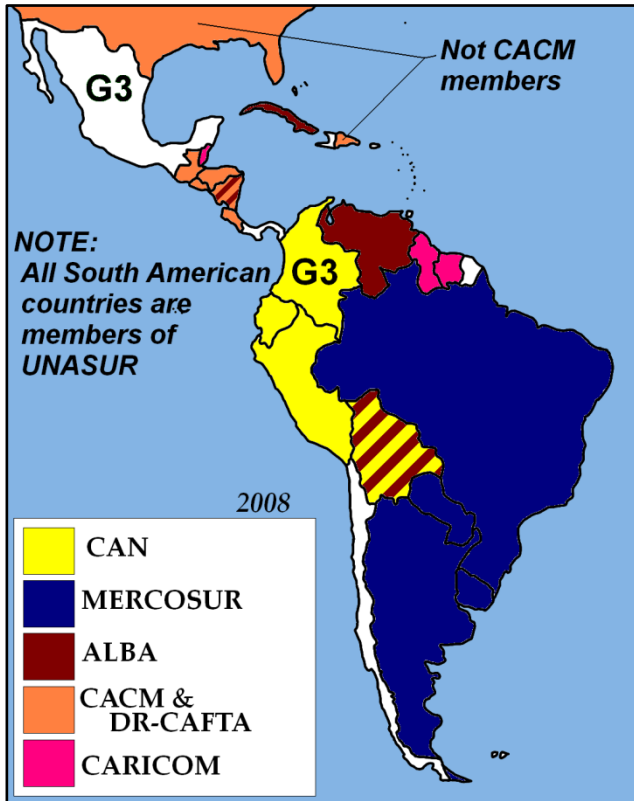
Figure 2-7. Map of regional association memberships, LAFTA excluded (2008)

March 2008 saw serious strains put on Colombia's relations with both Venezuela and Ecuador because of a unilateral Colombian strike just across the Ecuadorian border against FARC, the group that has been waging a decades-long rebellion against Colombia's government. Chavez proved again to be a danger to economic development in Latin America by mobilizing his army to the Colombian border, recalling and expelling ambassadors (as did Ecuador), and threatening to expel or nationalize many foreign-owned businesses.[2] Relations were quickly normalized, making the situation seem more like posturing and rhetoric, though such situations

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[1] Source: Klonsky and Hanson 2007

[2] Source: Suggett 2008

should raise serious questions for companies thinking of investing in the northern Andean nations, particularly Venezuela.

2.1.5 SUMMARY

After discussing the choppy and slow progress of Latin America's integration efforts, there are geopolitical trends to take note of. The first half of the twentieth century was marked with strong protectionist and import-substitution policies throughout Latin America. Beginning really with the 1960s, Latin American countries began to open their economic borders to other countries, but only with the region. This formation of regional trade blocs was based mostly on economics and determined by geography. Most all would be considered failures and largely culminated in the Lost Decade. The 1990s then began to see more of the region embrace globalization which really began taking hold of the region at the turn of the century. At this same time, however, strong voices of opposition to such free trade movements cropped up throughout the region led by Hugo Chavez of Venezuela and his increasing influence due to the global economics of oil (of which Venezuela is a major exporter). The resulting friction between the leftist governments of the region and those that maintained close relationships with the United States and participated in free trade policies has pressed the regional blocs farther from economics and into politics. Geographies no longer play as strong of a role in membership decisions as they once did, though they still exist to an extent.

For instance, among South American countries, regional integration efforts were originally premised on economics (though some level of political and administrative integration would sometimes be a distant goal) and based on physical geographies delineated by the Andes Mountains and Amazon Rainforest. Increasingly, we are seeing a regional shift to a more comprehensive effort to integrate societies and cultures as well as economies, based on political leanings and alliances. This is leading to lessened importance on geographical proximity and changing how South American countries interact with each other. ALBA is the most direct example of this, but can also be seen by the growing tensions in both CAN and MERCOSUR

which were founded on economics and geographic proximity, and raise questions about the future tractability of UNASUR.

In order to maintain a focus on a higher-level perspective of the region as a whole and avoid going too deeply into politics or economics, we only discussed select events in the previous sections. Not mentioned was much of the political turmoil that has embroiled the region for decades or countries attaining associate member or observer status within a bloc. There were also a number of related organizations and agreements not mentioned above. There is plenty of literature available, however, if one is interested in a much more detailed accounting of Latin America's geopolitical and economic evolution. Here, instead, we formed the overall regional context necessary when considering international supply chain applications. We conclude the section by discussing some of the outliers to complete the picture.

Mexico and Panama (and Chile to an extent) have frequently participated with Latin American treaties only as observers, evidenced by ALADI, CAN, and MERCOSUR, or in some other limited capacity such as Panama's involvement with the second incarnation of CACM. Mexico and Panama have not entered into UNASUR discussions to date. This information makes the CACM and DR-CAFTA borders that much more interesting. Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica have proven to consistently regard each other in a unified fashion as a five-nation bloc in various forms, while Mexico and Panama have resisted participation.

Mexico has shown far more interaction with the United States and South America than the Central American countries. This is mostly due to the extreme difference in economic development, which we saw was the initial death pang of LAFTA. Panama's separation from the CACM countries is both historically and economically ideological. The history reaches back to 1823 when the five future CACM countries formed a single country fashioned after the United States, the Federal Republic of Central America. This federation was short lived, but stands to show that these countries are much more the same than they are different. Economically speaking, Panama is more supportive of free trade than the other Central American countries,

despite what it may seem from its lack of RTA membership. Panama has resisted both CACM and CAFTA because it has chosen to pursue more liberal FTAs with countries on a bi-lateral basis, rather than be restricted to trade regulations of CACM's bloc.

Belize, another regional anomaly, falls into much the same category as the Guyanas, the three "non-South American" countries of South America: Guyana, Suriname, and French Guiana. Belize is the only country of Central America where English is the official language, with actual usage a blend between mostly Spanish, English, and a local Creole variant. Culturally, linguistically, and economically the Guyanas have even less in common with Latin America, often aligning themselves with Caribbean countries as we saw earlier. Uncharacteristically, they are, however, a part of the UNASUR negotiations (excepting French Guiana, which is only an extension of France and thus not a sovereign country but rather a part of the EU).

2.2 MONETARY POLICY AND FISCAL STABILITY

Some economies are currently far more stable than others in terms of inflation and some countries have seen extreme booms and busts due in part to their fiscal policies. Monetary policy has been drastically different from country to country in Latin America. The general cost of money throughout the region is also an important factor describing economic health and volatility which can wreak havoc on supply chains.

In recent history, Latin America has trailed the rest of the globe in terms of controlling its inflation. There is no formal definition of hyperinflation, but the term generally refers to fast and extreme periods of inflation. We will arbitrarily refer to any level of inflation over 200% as hyperinflation. This would mean that prices at least triple in only a year. Hyperinflation has both obvious and subtle consequences. An interesting result of hyperinflation on the supply chain is that the most basic inventory control concept, the minimization of required inventory levels, becomes

completely wrong. Since prices are increasing so quickly under hyperinflation, the best business practice is to store *as much inventory as possible* at all times, especially for domestically sourced goods, since the cost of production would be drastically higher the next day, and the goods will be significantly appreciating in value over the course of days (or even hours in the most extreme cases).

As it turns out, hyperinflation was one of the few economic problems that Central America mostly avoided. The 1950s, '60s, and into the '70s saw relatively negligible inflation rates because Central American countries all kept their currencies pegged to the United States dollar until the 1980s.[1] Since then, most of them have changed currency regimes frequently, battling through inflationary pressures during the Lost Decade. Nicaragua, and Mexico to a lesser degree, had particular trouble in the '80s and into the '90s. Nicaragua's inflation peaked in 1988 at over 14000%. They finally regained control of their economy after pegging to the dollar again in 1991.

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[1] Source: Kim and Papi 2005
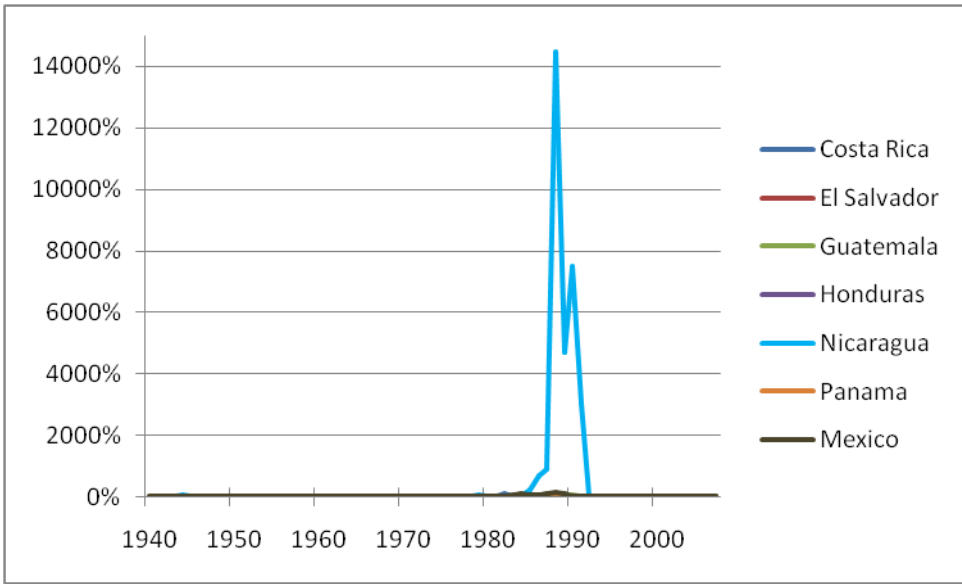
Figure 2-8. Historical annual inflation of Central America (extended scale)
Sources: Antonio Ocampo, Angela Parra, and Bergés 2003; Data and Statistics 2008
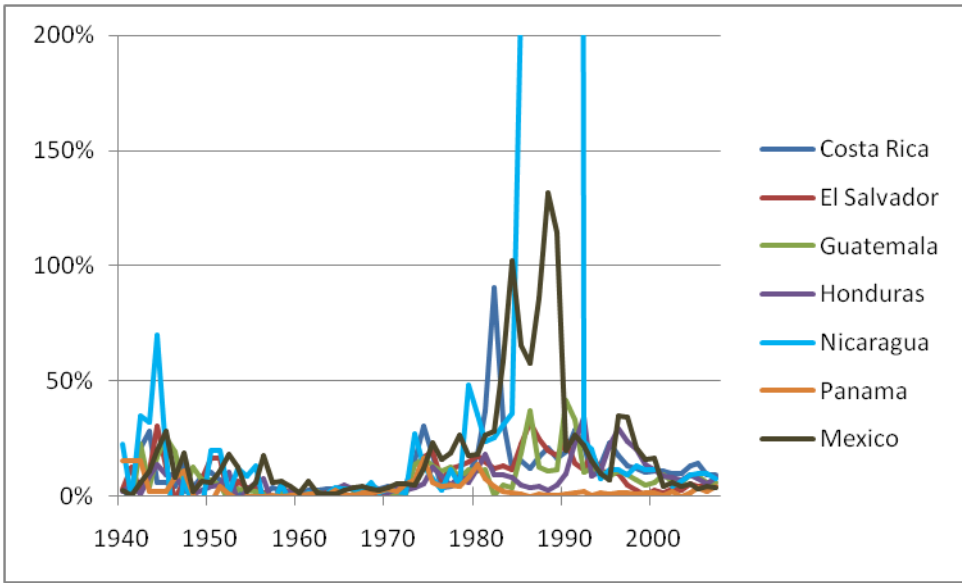
Figure 2-9. Historical annual inflation of Central America (reduced scale)
Sources: Antonio Ocampo, Angela Parra, and Bergés 2003; Data and Statistics 2008

South America, on the other hand, maintained their currencies independent of the dollar and had many more problems with inflation than did Central America.[1] Inflation surges across the region are too many to list individually. Generally speaking, from 1950 until recently there has always been high inflation somewhere in South America. The 1950s were most challenging for Paraguay and Bolivia, both peaking with inflation levels between 100% and 200%. The 1960s were a little better, with Uruguay and Brazil leading the region with annual inflation of around 100%. Inflation started pounding South American economies in the 1970s. Uruguay continued fighting the 100% mark, but Chile and Argentina both jumped over 400% that decade. The Lost Decade of the 1980s and leading into the 1990s was a brutal inflationary period. Bolivia almost hit 12000% annual inflation, while Peru's inflation peaked at over 7000% and both Argentina and Brazil experienced around 3000% inflation. The other South American countries, however, were generally able to keep inflation under 100% over the same period, though some flirted with that mark. South America made a successful Herculean effort in the mid '90s to reign in their hyperinflation and have since commendably followed smart monetary policies to stabilize and control inflation. Latin America's trailblazer in the way of fiscal, monetary, and economic policy has turned out to be Chile. Chile experienced a crisis (relatively minor considering its peers) in the early 1970s during a time of serious political unrest and Pinochet's eventual coup. Before the 1970s, Chile's inflation was well above average. During the early 1970s, though, the country's political unrest came to a head with Pinochet's successful coup. Very high levels of inflation challenged Pinochet's early years leading Chile, but his free-market ideology and openness to foreign trade helped Chile recover and send it down a path of constant fiscal improvement to become South America's most fiscally stable country. Colombia is also worth mentioning in that they have never let inflation rise over 33% in the 68 years of data that was compiled.

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[1] Source: Taylor n.d.
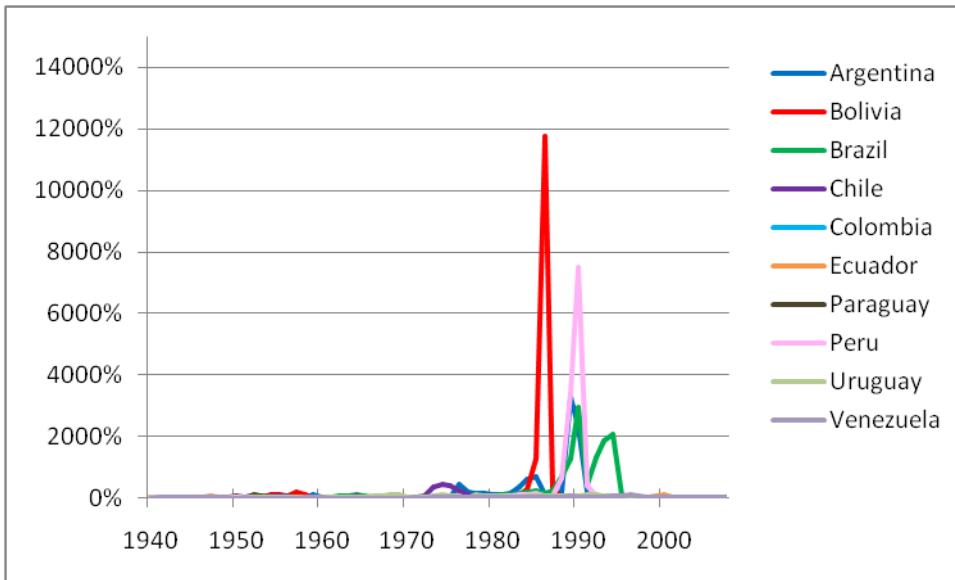
Figure 2-10. Historical annual inflation of South America (extended scale)
Sources: Antonio Ocampo, Angela Parra, and Bergés 2003; Data and Statistics 2008
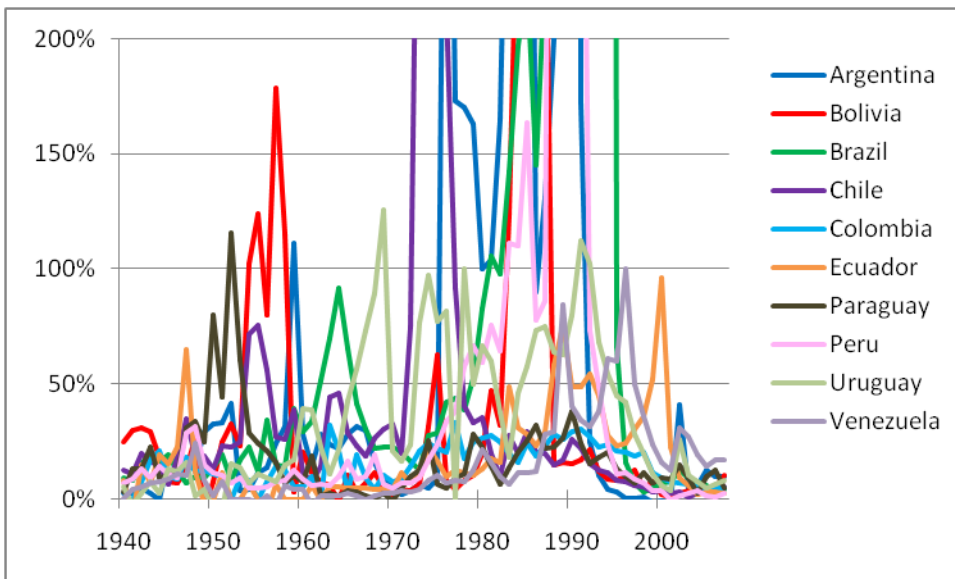
Figure 2-11. Historical annual inflation of South America (reduced scale)
Sources: Antonio Ocampo, Angela Parra, and Bergés 2003; Data and Statistics 2008

Generally speaking, all of Latin American countries have done an excellent job of stabilizing their financial systems over the past decade. There are still weak spots and crises that crop up, such as Argentina's bankruptcy of 2002 and Venezuela's inability to find single-digit inflation levels like the other countries, but it is still a vast improvement. Ben Bernanke, future Chairmen of the United States Federal Reserve Board of Governors, identified some of the factors responsible for the

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region's mid-90s recovery.[1] He determined that the most impacting (but not only) tool used was inflation targeting. He clarifies, however, that the root causes were threefold and fundamental. First, the region began adopting responsible fiscal policies and tending to their foreign debt levels. Secondly, the region undertook better regulation of their banking systems and thus improved both domestic and foreign trust in that sector of the economy. Lastly, many countries handed more autonomy and independence to their central banks, allowing them to operate unencumbered with the politics-of-the-day and thereby permitting them to more easily consider longer horizons in policy decisions. Although I am optimistic that the region is now developing quickly and seemingly on the right path, it is important to note that we are talking about over a dozen countries, and some will unquestionably be more successful than others in improving their economies. The current trends and policies are also still young and the region has not yet attained the political stability of the United States or Europe, so investors still bear some level of risk that the region will retreat from the current direction. Hugo Chavez's current influence and ambition in the region is another potentially destabilizing factor to be wary of as a supply chain engineer dealing with the region.

2.3   LATIN AMERICA'S SUPRANATIONAL BANKS

Beyond national economic and financial systems lie supranational banks, also called development banks. Most famous are the World Bank and International Monetary Fund (IMF). They serve as creditors to nations and often as overseers and advisors of the global financial system. There are also many development banks specifically targeted towards Latin America. The largest are the Inter-American Development Bank (IDB) which also serves the Caribbean, the Central American Bank of Economic Integration (CABEI) serving only Central America, and the Andean Development Corporation (CAF). In Latin America many countries, in particular those led by leftist leaders such as Bolivia and Venezuela, consider the World Bank, IMF, and

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[1] Source: Bernanke 2005

even the IDB to be controlled by the United States. In addition, these banks' policies tend to promote globalization and free-trade. Latin America's leftists label these policies *neo-liberalism* and have expressed vehement opposition. In recent attempts to break free of the largest existing development banks, Hugo Chavez has succeeded in rallying support for two supranational banking institutions specifically for Latin America. The first was the slightly more moderate and inclusive Bank of the South and the second was the leftist and currently exclusive Bank of ALBA. The goal of these institutions is to significantly reduce the United States's influence on the region by creating banks large enough to allow the region to bypass the World Bank, IMF, and IDB. Infrastructure development is a common usage of development bank funds.

2.4 OTHER INSTITUTIONAL CHALLENGES TO THE SUPPLY CHAIN

The previous discussion of Latin America's attempts at economic integration should have made apparent the frequency and seeming caprice with which the region's international policies can change. This is an obvious challenge for international supply chains that operate in the region because of the resources required to monitor the constant changes and understand their business implications. In addition, long term planning initiatives, legal requirements, and bureaucratic upkeep are also a resulting challenge of such unstable administrative environments. Latin American countries also present many internal challenges for supply chain engineers that are generally not found in developed countries.

2.4.1 CORRUPTION AND BRIBERY

Corruption can take many forms: governmental favoritism, judicial partiality, unethical corporations, bribes and kickbacks in regard to any of the above, and an influential black market (also called a parallel or informal economy). While no country is immune, developed countries' ability to marginalize these activities is part of what has strengthened their economies; in the absence of corruption, ethical businesses are more willing to invest and operate.

In the matter of corruption, Latin America shows room for improvement. While the region does not suffer to the extent of Africa or South Asia, it is still a long way from the United States or Europe. There are a number of indexes that attempt to quantify corruption in different ways. The World Bank provides the Logistics Performance Index (LPI). Their research does not concentrate exclusively on corruption, but includes a survey of international logistics professionals and experts. Figure 2-12 and Figure 2-13 present first the impact of bribery on specific regions and second the perceived three-year trend experienced. Most of the LPI scores are by country, but the corruption-specific data has been aggregated so that we cannot remove the included Caribbean countries from Latin America, therefore we are also registering the Dominican Republic, Haiti, Jamaica, and Guyana. It is important to realize that the regions include only developing countries, and the developed countries from all regions fall under "High Income Countries". Therefore Japan, the EU, the United States, et cetera are not being included within any geographical regions.
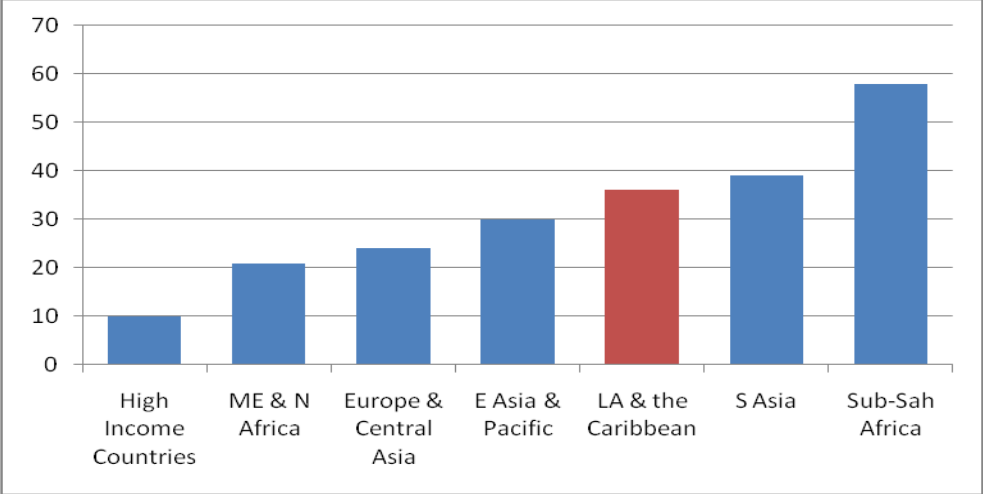
Figure 2-12. Surveyed impact of bribery (% responses of high/very high)
Source: Arvis et al. 2007
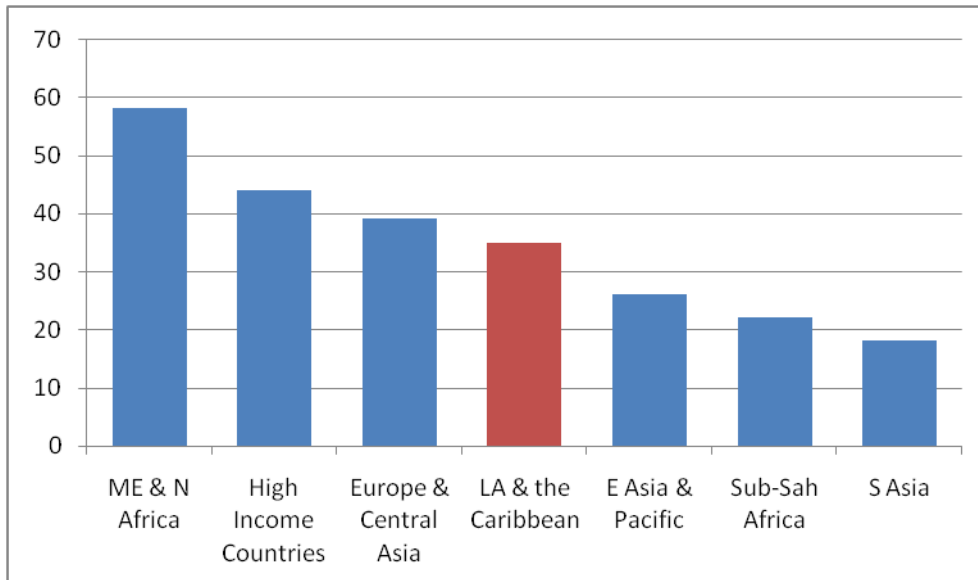
Figure 2-13. Three-year trend of governance and corruption (% responses of better/much better)
Source: Arvis et al. 2007

Transparency International provides the Corruption Perceptions Index (CPI), a very comprehensive index measuring corruption exclusively. The CPI allows us to look more specifically at individual countries amongst the 180 that it surveys. Table 2-2 provides the 2007 CPI scores, ranks, and percentiles for Latin American countries as well as some other benchmark countries. The following chart displays the CPI scores.[1] Chile and Uruguay are in the same class as higher-income, more-developed countries. Costa Rica has not come quite that clean, but still manages to separate itself from the rest of the pack. From there the rest of the Latin American countries slide into a morose. There does not appear to be a distinction between Central and South American countries.

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[1] Note that throughout this thesis, whenever possible, we will use orange to represent Central America, green to represent South America, and blue to represent non-Latin American countries to better facilitate quick surveys and better understanding of the information. In regionally aggregated data the non-Latin American countries are again blue, but Latin America will be red.

	Score	Rank	Percentile
Germany	7.8	16	91%
Japan	7.5	17	91%
USA	7.2	20	89%
Chile	7.0	22	88%
Uruguay	6.7	25	86%
Costa Rica	5.0	46	74%
Cuba	4.2	61	66%
El Salvador	4.0	67	63%
Colombia	3.8	68	62%
Brazil	3.5	72	60%
Peru	3.5	72	60%
Mexico	3.5	72	60%
China	3.5	72	60%
Panama	3.2	94	48%
Argentina	2.9	105	42%
Bolivia	2.9	105	42%
Guatamala	2.8	111	38%
Nicaragua	2.6	123	32%
Honduras	2.5	131	27%
Paraguay	2.4	138	23%
Ecuador	2.1	150	17%
Venezuela	2.0	162	10%
Sudan	1.8	172	4%

Table 2-2. CPI scores, ranks, and percentiles

Source: Lambsdorff 2007
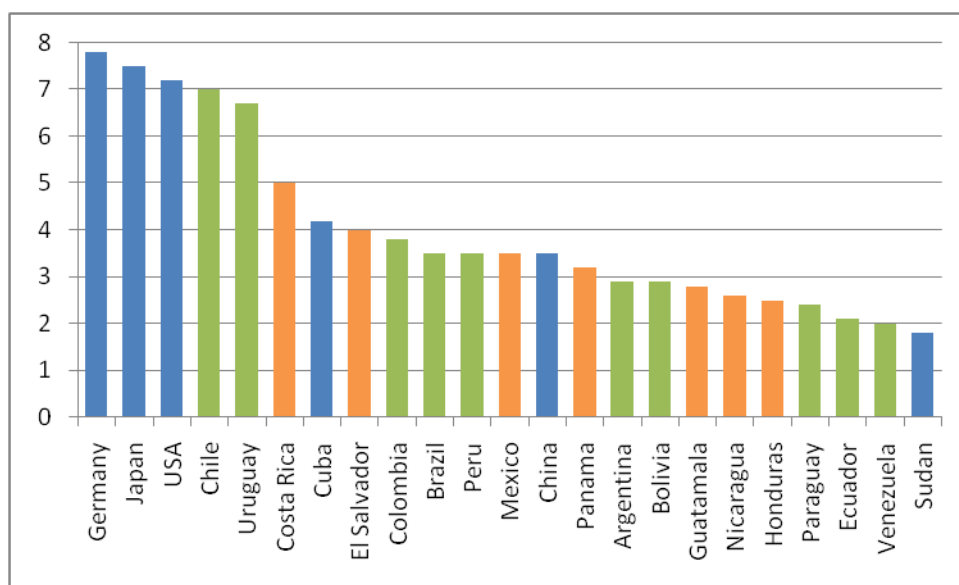
Figure 2-14. CPI scores: higher score = less corruption

Source: Lambsdorff 2007

Transparency International also provides a less expansive Briber's Payers Index (BPI). This index only captures the world's 30 largest exporters and thus only Mexico and Brazil from Latin America. The index communicates the international pervasiveness of bribery by companies based in a particular country. A higher score would mean that that country's companies participate less in bribery worldwide. Mexico lands clearly in the middle and Brazil straddles the third and fourth quartiles – neither impressive positions, but both ahead of China and India.

2.4.2 CUSTOMS

Trouble with customs can fall into the arena of corruption and bribery, but can also stem from oft changing regulations, sluggish bureaucracy, and systemic inefficiency. Compared to the rest of world, Latin America's customs operations do not compare favorably with that of high-income countries, or even Europe[1] & Central Asia. It is not the laggard that Africa is, however. Figure 2-15's block of graphs on the following page presents Latin America's performance in a variety of categories that the LPI has regionally aggregated. It has been arranged such that the better performers are always farther to the left of the graph.

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[1] We refer, in line with LPI categorization, only to the countries in Europe that are not in the "High-Income" category.
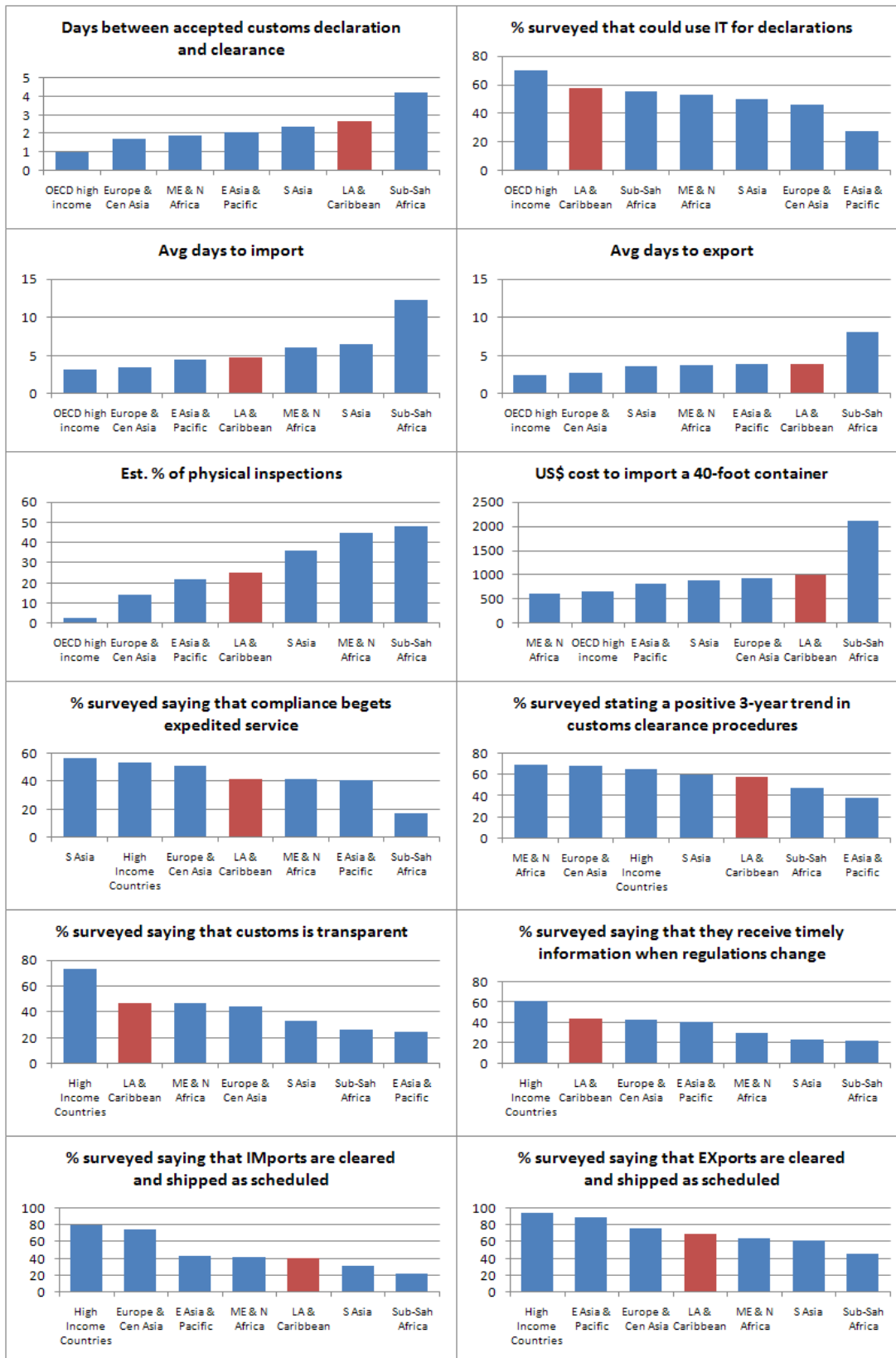
Figure 2-15. Various customs-related regional comparisons

Source: Arvis, et al. 2007

It is mentionable that Latin America performs well in the three categories related to communication. Operationally Latin America does not do as well, reaching no higher than the middle of the pack and often falling to the back, ahead of only Africa. Determining Latin America's rank only among the developing countries of other regions, however, can prompt overly-low expectations and shortchange the region's potential. The difference between Latin America and the high-income countries should be noticed as well. Figure 2-16, also derived from the LPI, provide further instances of how Latin America compares to other regions and how far it trails the developed countries in terms of customs logistics.
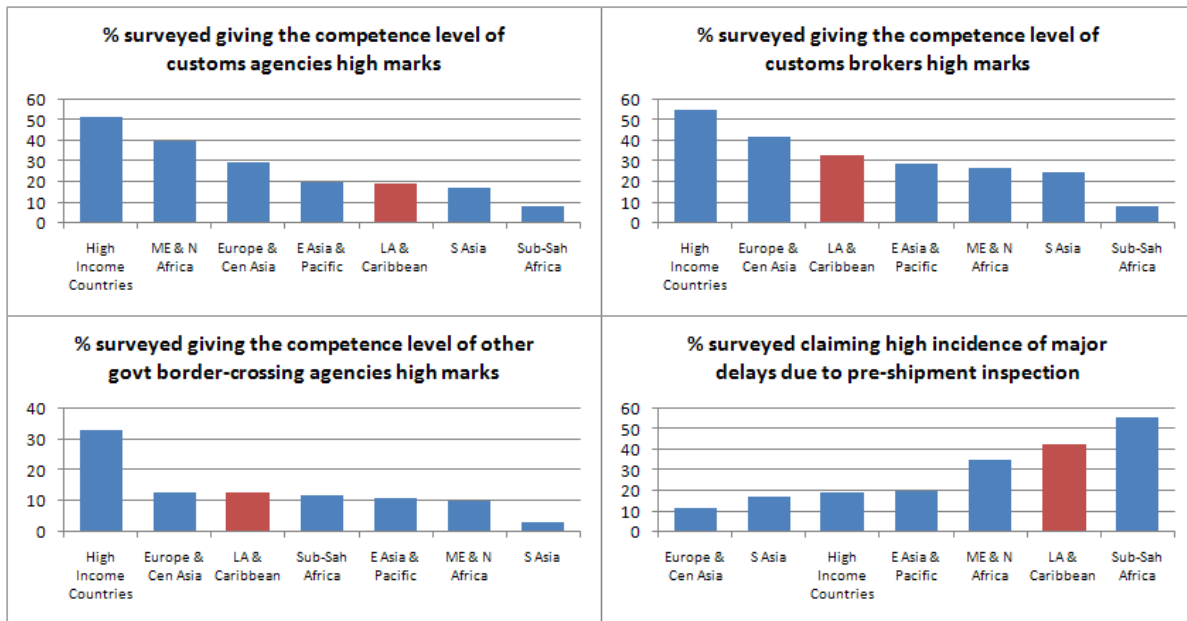
Figure 2-16. Further customs-related regional comparisons
Source: Arvis, et al. 2007

Some LPI survey data is presented by country and allows us to understand how individual countries are performing. Figure 2-17 displays the time it typically takes to clear customs. Colombia, Brazil, Paraguay, Venezuela, and Ecuador are the clear laggards of the region – all South American countries. When looking at the import and export costs to get through customs in Figure 2-17 we can see that Colombia's charges are excessive despite its poor performance. This is likely due to Colombia's strategic location and lack of seaport infrastructure. As we will discuss later, ground transport is exceptionally difficult in South America. Colombia straddles Panama,

gaining access to both the Pacific and Atlantic oceans. Any shipper unwilling to pay or wait for the Panama Canal, or too large to use it, might consider Colombia to be one of the most logical port destinations for an intermodal continuation of the shipment.
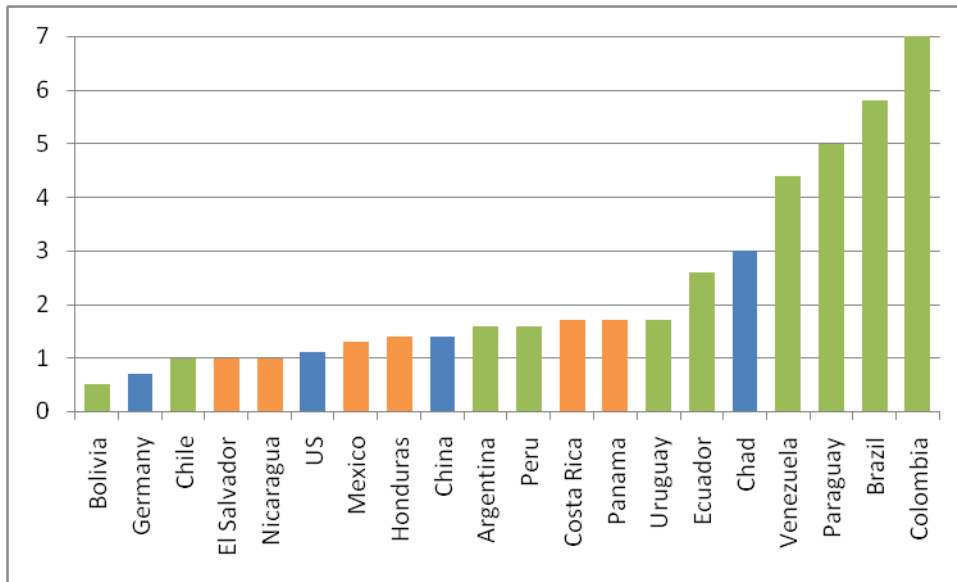
Figure 2-17. Average time it takes to clear customs (days)
Source: Arvis, et al. 2007
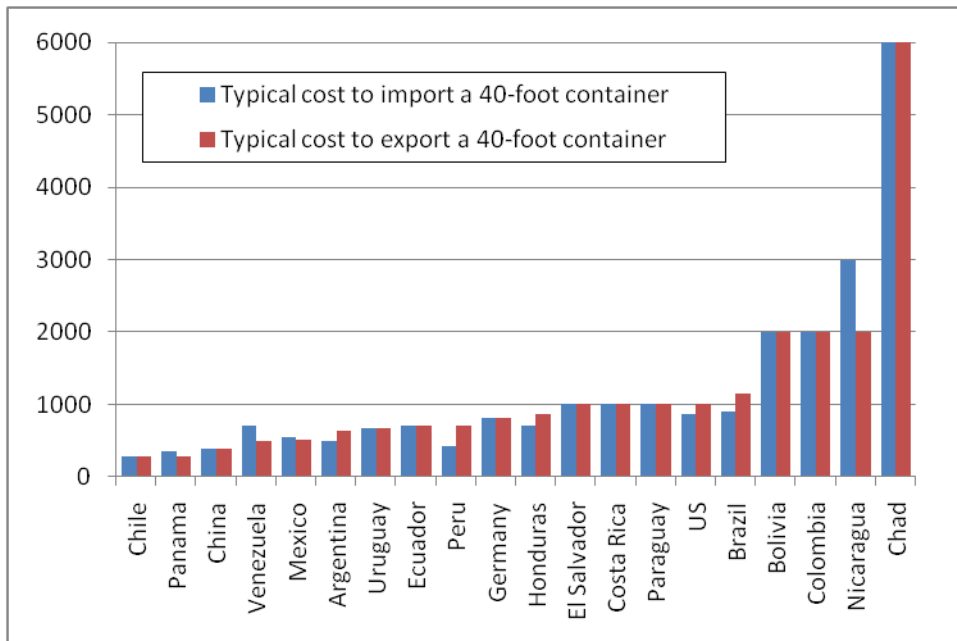
Figure 2-18. Typical import/export costs, includes both transport and port costs (USD)
Source: Arvis, et al. 2007

2.4.3 Violence and Theft

Latin America has yet to find the political and societal stability that most developed countries have attained. Colombia has been waging a slow-burning civil war for forty years with rebel forces using guerilla warfare and roaming the logistically strategic but undeveloped dense rainforest of the Darien Gap across the Colombia-Panama border. Both Bolivia and Ecuador went through political crises as recently as 2005 in which their presidents were forced to step down in the face of massive violent protests. In Paraguay there has been violence targeting its soy farmers for years.[1] These are just some examples of the political instability of the region.

Organized gangs of bandits can be a threat to the supply chain and Latin America is a primary battle ground. Barry Conlon, president of FreightWatch International USA, named four current global foci for theft and hijackings. Two of them, Mexico and Brazil, are Latin American.[2] In a 2005 survey given by the Center for Private Sector Economic Studies (CEESP), 94% of 2600 Mexican executives named safety from robbery, crime, and kidnappings as a significant obstacle to business development. This concern was the most mentioned and received the highest average significance of all other government- or market-related obstacles. Mexico's black market was the third-highest rated and mentioned obstacle.[3]

2.4.4 Transshipments & Trucking Regulations

Common policies requiring transshipment of ground freight at country borders is a hindrance to surface transportation, which we will see in chapter three is already problematic. Due to unsynchronized vehicle regulations, differing drivers licensing, and continued (though lessened) protectionism policies, many semi-trucks cannot travel from country to country. Rather they must meet a truck from the destination country at the border and exchange the cargo there. This incorporates extra travel time and logistical complexity into the supply chain.

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[1] Source: Dangl 2006

[2] Source: Supply Chain Digest 2007

[3] Source: Carranza Torres 2007

Other trucking regulations, or in some cases a lack of, also creates a challenge for the region's supply chains. For example, what little exists of Brazil's trucking regulations is completely ignored resulting in anti-competitive and unsafe practices. The fact that over 50% of Brazil's truckers are self-employed serves to feed this problem and helps create a ground transportation sector that is based on low cost and low efficiency.[1] In contrast, only about 13% of United States truckers were self-employed in 2002.[2] Brazil's roads are thus filled with trucks that are too old, overloaded, uninspected, and being driven by unrested and unregulated drivers. This results in an unsafe environment, low accountability and reliability, and extraordinary wear and tear on already poor roads. Brazil is only one example, but generally indicative of most of the rest of Latin America.

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[1] Source: Fleury 2007

[2] Source: Global Insight, Inc. 2005

3 PHYSICAL ENVIRONMENT

Even after considering the institutional and systemic supply chain challenges in Latin America, significant challenges still remain. The region's geography is at the same time both amazing and foreboding. Its various components provide some exceptional challenges to the creation of an effective or even functional supply chain. But in some cases, geographical advantages can be found.

Figure 3-1. Satellite image of Latin America
Source: Comsat International 2006

3.1   THE ANDES MOUNTAINS

The United States contends with the Rocky Mountains and Europe with the Alps, but neither compares to the Andes Mountains. The range stretches from Chile and Argentina's southernmost region of the continent all the way up along the western coast to the northern coast of Venezuela. At 9000 km it is the longest range in the world and runs twice the width of the United States. Aconcagua stands in Argentina as its tallest peak at 6960 meters. By comparison, Mount Everest, the tallest point in the world, rises 8850 meters and the tallest mountain in the Rockies is Mount Elbert at 4400 meters; over fifty of the Andes' peaks are over 6100 meters. Only the Himalayas of Asia is considered a bigger range, though it isn't nearly as long.

The Andes Mountains serve to effectively isolate the western coast of South America from the rest of the continent, including the economic powerhouse of Brazil, its active São Paulo seaport, and the highly industrialized Argentina. The Andes house many of the continent's largest cities such as Bogotá, La Paz, and Quito and the majority of the world's highest cities of notable size are in the Andes. In 2007, FIFA even banned international matches from Bogotá, La Paz, and Quito due to their elevation.[1] To impress upon the reader the challenges that the Andes Mountains present, Figure 3-3 and Figure 3-4 have been provided to allow a rough comparison of South America to the United States. They present the average elevation, ordered by population, of the 17 largest metropolitan areas of each region along with the two highest sizeable metropolitan areas with the highest

Figure 3-2. Map showing the Andes
Source: EROS 2006

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[1] Source: USA Today 2007

elevations (Denver and Albuquerque in the United States, and Quito and La Paz in South America). This represents, roughly, 40% of the United States' population and 30% of South America's population. The average elevation for these United States cities is 335 meters while the average South American elevation is 838 meters. The standard distributions are 494 and 1147 meters, respectively.
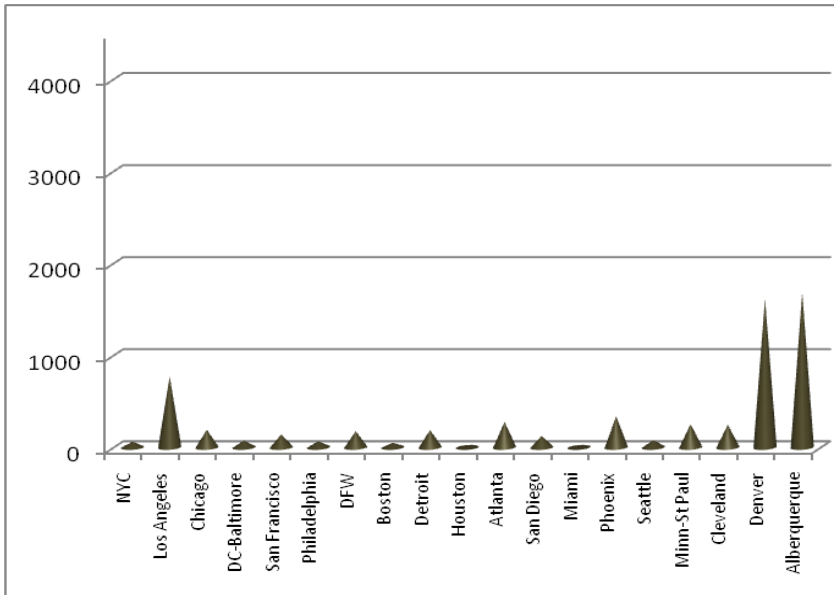
Figure 3-3. Elevation of populous US cities (meters)
Source: Wikipedia, various
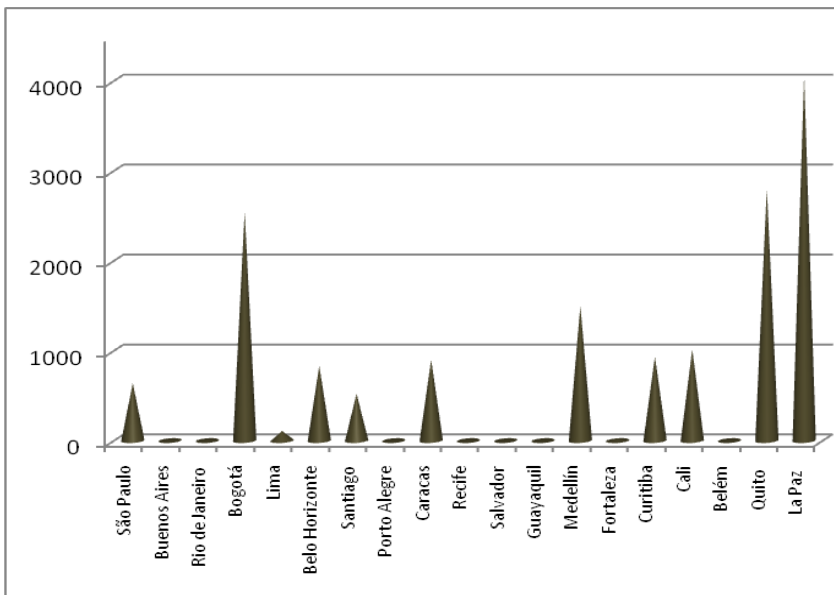
Figure 3-4. Elevation of populous South American cities (meters)
Source: Wikipedia, various

The Andes Mountains make it especially difficult to build and maintain roads and railways. The costs are high and once the roads are in, it still takes disproportionate amounts of time to traverse relatively small distances because of the routes and windings that the mountains dictate. For this reason, air transport has become increasingly used in order to bypass the Andes, with Colombia and Peru having best developed their air routes.[1]

Other mountains exist in southern Venezuela (the Guyana Highlands), Brazil (the Brazilian Highlands), and Mexico/Central America (the Sierra Madres). The Guyana Highlands are defined by their unusually high mesas, yet the tallest reach only 2800 meters. The Brazilian Highlands similarly peak out at 2900 meters and are formed generally between the populated southeast and northeast regions of the country.[2] Mexico is riddled with mountains, which can get as high as 5700 meters. The maximum elevations of the Central American countries range from 4200 meters in Guatemala to 2400 meters in Nicaragua.[3] Given how narrow the region is, these mountains dominate much of the terrain.

3.2   THE AMAZON RAINFOREST

Another physical obstacle for Latin American supply chains is the Amazon Rainforest. The Amazon Rainforest takes its name from the massive Amazon River and covers most of the Amazon Basin and about a third of all of South America. Another comparison for perspective: The Amazon Rainforest would cover two-thirds of the contiguous United States. Most of it lies within Brazil, but it maintains significant portions in every other South American country from Bolivia on northward. There is, of course, no clear cut way to draw the borders of the Amazon Rainforest, but Figure 3-5 gives a rough representation of it (as well as the Central

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[1] Source: Encyclopedia Britannica Online, "Colombia" 2007

[2] Source: Lydolph 1985

[3] Source: CIA World Factbook 2008

American Rainforest).   The rainforest is widely believed to provide 20% of the world's oxygen and to house the greatest collection of biodiversity in the world.[1]   In less than forty years, we have cleared nearly 20% of the forest's 1970 cover.[2,3]

Figure 3-5. Map of rainforests in Latin America
Source: Butler (Rainforest Map) n.d.

The Amazon River claims the rainforest and slightly beyond as its watershed and is the most voluminous river in the world and some contend it to also be the longest.[4] The Nile is generally considered the longest, but the Amazon has such an extensive system of tributaries and different interpretations of the river proper, that it ends as a matter of perspective and definition.   The river has over 1000 tributaries, seven of

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[1] Source: Corwin 2007

[2] Source: Butler 2007

[3] Source: Corwin 2007

[4] Source: Duffy 2007

which flow for over 1600 km.[1] It is a 12th-order stream by the Strahler Stream Order algorithm which measures the magnitude of a river network, the highest realized order.[2]

While the Amazon River and Rainforest are natural marvels of beauty and life, they are also formidable foes of supply chain networks. While not non-existent, the road system piercing the Amazon Basin is negligible and largely a smattering of unpaved roads. These unpaved roads are even more worthless than most because of the 200 days and 100 inches of annual rainfall the region sees.[3] Increased awareness of environmental impact prevents development of transport corridors, so the supply chain operators are left with the headache of always working around or over the rainforest. The less destructive option of using its powerful river system exists, but is currently underutilized. There is also the amazing fact that the Amazon River, at no point, is crossed by a bridge.[4]

Central America also has a lush rainforest. It does not approach the enormity of the Amazon, but has already seen even higher rates of deforestation.[5] Alternatively, the deforestation of the rainforest in Panama is making it harder and harder to maintain the Panama Canal[6] – a rare direct correlation between maintenance of environment and infrastructure.

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[1] Source: WorldAtlas 2008

[2] Source: Strahler 1952

[3] Source: WorldAtlas 2008

[4] Source: Augelli 2007

[5] Source: Butler, "Neotropical" 2006

[6] More on this in the Panama Canal section of chapter four.

4 INFRASTRUCTURE

Challenges abound beyond the geophysical. The Andes Mountains and Amazon Rainforest are troublesome for supply chain engineers, but nothing much can or should be directly done about them. Here we present the current condition of Latin American infrastructure. Where something is lacking, as we'll see in Latin America, there can be great opportunities for investment. The challenge is that it has been financially difficult and sometimes risky to capitalize on those opportunities. Progress is being made, but unfortunately, it is being made too slowly.
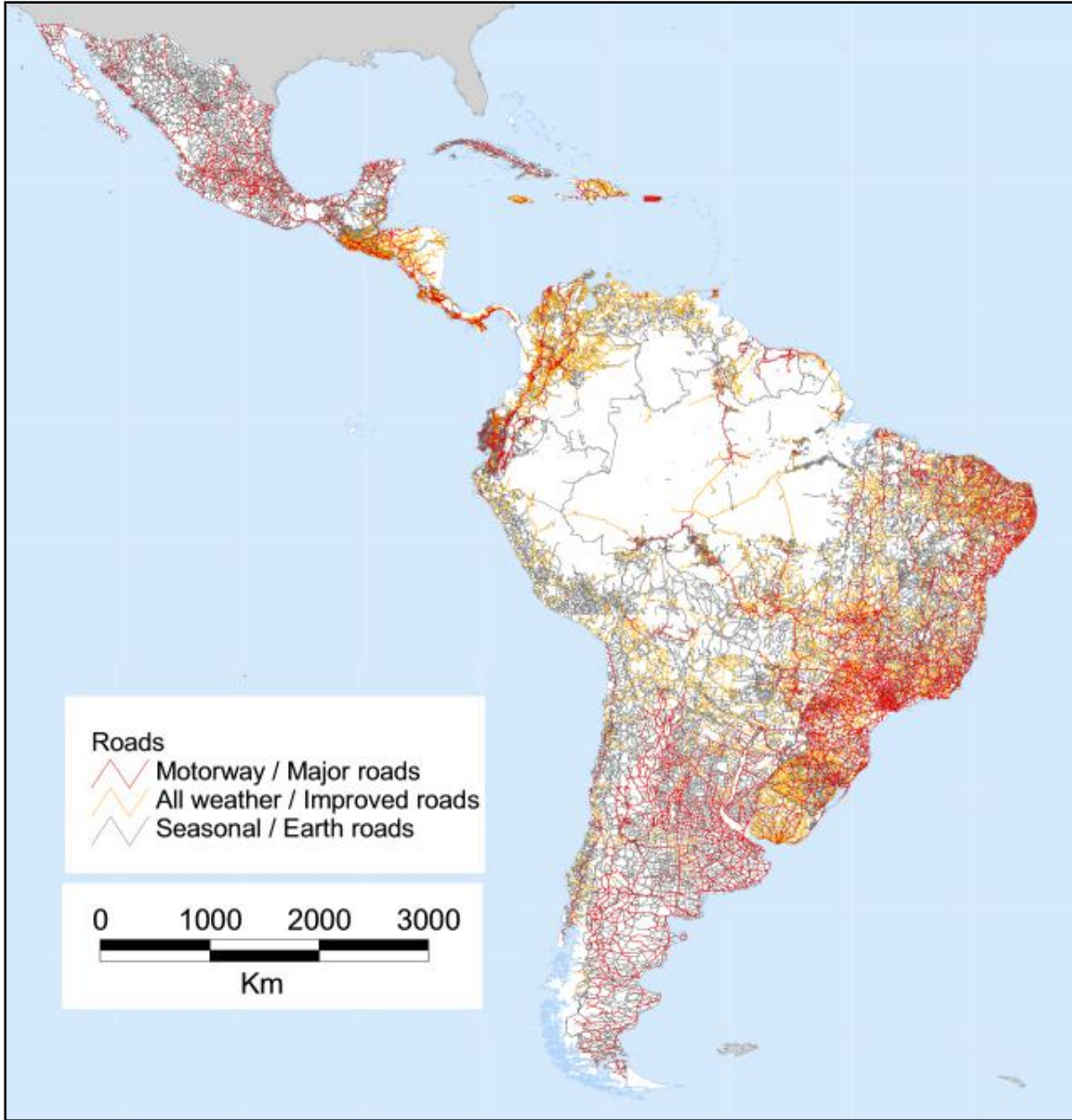
Figure 4-1. Map of road networks across Latin America
Source: CIAT 2005

The overall LPI score is comprised of various subcategories (customs, infrastructure, international shipments, logistics competence, tracking & tracing, domestic logistics costs, and timeliness). Of the 150 countries' LPI scores, Chile and Argentina lead Latin American countries in infrastructure at 32nd and 45th on the list, respectively. Thirteen Latin American countries dominate the rankings from 54th to 82nd. Bolivia and Nicaragua bring up the rear at 107th and 122nd. These rankings are decidedly middle-of-the-road and are a good indicator of the different levels of development interwoven throughout the region.

| | | Overall LPI | |
Quartile	Country	Score	Rank
1st	Germany	4.1	3
	USA	3.8	14
	China	3.3	30
	Chile	3.3	32
2nd	Argentina	3.0	45
	Panama	2.9	54
	Mexico	2.9	56
	Peru	2.8	59
	Brazil	2.8	61
	El Salvador	2.7	66
	Venezuela	2.6	69
	Ecuador	2.6	70
	Paraguay	2.6	71
	Costa Rica	2.6	72
	Guatemala	2.5	75
3rd	Uruguay	2.5	79
	Honduras	2.5	80
	Colombia	2.5	82
	Russia	2.4	99
	Bolivia	2.3	107
4th	Nicaragua	2.2	122

Table 4-1. Overall LPI scores and ranks (of 150 countries)
Source: Arvis, et al. 2007

The subcategory most tangibly applicable to transportation is infrastructure. The scores and ranks (out of 150 countries) for this subcategory are shown in Table 4-2. The numbers are actually quite similar to the overall LPI results, with the biggest exception being a 29-place drop by Guatemala. In fact, by comparing the rankings of the two tables we can see for which countries infrastructure is a weakness and for which it is a strength, relative to their other logistics factors. Picking out the countries with double-digit swings between the two tables, Brazil and Venezuela's infrastructure are relative strengths, but it drags down Guatemala and Nicaragua.

Note that this does not mean that these countries' infrastructure is good or bad, it is only a relative comparison to their other logistical components measured by the LPI. Chile may be the only Latin American country to break into the top quartile, but it is encouraging that the majority of the rest of Latin America maintains position in the second quartile. As we will see in the ensuing sections, however, the GCI data (which is used because of its ability to break down into quality-by-mode) is much less rosy. See

Table 4-3 for how the GCI ranks its infrastructure pillar (out of 131 countries).

LPI subcategory: Infrastructure					GCI pillar: Infrastructure			
Quartile	Rank	Score	Country		Country	Score	Rank	Quartile
	3	4.2	Germany		Germany	6.7	1	
1st	7	4.1	USA		USA	6.1	6	1st
	30	3.2	China		Chile	4.6	31	
	34	3.1	Chile		Panama	4.0	50	
	47	2.8	Argentina		El Salvador	4.0	51	
	48	2.8	Panama		China	4.0	52	2nd
	49	2.8	Brazil		Mexico	3.6	61	
	53	2.7	Mexico		Uruguay	3.5	64	
	57	2.6	Peru		Russia	3.5	65	
2nd	59	2.5	Venezuela		Guatemala	3.3	70	
	64	2.5	Paraguay		Honduras	3.2	75	
	67	2.4	Costa Rica		Brazil	3.1	78	
	68	2.4	El Salvador		Argentina	3.0	81	3rd
	70	2.4	Uruguay		Colombia	2.9	86	
	73	2.4	Ecuador		Costa Rica	2.7	95	
	79	2.3	Honduras		Ecuador	2.6	97	
	85	2.3	Colombia		Peru	2.6	101	
3rd	93	2.2	Russia		Venezuela	2.5	104	
	104	2.1	Guatemala		Nicaragua	2.3	116	4th
	109	2.1	Bolivia		Bolivia	2.2	118	
4th	137	1.9	Nicaragua		Paraguay	2.0	126	

Table 4-2. LPI infrastructure rankings   Table 4-3. GCI infrastructure rankings
Source: Arvis, et al. 2007   *Source: Arvis, et al. 2007*

The red lines between the tables match the countries from one table to the next. We can see at a glance drastic differences between the two tables. In the following sections we use GCI variables to indicate modal quality per country (which are used with other like-mode variables to build pillars, which in turn roll up into the GCI score). The GCI's choice of variables is at times circumspect, so while we use selected

variables in the coming sections, we should be careful to quickly accept the GCI's aggregated pillar. Another factor which can explain the drastic quartile differences between the two indexes (though does not explain the ranking shuffle) is the fact that each index considers countries that the other does not. The GCI includes 9 countries not in the LPI, and the LPI includes 29 countries not in the GCI. Many of the latter are African countries thus improving the overall rankings of most Latin American countries. Probably the biggest issue with trusting the LPI scale is the high ranking of Paraguay which, as we will see soon, is in dire straits with its infrastructure.

Exploring not current conditions, but rather trajectory, one of the LPI's many survey questions to executives was if they believe there has been improvement in regional infrastructure and telecommunications (two separate questions). Figure 4-2 and Figure 4-3 show that Latin America finds itself below average in both categories. Infrastructure, though, is an umbrella term for a complex system with many components, so we will discuss it in more detail using four subgroups: roadways, railways, waterways/seaports, and airports. This thesis is focusing on direct factors influencing logistics transportation; therefore we will not address telecommunications past this point.
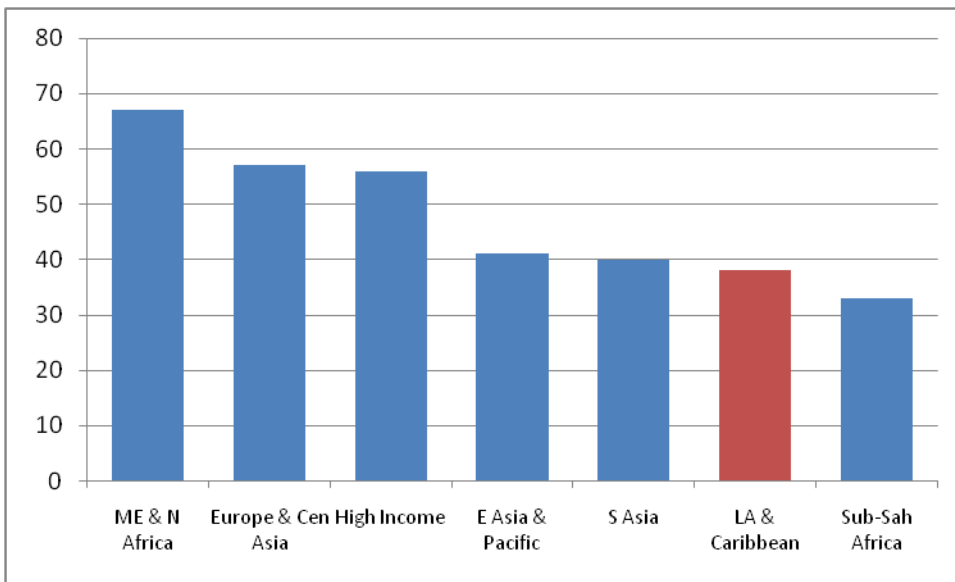
Figure 4-2. Three-year trend of transport infrastructure quality (% responding positive)
Source: Arvis, et al. 2007
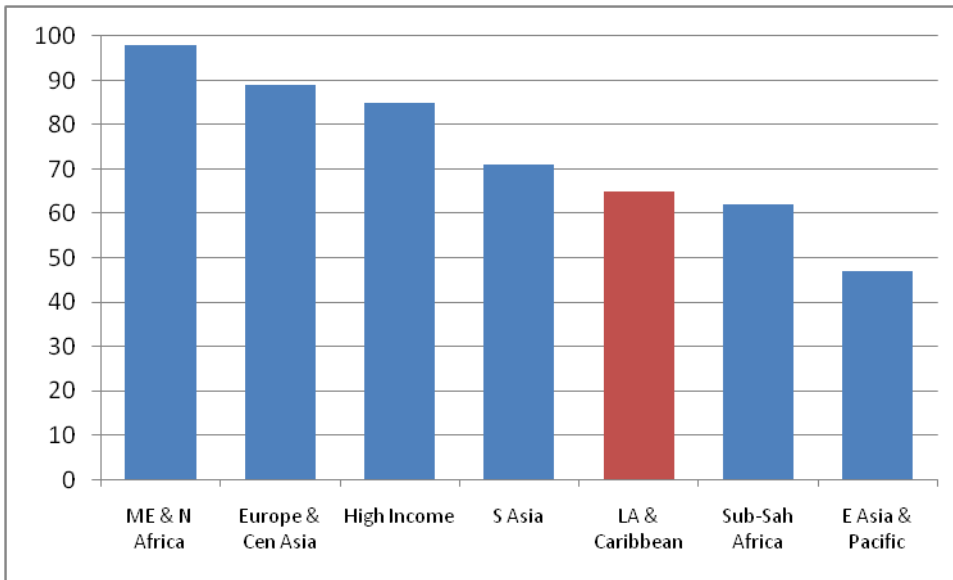
Figure 4-3. Three-year trend of telecommunications infrastructure quality (% responding positive)
Source: Arvis, et al. 2007

4.1 ROADWAYS

The road systems across Latin America are notoriously poor. Most countries struggle to provide adequate connectivity and quality and have historically build their surface networks (both road and rail) out to the coasts rather than towards surrounding countries, which further challenges efficient intraregional trade.[1] It should come as no surprise that the Andes and Amazon both play a role in hampering many countries' efforts along these lines. While there is no perfect way to objectively compare differing countries' road networks, below we present a graph that gives the reader a rough impression of the road network differences between countries. The Latin American countries are on the left and some international benchmarks are on the right, each group ordered by urbanization level from most to least.

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[1] Source: Meléndez O. 2001
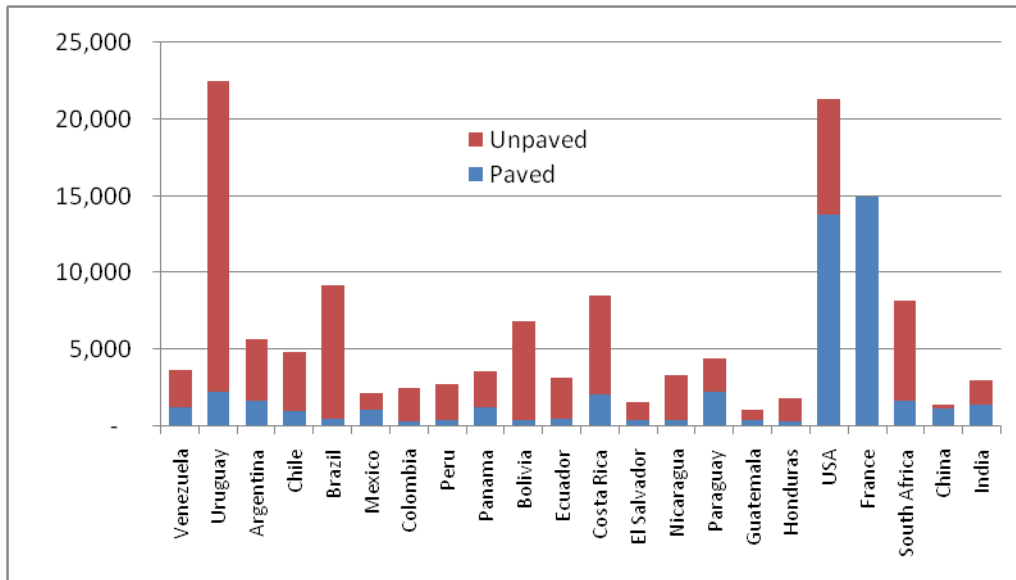
Figure 4-4. Road per 1000 people (kilometers)
Source: CIA World Factbook 2008

From the chart we can see the vast difference between the developed and developing world when it comes to infrastructure. Of Latin America, only Mexico and Paraguay achieve even a 50/50 split in paved and unpaved roads. All other countries find themselves largely unpaved. The mountain roads, of which the Andes contain plenty, often make sharp turns, require winter chains, and have no guardrails. Companies accustomed to operating their supply chains in the United States will find a much different comparative transportation landscape in Latin America. Including Alaska (which will make things look rosier in Latin America than they are), the United States is only half the size of Latin America, yet has ten times as many kilometers of paved road and almost as many kilometers of unpaved road. In all, the United States has 654 meters of road per square kilometer, whereas Latin America has only 146. Note that these are pure kilometers, not lane-kilometers which would certainly translate into an even greater skew towards the United States.

It is important to clarify that I am not suggesting that Latin America must build their road networks to United States levels for the sake of the supply chain. I am bringing up Latin America's lesser connectivity (as compared to the United States) in order to impress upon the reader the fact that Latin American logistics cannot be approached in the same way, or with the same expectations, as those of the United States and

Western Europe. For the sake of the Amazon and the Central American rainforests, we should be careful in our fervor for building infrastructure that could threaten these global and regional assets. What is unarguably essential to Latin America's ability to support the supply chains of increasing trade and globalism is the maintenance and quality of the roads already in place. Latin America is notorious for its poor roads, particularly outside of the major cities. This slows transportation, increases the physical toll on trucks thus shortening their lifespan and/or increasing maintenance costs, and increases damage-in-transit to products.

There are a number of large, notable highways that have been or are currently being built, with the intention of improving trade routes and transcontinental movement, often with international and IDB support. These include, but are not limited to, the Pan-American Highway, the Trans-Amazon Highway, and the Interoceanic Highway. It should be mentioned that, where the term "highway" in the United States almost always refers to a paved road, it is very common for even major highways in Latin America to be unpaved.

The Pan-American Highway was the first road built of the ones listed here.[1] Discussions of the highway began in the 1920s. It stretches along various routes (depending on the source) from Alaska all the way to Argentina, with the exception of 87 kilometers – the Darién Gap. The construction of this final piece of the highway through the Darién Gap is highly contentious with politicians and trade advocates facing off against those with environmental concerns for the extraordinarily lush rainforests there. The section dubbed the Inter-American Highway, which is the part running through Mexico and Central America, was completed during World War II with the assistance of the United States. In South America, Brazil's Trans-Amazon Highway opened in 1972. As the name implies, it runs through the Amazon Basin from the Atlantic towards Peru, though some refer to the Trans-Amazon Highway as a system of highways and others specify Br-230 or some other east-west route through the northern section of Brazil. This highway is causing much of the

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[1] Source: Alloway 1994

deforestation of the Amazon, in part because of the construction of the highway itself, but mostly because of the ensuing development that has taken place along it. Further connecting Peru and Brazil is the Interoceanic Highway which is still under construction. It effectively connects the Pacific coast of Peru to some eastern Brazilian coastal cities. Figure 4-5 presents the rough locations of these highways.
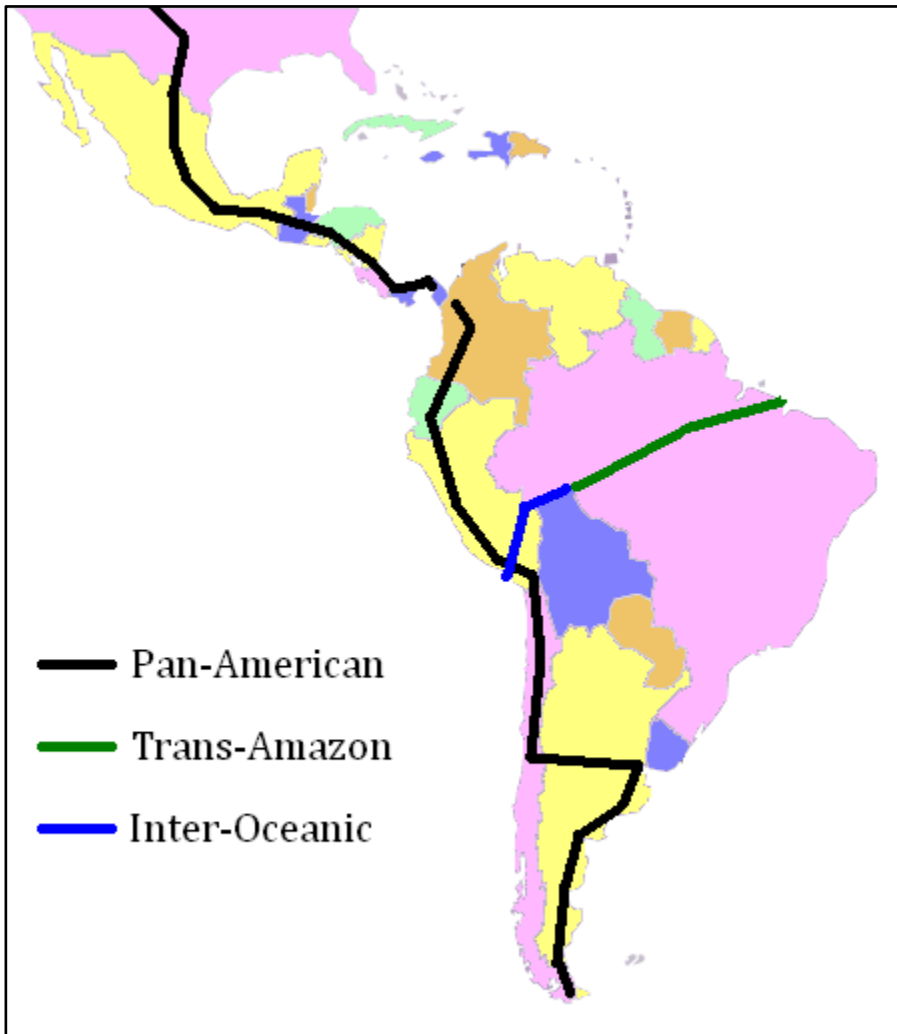
Figure 4-5. Map of major transnational Latin American highways

Focusing on Brazil and Mexico for a moment because of their economic dominance of Latin America in terms of GDP, and their more available data, we are able to explore some further details. Brazil's development has logically concentrated along its coast like the rest of South America. This is for the obvious reason of port accessibility, but also because of the Amazon Rainforest dominating its interior. Its highway network

carries 60% of Brazil's tonnage-miles. The figure above presents the extent and condition of Brazil's highway network in 2004 as given by Brazil's National Transportation Council. The quality scale can be seen in the legend with dark blue being the best and red being the worst (excellent, good, deficient, bad, and unacceptable, in that order). The Trans-Amazon Highway is largely missing from this map. You can see that the best roads are concentrated around the capital, São Paulo, and that the best roads are all in the southeastern region.

Figure 4-6. Map of detailed Brazilian road quality
Source: CNT 2007

Mexico's road network is easily one of the most developed in Latin America. It has the most paved roads in the region, ahead of the much larger Brazil and the generally considered industrialized Argentina, and has the third highest proportion of paved roads to square-kilometers behind the much smaller countries of Costa Rica and El Salvador.[1] Probably not surprisingly, Mexico's wealth and road development are focused largely in the northern region near the United States.[2] The political and tourist centers of the DF and the Yucatan, respectively, also have healthy GDP per capita numbers, although the road development is mixed in both. Mexico, like Brazil, also sees its logistical efficiency reduced by a high proportion of independent truckers.

4.2   RAILWAYS

If Latin America is simply underdeveloped in terms of highways, its rail infrastructure is challenged by a nearly impossible situation. When discussing roads, there are really no incompatibilities to address because of the relative independence of the vehicle to the right-of-way. Rail, however, is another matter. In the United States, all rail is of a single type: 1.435 meter standard gauge. Throughout Latin America, however, you have no such consistency, seriously hampering the efficiency and usefulness of what little rail infrastructure exists. Almost universally throughout Latin America, the 1990s became a period of rail privatization and concession granting, which has saved the mode in many countries.

It is useful to spend just a moment discussing the different types of tracks. There are dozens of different gauge tracks (measured as the distance between the inner edges of the parallel tracks). Standard gauge is 1.435 meters and by far the most common,

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[1] Source: CIA World Factbook 2008

[2] Source: Carranza Torres 2007

globally speaking. [1]   North America, Europe, the Middle East, and China are predominantly standard gauge.   Anything wider than standard is called broad gauge, and anything smaller is narrow gauge. Broad gauges offer more stability and speed, while narrow gauges are cheaper and can handle better. Seven different gauges can be found throughout South America, three of these in Central America (including non-operational tracks, of which we will explain more later). Table 4-4 and Table 4-5 show kilometers of track by country and by gauge as measured by the CIA World Factbook 2008. These are not to be taken at face value without reading the rest of this section, since these numbers do not differentiate between operating and defunct tracks. You will notice that Table 4-4 does not have columnar totals or percentages. This is because of the extreme non-functioning of Central American rail (only Mexico and to some level Panama have anything remotely useful in terms of rail). The Central American countries in red have no current rail operations. Break-of-gauge is a term to indicate the point at which two tracks of differing gauge meet. A rack railway is used for steep inclines and has a mechanism running up the center to help pull the train up the tracks.

	1.676	1.600	1.435	1.067	1.000	0.914	0.750	TOTAL
Mexico	-	-	17,665	-	-	-	-	**17,665**
Guatemala	-	-	-	-	-	886	-	**886**
El Salvador	-	-	-	-	-	562	-	**562**
Honduras	-	-	-	279	-	420	-	**699**
Nicaragua	-	-	-	6	-	-	-	**6**
Costa Rica	-	-	-	278	-	-	-	**278**
Panama	-	-	77	-	-	278	-	**355**

Table 4-4. Rail infrastructure in Central America by gauge (kilometers)
Source: CIA World Factbook 2008

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[1] Source: Encyclopedia Britannica Online, "Gauge" 1998

	1.676	1.600	1.435	1.067	1.000	0.914	0.750	TOTAL
Argentina	20,858	-	2,885	-	7,922	-	237	**31,902**
Brazil	-	5,328	194	-	24,169	-	-	**29,691**
Chile	2,831	-	-	-	3,754	-	-	**6,585**
Bolivia	-	-	-	-	3,504	-	-	**3,504**
Colombia	-	-	150	-	-	3,154	-	**3,304**
Uruguay	-	-	2,073	-	-	-	-	**2,073**
Peru	-	-	1,726	-	-	263	-	**1,989**
Ecuador	-	-	-	966	-	-	-	**966**
Venezuela	-	-	682	-	-	-	-	**682**
Paraguay	-	-	36	-	-	-	-	**36**
TOTAL	**23,689**	**5,328**	**7,746**	**966**	**39,349**	**3,417**	**237**	**80,732**
	29%	7%	10%	1%	49%	4%	0%	

Table 4-5. Rail infrastructure in South America by gauge (kilometers)
Source: CIA World Factbook 2008

Mexico's rail system is arguably the best in all of Latin America because of three compounding factors. First, it has one of the better networks in terms of coverage. Second, it uses standard gauge throughout the country. Third, it operates over international boundaries. Since the United States is exclusively standard gauge, Mexico has proven to be wise in its choice of rail development. Because of Central America's failures to use a constant gauge and to maintain their rail infrastructure, Mexico has absolutely no operating connection with Guatemala, its geographical conduit to the rest of Latin America. As such, Mexico's only rail operations are domestic or with the United States. In fact, Central America is so destitute of rail that it forms an almost insurmountable obstacle to hemispheric rail continuity. Mexico privatized its rail system in the late '90s[1] and saw steady growth in the tonnage of freight moved via rail from 2001 to 2005, from about 75 million to about 90 million.[2] This privatization encouraged private investment into the networks, but has also created some logistical complication, especially in the transfer of goods from company to company since the companies own specific routes. Mexico used to have a Central American connection through Ciudad Hidalgo into Guatemala. Since Guatemala uses a different gauge, the warehouse just across the Guatemalan border

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[1] Source: McManus 2008

[2] Source: Carranza Torres 2007

supported both gauges and transshipment had to occur. The line to Guatemala still exists but no longer operates after Hurricane Stan damaged it in 2005. The company in charge of that line could not find reconstruction support from the Mexican government and is therefore abandoning its Chiapas-Mayab concession.[1]

Guatemala's example illustrates the challenges of developing rail infrastructure in much of Central America.[2] As was common with most Central American countries, its rail system was built up during the early twentieth century but later fell into disrepair and was shut down entirely in 1996. Because of the country's political and financial instability, neither private entities nor IDBs were willing to invest in Guatemala except RDC, an American company that focused on developing countries.

Figure 4-7. Map of Guatemalan rail
Source: Metzger 2006

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[1] Source: Railway Gazette, "Central America" 2007

[2] Source: Thomas 2007

In 1997, RDC and some local partners were granted a 50 year concession as CODEFE, later to become Ferrovías Guatemala (FVG). In only ten years, however, despite increasing utilization and freight movement, Guatemalan rail was shut down once more. The Guatemalan government had refused to uphold its contractual obligations, thus causing financial and operational hardships for FVG, and Hurricane Stan had destroyed the only connecting rail to Mexico, which the Mexican government refused to help reconstruct. When FVG took its complaints to the Guatemalan government, the government repossessed the rolling stock which caused FVG to take its case to arbitration through DR-CAFTA.

Guatemala is a clear example of the unfriendly environment that private investments can find in Central America and is just the first in a long string of broken railway links throughout the region. Guatemala did have a line crossing into El Salvador and reaching San Salvador – even matching gauges – but that line is no longer operational. In fact none of El Salvador's over 550 kilometers of track have been in operation since 2005 due to a lack of maintenance;[1] the unused network, however, is extremely robust at over 26 meters of track per square kilometer (second to this is Uruguay with a distant 12 meters of track per square kilometer). Honduras's system only exists along the northern coast of the country, consists of 280 and 420 kilometers of 1.067 and 0.914 meter gauge tracks (respectively), never crosses any international borders, doesn't even approach Tegucigalpa (the country's capital and largest city), and is currently only partially operational. Nicaragua had almost 400 kilometers of rail at one point, but the country's rail industry and infrastructure has been collapsing for decades. Currently no rail companies operate in the country and only 6 kilometers of track still even exist. The same story continues in Costa Rica, where almost 300 kilometers of rail exist (all 1.067 meter gauge) but, according to the CIA, none are in use. Panama is only slightly better, with barely 20% of its 355 kilometers of rail in use. The other 80% is being dismantled and put to the construction of roads and bridges or have been stolen by looters.[2] The operating section, the Panama Canal

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[1] Source: CIA World Factbook 2008

[2] Source: Alicia Rivera 2003

Railway, is claimed to be the oldest transcontinental railroad in the world, running from Panama City on the Pacific, to Colón on the Atlantic.[1] First run by the United States, then the Panamanian government (1979-1998), it is now privately owned and operated. While the non-functioning sections were narrow gauge, the Panama Canal Railway was originally constructed as a broad gauge track but was reconstructed as standard gauge in 2000. The Darien Gap was mentioned for its lack of roads earlier, and this applies to rail as well – there is no infrastructure linking Panama and Colombia in any way. In summary, no rail operates over international borders in Central America (discounting the United States/Mexico border).

In some cases, South American rail resembles its Central American counterparts. In others, South American rail has become a relatively reliable mode of transport, much like in Mexico. The next figure presents the region's current situation pictorially. The area of each pie represents, proportionally, the total kilometers of track within that country, according to the 2007 CIA World Factbook. Not all of the represented rail is currently in operation, but this is not as epidemic a problem as seen in Central America so it was left on the map. It was also left on the map because many countries in South America have real plans to rebuild much of their inoperable tracks, though some do not. The pie slices indicate the share of each country's rail that is of a particular gauge. The area of each slice is also proportional to actual kilometer measurements.

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[1] Source: Panama Canal Railway Company 2005
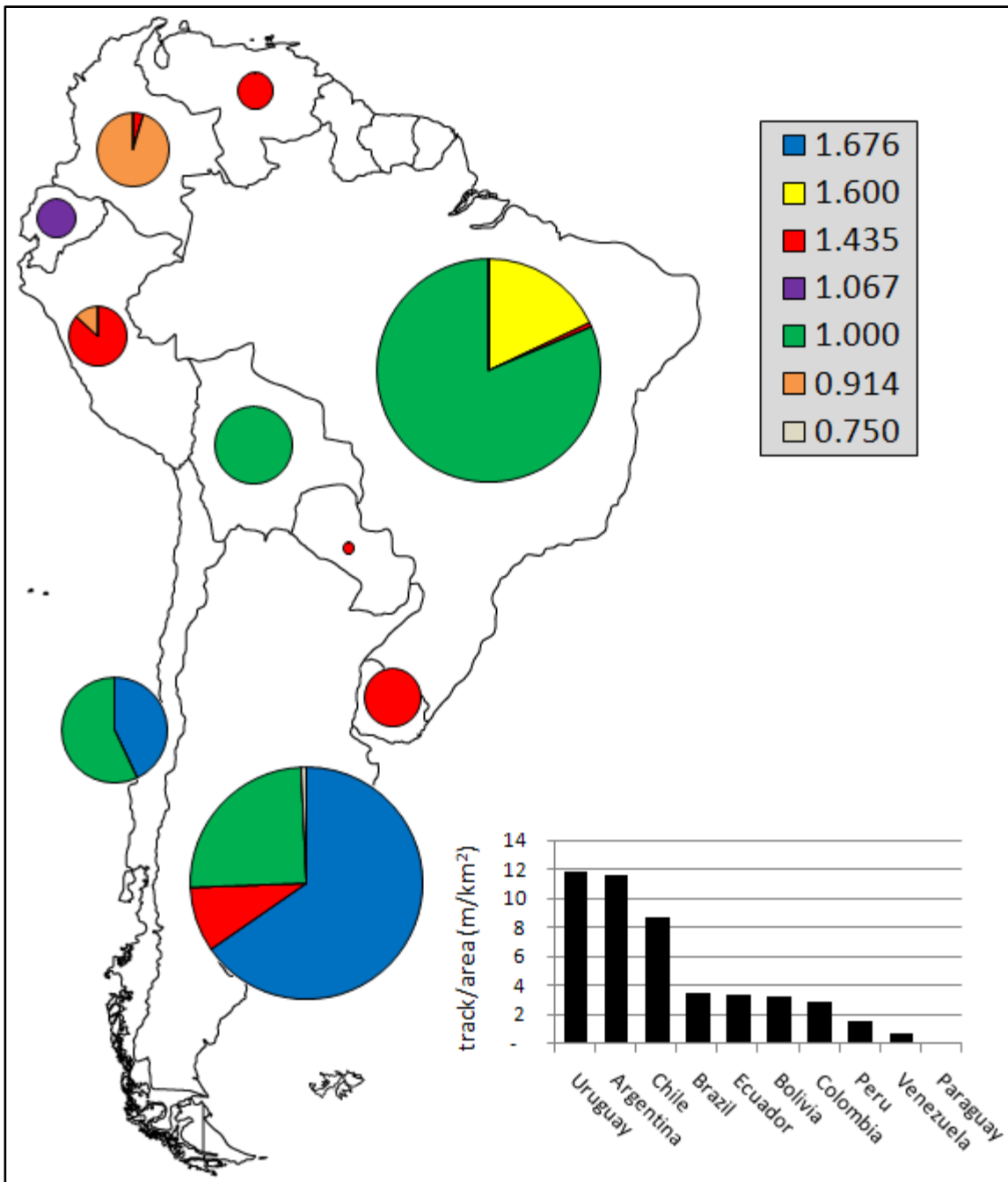
Figure 4-8. Map of South American rail prevalence and gauge-split
Source: CIA World Factbook 2008

First a short summary of each country's rail situation, and then we will speak a little more holistically of the continent. In Colombia, the standard gauge rail seen is a state-owned mine-to-port connection. The rest of the rail, all 0.914 gauge, connects many cities and ports throughout the country, yet is only half operational. Frequent

landslides are to blame for much of the inoperable lines.[1] Colombia is investing heavily in rail improvements and expansions, however.[2] Venezuela, with an unoperated connection with Colombia, currently has minimal rail lines, but is also investing heavily in expansion.[3] Ecuador's rail was originally a relatively decent network, connecting Quito and some of the southern region to two coastal ports, though there are no international connections and the gauge is entirely unique within South America. Through a lack of attention, landslides, and El Niños, the tracks have become largely unusable. Ecuador's government has with renovation, and has come up with attractive propositions that foreign investors are interested in, but has had trouble materializing the plans and funding.[4] Also, some portions of the rail carry steep grades through parts of the Andes[5], making freight even less viable. In Peru we begin to see more, better, and functioning railways. There are basically two unconnected networks in Peru. The northern network connects Callao on the coast to Lima, after which it eventually branches both north through more cities to the coal mines of Goyllarisquizga, and south to Huancavelica. Incidentally, the RDC, mentioned earlier in the Guatemala fiasco, is involved in the operation of these lines. The last section of the Huancavelica branch is currently being regauged from 0.914 to standard to match the rest of the line. The other micro-network connects the port city of Matarani to Arequipa, Cuzco, and across Lake Titicaca by ferry into Bolivia. This is all standard gauge except for the 0.914 meter portion extending past Cuzco utilizing switchbacks up and then down to Machu Picchu.

Bolivia brings us to our first of two landlocked countries in Latin America and of the entire Western Hemisphere. Since South American logistics is deeply reliant on ocean freight, being landlocked is an extraordinary disadvantage. We haven't found it necessary to mention the geopolitical territory changes that have taken place over

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[1] Source: Encyclopedia Britannica, "Colombia" 2007

[2] Source: Railway Gazette, "Colombia" 2007

[3] Source: Construction & Maintenance 2006

[4] Source: Sacco 2008

[5] As steep as 1 in 18, which means that the track rises 1 meter over the course of 18 meters. An incline of 1 in 100 is generally considered steep by rail standards and cuts feasible payloads in half.

the centuries, but one that is interesting to note is that Bolivia (and Peru) once owned coastland that is today Chile. It was lost to Chile during the War of the Pacific around 1880, yet to this day Bolivia maintains a navy in Lake Titicaca. As did much of the rest of Latin America, Bolivia privatized its rail in the 1990's. Like Peru, Bolivian rail is operated by two different companies: FCO (Ferroviaria Oriental) and FCA (Ferroviaria Andina). Both rail operations are cleanly described as operating in the southeast and southwest quadrants of the country.

Unlike nearly all Latin American countries already discussed, Bolivia has made a point of establishing and maintaining international rail connections, likely due to its landlocked position. Oriental Rail's network emanates from Santa Cruz in two branches, one eastward into Brazil and another southward into Argentina. The only non-operating portion of rail is a branch leading away from Bolivia's second city, Santa Cruz, northward towards Trinidad. A current project is underway to rehabilitate this section of rail and then continue on to finally connect with Trinidad. Andina Rail connects La Paz and many other major cities with Peru, Chile, and Argentina, with access to a couple north Chilean coastal ports. Bolivian rail is also blessed with complete gauge uniformity. Not only does this make all of their tracks networkable with much of Chile, Argentina, and Brazil, but also allows them to join their currently disconnected internal networks, making Bolivia one of the better connected Latin American countries in terms of rail. Once the systems are connected, it will create a fully connected railway from the Atlantic to the Pacific.

Paraguay, on the other hand, does not contend with the Andes or the Amazon, yet has only managed to keep 36 kilometers of rail operational serving an international crossing at its southeastern border with Argentina. Being landlocked with virtually no rail network and the lowest per capita GDP in South America, Paraguay is not an attractive offering to supply chain managers.

The remaining countries all have quite well-developed rail networks for Latin America. Chile, the healthiest and most open economy, Argentina, often considered the most industrialized country, and Brazil, the largest economy, support over two

dozen operating companies, with Uruguay using its central location to these countries to serve as an effective hub for the region (discussed more in the Waterways section). Chile's rail system incorporates numerous east-west branches from its expectedly north-south spine, often called the Longitudinal Railway, particularly the section south of Valparaiso. These excursions serve to connect the central rail artery with over a dozen ports, two Bolivian crossings, and one northern Argentinean crossing.

Chile uses narrow 1.000 meter gauge mostly in the north, compatible with Bolivia. A second Argentinean crossing, not operating and farther south than the first, near Santiago, is a narrow gauge rack rail to get through the Andes, meaning that each end has a break-of-gauge where it meets the 1.676 meter rail which is predominant in southern Chile and much of Argentina.[1] A third connection between the countries is being worked on farther south between Lonquimay, Chile and Zapala, Argentina.[2]

Argentina's rail network clearly uses Buenos Aires as its nexus, with Rosario, a distance farther up the Rio Paraná, as another central rail location. Argentinean rail also serves a number of other ports, the Chilean, Bolivian, and Paraguayan crossings we already mentioned, a crossing each to Brazil and Uruguay, and a vast interior network of cities almost entirely in Argentina's northern half. This northern region of Argentina is where the population and development concentrates, with particular rail density through a central belt of the country pushing west from its northern coast.[3] North of this central belt one finds mostly 1.000 gauge track, facilitating connection with Chile and Bolivia, but the majority of the network is made up of the broad 1.676 meter gauge track.[4] Argentina boasts the greatest amount of rail of any Latin American country and continues to invest in its network and rolling stock.[5]

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[1] Source: Se Construye 2006

[2] Source: Preston 2005

[3] Source: Sharp 2005

[4] Source: Railway Gazette, "Rail industry" 2007

[5] Source: International Railway Journal 2008

Uruguay also sports a well connected rail network mostly grown out of Montevideo, though track also leads from a few other port cities. The track spiders to Argentina and Brazil, though not always passing over the border. The drawbacks are that Uruguayan rail does not integrate well with most of the surrounding countries since it uses only standard gauge, and that some of the secondary branches and connections to the more minor port cities are no longer carrying freight.[1]

This brings us finally to Brazil. In terms of rail, Brazil resembles Argentina in the multitude of concessionaires, very similar total rail (both approximately 30,000 kilometers), and international connectivity. As previously mentioned, Brazil connects with its southern neighbors Bolivia, Argentina, and Uruguay, but none of the north Andean countries because of the Amazon. Brazil uses predominantly the narrow 1.000 meter gauge track, causing breaks-of-gauge in the Argentinean and Uruguayan connections. Bolivia, remember, uses all 1.000 meter track. The network expectedly concentrates around the coastal areas like the population – mostly in the southeast and northeast. A couple very long lines are currently planned and built into the depths of the Amazon, though not quite as far as any of the Andean countries. Brazil, like Mexico, has problems related to the number of rail companies operating in the country, stemming from regulations that do not encourage cooperation or collaboration.[2]

Latin America's scarcity and poor quality of roads and railways, as well as how disjointed the rail networks are, paints a bleak picture for Latin America's surface transportation. Up to this point, the discussion has been centered primarily on the coverage, availability, and connectivity of the networks. To put some context on the quality, we will use the detailed data behind The World Economic Forum's Global Competitiveness Index (GCI). Cognizant of the point-of-reference problem inherent in a survey-based comparison study such as the GCI, it is still one of the best and most comprehensive measures we have to measure something as difficult to quantify

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[1] Source: Líneas Férreas Uruguayas 2008

[2] Source: Fleury 2007

as infrastructural quality. Table 4-6 and Table 4-7 present the average answer given in each country by asking executives to rate their roads or rail from 1 to 7. Note that the worst one can do is 1, not 0. Orange countries are Central America/Mexico, green countries are South America, and blue countries are global benchmarks. The average score worldwide for road quality was 3.7, and for rail quality was 2.9. Notable on the road table is that while Latin America underperforms, its countries are across the full spectrum; Chile and El Salvador break the first quartile while Paraguay and Bolivia languish at the bottom. Central America also clearly has the superior roads to South America with a few exceptions. Concerning the rail quality results, at first glance it seems to be the opposite. But a closer look at the actual numbers reveals very little difference, only 0.7 points between 13 of the 17 Latin American countries. What the rail results really reveal is that in sweeping terms, Latin America's rail infrastructure is frighteningly poor. While Panama, Chile, Mexico, and Argentina try to separate themselves from the pack, we cannot ignore the fact that not a single country beats the global average and that almost two-thirds of Latin American countries find themselves in the bottom quartile.

GCI: Roads

Quartile	Country	Score	Rank
1st	Germany	6.6	4
1st	USA	6.2	8
1st	Chile	5.4	22
1st	El Salvador	5.0	31
2nd	Uruguay	4.1	49
2nd	Panama	4.0	52
2nd	China	3.9	53
2nd	Guatemala	3.8	56
2nd	Mexico	3.6	59
2nd	Honduras	3.5	62
3rd	Argentina	2.9	84
3rd	Ecuador	2.9	85
3rd	Venezuela	2.7	92
3rd	Colombia	2.6	94
3rd	Peru	2.6	95
4th	Nicaragua	2.5	102
4th	Russia	2.4	106
4th	Brazil	2.3	110
4th	Costa Rica	2.0	121
4th	Bolivia	1.9	125
4th	Paraguay	1.9	126

Table 4-6. GCI road quality rankings (mean 3.7)
Source: Sala-i-Martin, et al. 2007

GCI: Rail

Quartile	Country	Score	Rank
1st	Germany	6.4	4
1st	USA	5.2	14
1st	Russia	4.1	29
2nd	China	3.9	38
2nd	Panama	2.6	63
3rd	Chile	2.5	66
3rd	Mexico	2.2	74
3rd	Argentina	2.1	78
3rd	Brazil	1.7	91
3rd	Peru	1.7	93
4th	Uruguay	1.6	99
4th	Bolivia	1.5	102
4th	Venezuela	1.4	113
4th	Honduras	1.4	114
4th	Costa Rica	1.4	115
4th	El Salvador	1.4	117
4th	Colombia	1.4	118
4th	Guatemala	1.3	120
4th	Ecuador	1.1	127
4th	Nicaragua	1.1	129
4th	Paraguay	1.0	130

Table 4-7. GCI rail quality rankings (mean 2.9)
Source: Sala-i-Martin, et al. 2007

These results are particularly distressing for Bolivia and Paraguay, who need to have efficient surface transportation to offset the disadvantages they face in being landlocked. Landlocked countries contend with extra costs when importing and exporting goods beyond their neighbors since they must use other countries' ports and must always cross through at least one other country, potentially resulting in extra tariffs, bureaucracy, and customs delays. These disadvantages tend to manifest in lower levels of economic development which make it more difficult to invest in infrastructure, and the cycle feeds itself. Fortunately for Bolivia, it has a respectable amount of operational track in place, although the quality is very poor. Paraguay cannot claim even that much.

4.3   WATERWAYS AND SEAPORTS

Waterways in Latin America consist of ports and rivers. The unreliability and lack of surface transport connectivity options also hampers the effectiveness of Latin American ports. Like the railroads, the region began promoting privatization of its ports en masse during the 1990s. Many sources note the drastic productivity increases obtained from this over the past decade. Examples are Brazil's increase from approximately 12 containers per terminal per hour in 1995 to 38 just eight years later[1], and Colombia's 16 containers per vessel per hour pre-1993 to 25 in only four years.[2] In addition, the abundance of rivers, or inland waterways, is an immense asset to the region, potentially offsetting some of the surface transport problems. This section also discusses the Panama Canal and its importance to both the region and the world.

The CIA World Factbook coverage of ports is noticeably barren. The most comprehensive source I found for international water infrastructure is the World Port Source website (WPS) run by Mark Waters. The site provides a long list of ports in each country and provides a category, size, and satellite image for each, as well as contact information and statistics when available. While Waters admits to the unavoidable subjectivity in some of the categorizations and size assessments, it still gives a sufficient barometer for a cursory regional overview and comparison. For instance, some decisions fall into shades of grey when trying to determine if a port is a "large river port" or a "medium seaport" that happens to be just inside the mouth of a major river. By focusing on types of infrastructure important to supply chain managers, we will consider only the river ports, seaports, and deepwater seaports as determined by the World Port Source. In some cases, harbors could be feasible cargo destinations, but this is where the categorization begins to grey so we are not considering them. Before we look at Latin American countries, let us first compare the entire region to the contiguous United States. Ignoring river ports for just a

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[1] Source: Fleury 2007

[2] Source: Gaviria 1998

moment, Figure 4-9 compares their different types of seaport infrastructure. Latin America clearly lags the United States by a simple quantitative comparison because of its lack of large and very large ports, but realizes a disparity arguably less pronounced than what we saw with roads (10:1 paved, 11:5 total) and rail (9:4 including inoperable lines). Latin America has nothing comparable in size to the ports of Houston (a very large seaport), Long Beach (a very large deepwater seaport), or the other eleven very large ports in the continental United States. Nonetheless, the region's ports look much better than do its rail systems, with some countries sporting world-class ports.
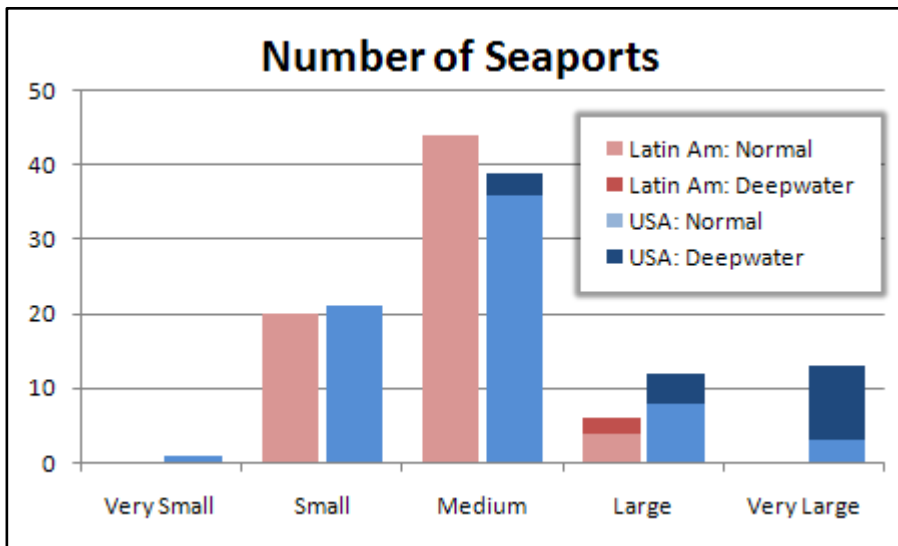
Figure 4-9. Number of Seaports: Latin America vs. USA
Source: Waters n.d.

In addition to quantity, we must consider the quality of infrastructure at the ports. Just as any other modal infrastructure, capacity is a function of both quantity and quality. Unlike roads and rail, which are the creation of right-of-ways and network arcs, ports (and to a lesser degree, airports) are intermodal hubs and network nodes. Whereas road and rail infrastructure quality contribute to determining the speed and payload of transiting goods, port infrastructure quality impacts the speed and capacity of transferring goods. There is an inherent intermodalism to port operations and this is a large part of the infrastructure needs. Port infrastructure encompasses the technology and machinery needed to guide the ships to/from dock (tugboats),

unload cargo (gantry cranes, Portainers, etc.), process customs, and transfer these containers or bulk goods to trucks, trains, and warehouses (forklifts, sideloaders, etc.). Quality will be discussed at the national level.

Mexico is in a great position logistically speaking because it can easily be considered a geographical center for Asia, the United States, Europe, and South America. Adding to its hub potential is the generally short distance between its Atlantic and Pacific ports, which Mexico has invested in considerably, realizing its potential and the integral nature of an efficient port system, coupled with its tolerable surface transport environment. According to WPS, Mexico has 1 in 5 of Latin America's seaports (13) and 1 in 8 of its harbors (7). Central America has much the same potential that Mexico does with such a central location and short expanses between the two oceans. As we already know, however, the rail and roads of the countries are grossly insufficient for concentrated international use (excepting maybe Panama). Looking at their ports, Honduras's largest port facility is a single small seaport and both Guatemala and Nicaragua have only a single medium harbor; Nicaragua's has but one crane. El Salvador has a medium seaport, but of course only accesses the Pacific coast, meaning that through-cargo would have the added complexity of crossing more international borders. Costa Rica and Panama, on the other hand, each support medium seaports on both coasts. Figure 4-10 maps out all of the larger Latin American ports.

Figure 4-10. Map of medium and larger harbors, river ports, & seaports of Latin America
Source: Waters n.d.

The quality picture looks a little different, however. According to the GCI, Panama has world-class port facilities[1] followed by Honduras. Costa Rica squanders its geographical advantage by providing the worst ports of all of Latin America and ranking 100 out of 103 countries[2].

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[1] Not surprising because of United States investments and long-standing presence in the Panama Canal.

[2] The GCI ranks 131 countries but I have re-ranked the list by removing the landlocked countries.

Quartile	GCI: Ports Country	Score	Adj Rank
1st	Germany	6.5	4
	USA	5.8	11
	Panama	5.7	15
2nd	Chile	4.8	31
	Honduras	4.7	37
	Uruguay	4.3	46
3rd	China	4.0	55
	Russia	3.7	58
	Guatemala	3.7	59
	El Salvador	3.5	66
	Mexico	3.3	73
	Argentina	3.2	76
4th	Ecuador	2.8	83
	Colombia	2.7	85
	Brazil	2.6	93
	Venezuela	2.6	94
	Peru	2.4	98
	Nicaragua	2.3	99
	Costa Rica	2.2	100
n/a	Bolivia	--	
	Paraguay	--	

Table 4-8. GCI port quality rankings (mean 4.0)
Source: Sala-i-Martin, et al. 2007

In South America, Colombia is the only country to enjoy highly advantageous exposure to both oceans since it straddles Panama. (Technically speaking, Chile touches both oceans as well, but not in any practical way.) Unfortunately, Colombia has only five seaports, river ports, and harbors combined. The rest of South America's Pacific coast houses 12 seaports, 5 river ports, and 10 harbors – the large majority of which are predictably in Chile which has embraced and promoted international trade more so than any other country of the continent. The Atlantic coast is much better developed with Argentina and Brazil providing expected capacity, but Venezuela contributing perhaps surprisingly to the level of port infrastructure. The Pacific coast (excepting already mentioned Colombia) has 2 deepwater seaports, 31 normal seaports, 33 river ports, and 25 harbors. Brazil and Venezuela generally dominate about equally in number of seaports, though Brazil's are larger. Argentina does however own the only two deepwater seaports of Latin America recorded by WPS. Argentina has a large number of river ports (20 of the coast's 33) because of the prominence of the Rio de la Plata and Paraná River in relation to its populated areas. Referring back to the earlier GCI table, one sees that Chile and Uruguay both have developed and maintained their ports better than the

international average, and far better than any other South American country. This follows the same pattern we saw with road quality and speaks to Chile's decision to promote an attractive investment atmosphere and to Uruguay's efforts to establish Montevideo as a hub to MERCOSUR.

Figure 4-11. Map of Argentinean cities with populations over 500,000
Source: Brinkhoff 2007

Figure 4-12 presents the quality of each country's infrastructure discussed thus far. We can see by inspection a reasonable correlation between the different modes. Panama provides the best ports and rail of Latin America and Chile makes up for in roads what little it lacks elsewhere. Paraguay's situation appears almost hopeless unless it can find a way to attract significant investments in its infrastructure.
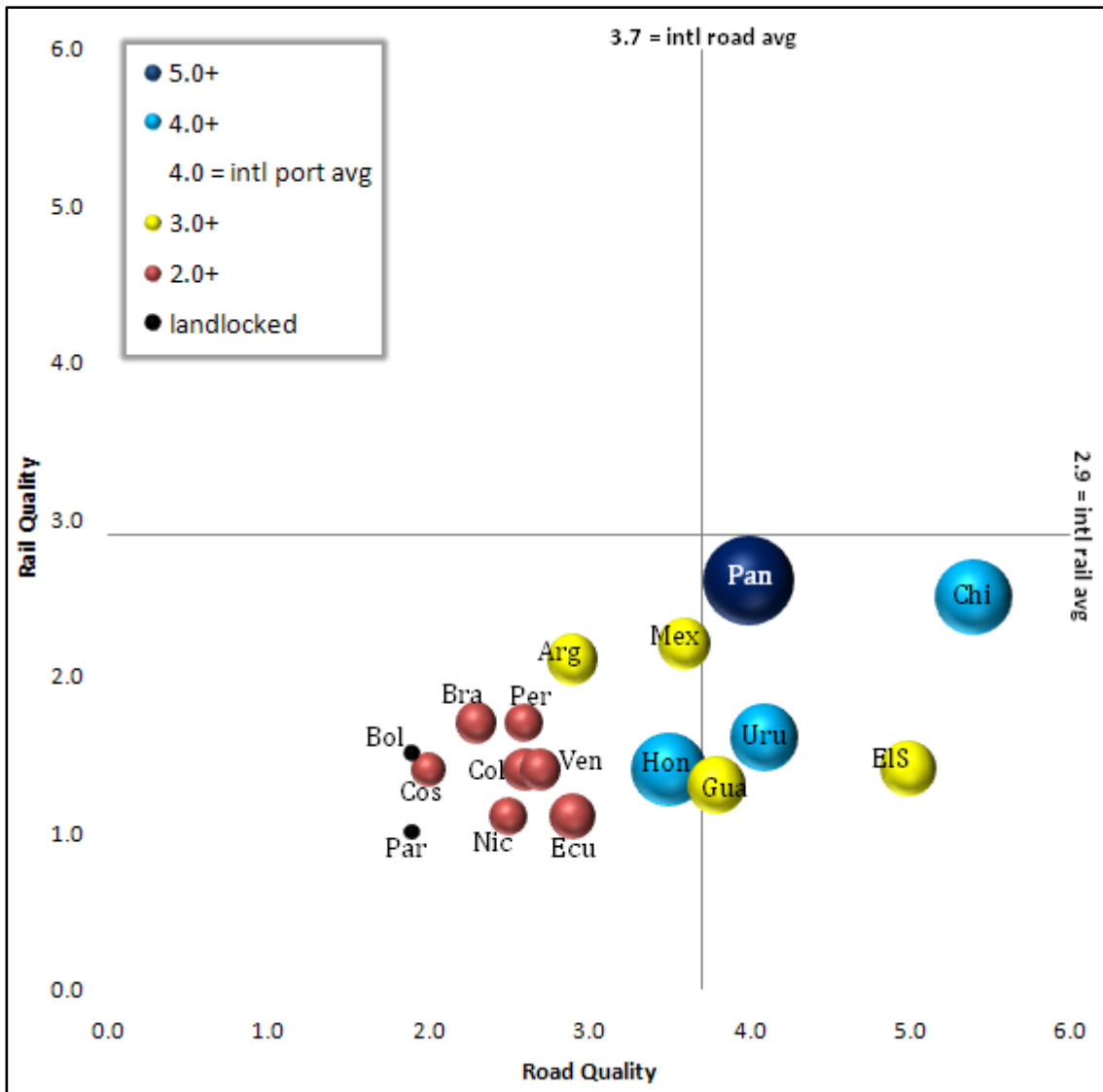
Figure 4-12. Three-dimensional road, rail, & port quality comparison
Source: Sala-i-Martin, et al. 2007

Latin America's geography is a hindrance in many ways. It turns out to be a blessing for many countries, however, in terms of inland waterways. While these are generally not suitable for ocean-going vessels, they have the potential to shoulder a significant portion of domestic freight or to connect international trade to and from the seaports with more inland parts of the region. Not every country has an intricate navigable river network, but five of the world's fifteen countries with the most kilometers of river are in South America with Brazil in third and Colombia in sixth. Calculating the river densities of countries in Latin America reveals that Nicaragua, Colombia, Costa Rica, El Salvador, and Panama are very rich in navigable inland

waterways. Colombia, in particular, has an extraordinary resource in this because of its size. The WPS does not have any river ports listed for Colombia, though. Hopefully there are some that have not yet been recorded there, but otherwise Colombia has an extraordinary unrealized potential. Brazil also highly underutilizes its vast waterway resources. It is estimated that Brazil utilizes only 60% of its navigable rivers, which have the unique benefit of curling deep into the Amazon. This characteristic is also part of the reason that its rivers see less traffic; there is less economic activity in the Amazon. Regardless, only 1% of cargo in Brazil moves via inland waterways, also showing unrealized potential.[1]
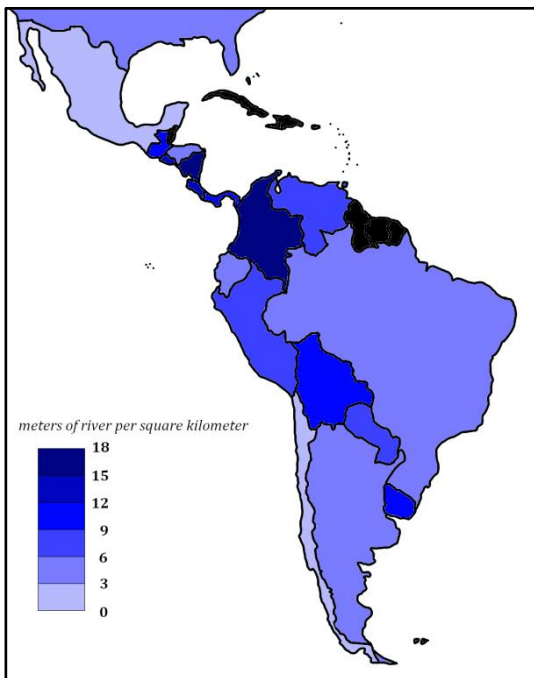
Figure 4-13. Map of river density in Latin America (meters of navigable riverway per km²)
Source: CIA World Factbook 2008

4.4   THE PANAMA CANAL

Panama is home to one of, if not the, largest and most difficult engineering projects in the world. After others' failed attempts, Theodore Roosevelt and the United States

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[1] Source: Fleury 2007

were able to successfully build it, and it opened in 1914. The French lost over 20,000 men trying to build it, and the United States then lost an additional 5600, mostly to disease and landslides. Land rights, construction, and fortification cost the United States only $387 million at the time – $8.0 billion in 2007 dollars, notably under budget and ahead of schedule. So while technically the Panama Canal is a waterway and belongs in the previous section, it is singularly significant and interesting enough to warrant its own section.

The canal is about 80 km long and takes nine hours to travel (not counting queue and lock times). It was not possible to build it at sea level, therefore necessitating a pair of locks at both ends – the Pedro Miguel Locks on the Pacific side and the Gatun Locks on the Atlantic – and a massive dam. The canal has a capacity of about 40 ships per day, mostly all large commercial traffic.[1]

The Panama Canal is a boon to Latin America, as well as the entire international shipping community. But while it is true that it presents supply improvements when compared to the 19th century, many challenges related to the canal are increasingly coming to the forefront. As previously stated, the canal is running at capacity. This frequently results in daunting queues of as many as 100 ships at either entrance – a two-and-a-half day wait.[2] The canal is not only being used to capacity, but that capacity is actually being threatened by the clearing of the Central American rainforests. For environmental reasons that we need not go into, the reduction of the Central American rainforests is making it more challenging to maintain the water levels necessary to operate the canal and resulting in silt deposits along its bottom.[3] Of Latin American countries, Chile relies most heavily on the Panama Canal (excepting obviously Panama). President Lagos of Chile noted in 2006 that half of all Chilean imports and exports utilize the canal. In fact, Chile considers the canal so vital to their economy that they signed on with the United States and Panama in 2003

[1] Source: US Bureau of Transportation Statistics 1999

[2] Source: Gumbel 2007

[3] Source: Dean 2006

to use their military to help protect the canal from terrorism.[1] But while the canal is essential to Latin America, its three largest users are the United States, China, and Japan, in that order.[2] (Chile is the fourth.) Due to the very nature of increased globalization and the double digit growth of China and many Latin American countries, it is obvious that the canal will only experience more and more demand, further establishing its position as a bottleneck of international trade.
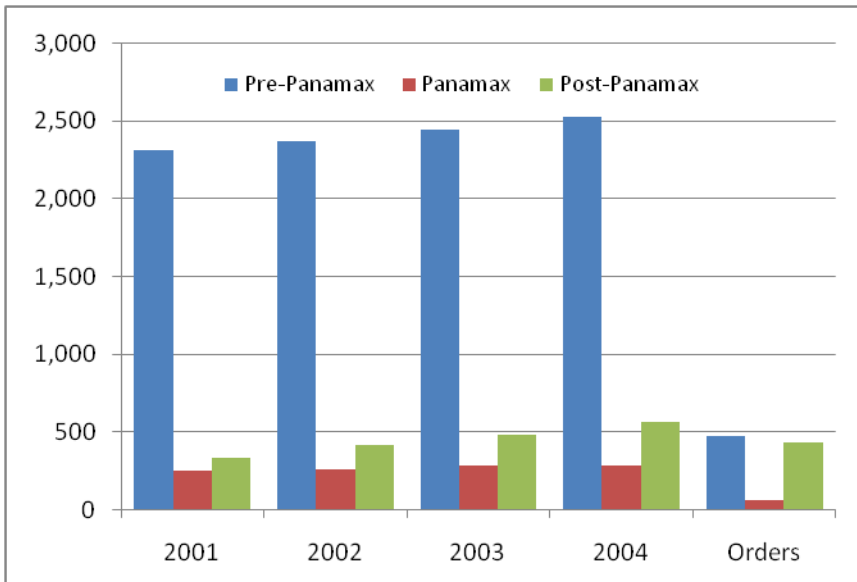
Figure 4-14. World containership fleet by vessel type
Source: US Maritime Administration 2005

The canal's costs are also of concern. The fee for passage through the canal is not always a simple calculation. For container ships the fee is simpler, but for other large commercial ships it is much more complicated. Table 4-9 presents costs for container ships over the three year period starting in 2007. Where goods being sold in markets such as the United States or Japan might better be able to absorb the shipping cost increases seen in the table, goods being made and sold in less developed economies (i.e. Latin American intraregional trade) will inevitably feel these fee increases much more and challenge the viability of many more products. The costs listed above, however, refer to the fee charged by the Panama Canal Authority. There are also

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[1] Source: Cohen 2003

[2] Source: Chilean government 2006

costs associated with the growing queue times that add an additional $50,000 of cost per ship.[1]

	Cost per 20ft container (US$)	Annual increase (%)	Cost for a full Panamax vessel (US$)
2007	54		243,000
2008	63	17%	283,500
2009	72	14%	324,000

Table 4-9. Panama Canal fees for 2007-2009
Source: Panama Canal Authority 2007
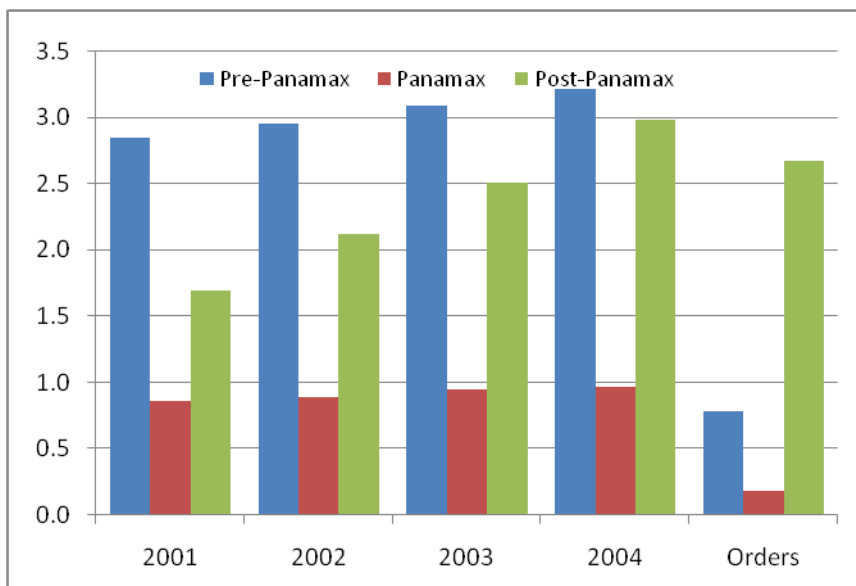
Figure 4-15. Annual global TEU's carried by vessel type (in millions)
Source: US Maritime Administration 2005

Issues surrounding the Panama Canal continue when we look at the world's merchant fleets. The Panama Canal can accommodate ships up to a certain size. The largest ships able to navigate the Panama Canal are called Panamax ships, able to carry about 4500 TEUs (twenty-foot equivalent units, or containers). These ships are made to the specifications of the canal and require extra attention and time and special routing and conditions. In recent times, however, shipbuilding technology has enabled, and ever increasing global trade has encouraged, the construction of ever larger ships. They are now produced so large that they cannot fit in the Panama

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[1] Source: Gumbel 2007

Canal's locks and are too deep for parts of the canal. These are called post-Panamax ships and can carry as much as 12,000 TEUs. As of 2004, 17% of the world's containership fleet were post-Panamax ships, representing 42% of available worldwide capacity. This was up sharply from the respective 11% and 31% seen only three years before. Panamax ships, on the other hand, saw declines over that period. Nearly half of all ships on order at that time were post-Panamax ships.[1]

In an attempt to address the capacity and post-Panamax issues, the Panama Canal Authority just started a $5.3 billion expansion project that received overwhelming public support in a national referendum. It will add a third, larger set of locks, dredge more of the canal, and raise the water level, scheduled to complete by 2015.

4.5 AIRPORTS

The final mode to consider is air. Generally, ocean freight is the cheapest means by which to ship goods, followed by rail and then truck. Trucking is often less expensive in Latin America than in more-developed countries because of Latin America's lack of regulations. As we all know, air transport is the fastest and most expensive. Considering the overall road, rail, and port conditions and capacities, the sheer size of Latin America, and the geological obstacles of the Amazon and Andes Mountains, air transportation can look increasingly attractive. Air freight does not have the same appeal in Central America as it does in South America, however, particularly for regional trade, because of Central America's far easier access to both oceans. As an example, when shipping to Lima, Peru from Caracas, Venezuela (a straight-line distance of 2750 km), air transport is far more attractive than it would be from Guatemala City (a straight-line distance of 3320 km). To move goods between Lima and Caracas by surface transport requires an arcing route around the Amazon, alongside and through the towering Andes Mountains, over very poor Peruvian roads, and across three international borders. To achieve the same purpose by sea

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[1] Source: United States Maritime Administration 2005

requires a long wait and costly fee for using the Panama Canal. Air transport is much closer to point-to-point travel (depending on air routes) and avoids many of these problems in much less time, though at greater cost. To move the same goods from Guatemala City to Lima, ocean transport is much more competitive because Guatemala can access the Pacific Ocean directly and has a more direct route to Lima. The scenario can be reversed as well, with Caracas as the final destination and comparing the routes from Lima and Guatemala City. Guatemala City has relatively easy access to the Atlantic Ocean as well, again leading to the conclusion that air transportation is more competitive in South America. It is interesting to compare the distances too. We mentioned above how Caracas is approximately 600 kilometers closer to Lima as-the-crow-flies than is Guatemala City. Considering the arcing route that a sea vessel would have to travel from Caracas, the effective distance to Lima increases by about 1500 kilometers, now making Guatemala City closer by approximately 900 kilometers. Assuming that the ships travel at an average of 12 knots, adding a two-day queue at the Panama Canal and, all other things being equal, getting to Lima will take a ship about 6.5 days from Guatemala City, but 10 days and extra costs from Caracas. Compare this to a third party logistics provider's (3PL) lower-level air service quote of 3-5 days and one can see how Latin American geography, geology, and policy can have a significant impact on modal choice. It is unlikely that many other regions have as nuanced a logistics environment as does Latin America.
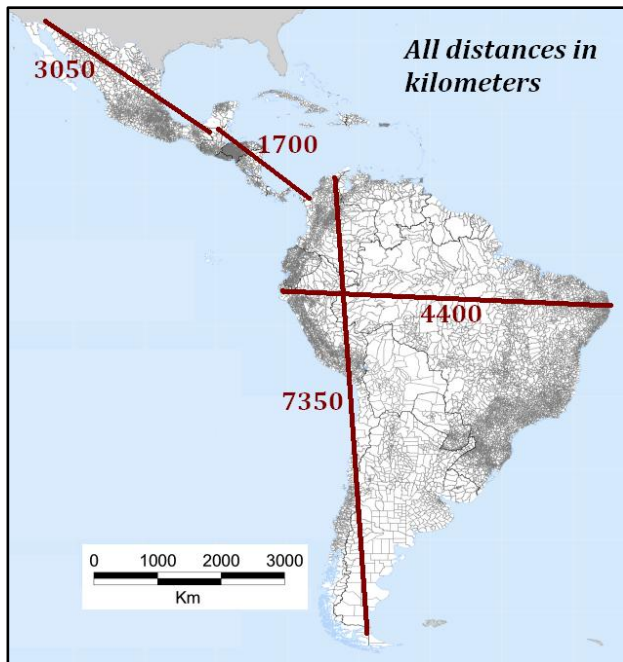
Figure 4-16. Map of extreme distances across Latin America
Source: CIAT 2005; Geobytes 2006

The most readily available data is from the CIA World Factbook which is much more informative on airports than it was for ports. There we find the number of airports for each country broken down into airports with paved or unpaved runways, and further categorized by how long each airport's longest runway is (greater than 10000 feet, 8000 feet, 5000 feet, 3000 feet, or less than 3000 feet). The length of a runway determines, in the simplest terms, the size of the aircraft that can use it. More precise aircraft considerations are the lift/drag devices and the weight of the plane, payload, and fuel. Other runway factors that determine what planes may potentially use it are slope, surfacing, nearby obstacles, and elevation. This paper is concerned with freight transportation, which easily lends itself to larger planes because of the cost of using air and ability for surface transport to satisfy smaller regional needs. Thus a focus on freight encourages us to focus on the availability of longer runways. This is reinforced by the extreme elevations in Latin America. Neufville and Odoni state in their book that "runway length should be increased [beyond "basic length"] by 7 percent for each 300 meters of airport elevation. Such approximations, however, are valid only as long as the total correction does not exceed about 35 percent of basic length." Neufville and Odoni also provide some rough interpretations of the

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usefulness of various runway lengths; a 7500 foot runway accommodates practically all 3000 kilometers flights in normal climate at sea level. Referring back to the section in which we discussed elevation, we know that many highly populated Latin American cities are many hundreds of meters above sea level, meaning that they will need to have even longer runways. Also considering the size of the region and population concentrations set almost exclusively along the coastlines, we can easily see that many flights will be far more than 3000 kilometers. To relate this to Latin America, refer to the example we just described with Lima and also to Figure 4-16. For some additional context in terms of elevation, we look at the specification charts of the very large Boeing 747-400. Maximum takeoff weight (MTOW) for the plane is almost 400,000 kilograms. At a weight of only 350,000 kilograms, on a standard day at sea level with no wind or runway slope, this plane would need a runway no shorter than 8000 feet to take off. At São Paulo (640 meter elevation), it will need almost 9000 feet of runway.[1] In Bogotá (2500 meter elevation), the same plane requires almost 13,000 feet of runway and a city as high as La Paz at 4000 meters is not even addressed on the specification chart. Consider the addition of less than perfect weather or runway gradients (which can have opposite effects depending on the direction of the slope). Bringing all of this together by using the CIA collection of Latin American airports, we narrow our consideration to the more logistics-friendly airports with at least one paved runway of 8000 feet or longer.

In total airports (all surfaces, all lengths), Latin America is much more similar to the United States than we saw with roads, rail, or seaports. However, comparing airports with paved 8000+ foot runways presents a more-than 2-to-1 ratio in favor of the United States. Each country with some international comparators is displayed in Table 4-10, Table 4-11, and Table 4-12. Each table is ordered by population per paved 8,000+ foot airport, least to most, which gives an impression of how much infrastructure is available by relating how many people, on average, each airport must serve.

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[1] Source: Boeing 2002

	unpaved airports					
	under 3,000 ft	3,000-5,000 ft	5,000-8,000 ft	8,000-10,000 ft	over 10,000 ft	total unpaved
Russia	484	89	69	13	4	659
USA	7912	1732	153	7	0	9804
Peru	117	40	24	2	0	183
Bolivia	800	183	57	4	1	1045
Germany	181	34	3	1	0	219
Chile	216	49	12	2	0	279
Argentina	556	515	44	1	2	1118
Panama	50	11	1	0	0	62
Venezuela	149	97	15	1	0	262
Nicaragua	135	16	1	0	0	152
Ecuador	268	34	0	0	0	302
Costa Rica	96	19	0	0	0	115
Paraguay	532	267	26	0	0	825
Honduras	83	15	2	0	0	100
Mexico	1131	408	63	0	1	1603
Uruguay	29	19	3	0	0	51
Guatemala	301	82	6	1	0	390
Colombia	580	216	34	0	1	831
Brazil	1907	1555	83	0	0	3545
El Salvador	48	12	1	0	0	61
China	26	17	13	4	4	64
India	47	40	7	1	1	96

Table 4-10. Unpaved airports in Latin America
Source: CIA World Factbook 2008

	paved airports						
	under 3,000 ft	3,000-5,000 ft	5,000-8,000 ft	8,000-10,000 ft	over 10,000 ft	total paved	TOTAL airports
Russia	122	102	129	197	51	601	1260
USA	953	2323	1452	224	191	5143	14947
Peru	3	11	14	20	6	54	237
Bolivia	0	3	5	4	4	16	1061
Germany	135	72	58	52	14	331	550
Chile	19	25	22	8	5	79	358
Argentina	9	50	65	26	4	154	1272
Panama	29	18	5	1	1	54	116
Venezuela	18	61	34	10	5	128	390
Nicaragua	3	3	2	3	0	11	163
Ecuador	54	26	17	3	4	104	406
Costa Rica	11	21	2	2	0	36	151
Paraguay	5	0	5	0	3	13	838
Honduras	3	4	2	3	0	12	112
Mexico	29	77	84	29	12	231	1834
Uruguay	2	2	4	0	1	9	60
Guatemala	3	4	2	3	0	12	402
Colombia	12	42	39	8	2	103	934
Brazil	52	467	167	25	7	718	4263
El Salvador	0	2	1	0	1	4	65
China	67	20	130	128	58	403	467
India	21	84	75	52	18	250	346

Table 4-11. Paved airports in Latin America
Source: CIA World Factbook 2008

	total paved over 8,000 ft	... per paved airport over 8,000 ft		
		Area (km^2) ...	Population (in thousands) ...	GDP-PPP (in billions) ...	GDP-PPP (per capita) ...
Russia	248	68,852	570	8.37	59
USA	415	23,679	726	33.40	111
Peru	26	49,432	1,103	8.37	292
Bolivia	8	137,323	1,140	4.97	550
Germany	66	5,409	1,248	42.92	521
Chile	13	58,227	1,253	18.03	1,108
Argentina	30	92,230	1,343	17.46	433
Panama	2	39,100	1,621	14.57	4,500
Venezuela	15	60,803	1,735	22.33	853
Nicaragua	3	43,165	1,892	6.06	1,067
Ecuador	7	40,509	1,965	14.04	1,014
Costa Rica	2	25,550	2,067	27.98	6,750
Paraguay	3	135,583	2,223	8.85	1,333
Honduras	3	37,363	2,495	8.23	1,100
Mexico	41	48,111	2,651	33.00	305
Uruguay	1	176,220	3,461	37.05	10,700
Guatemala	3	36,297	4,243	22.48	1,800
Colombia	10	113,891	4,438	32.04	720
Brazil	32	265,999	5,938	57.44	303
El Salvador	1	21,040	6,948	35.97	5,200
China	186	51,597	7,107	37.87	28
India	70	46,966	16,141	42.36	39

Table 4-12. Normalized airport statistics for Latin America
Source: CIA World Factbook 2008

Peru and Bolivia are seen to have disproportionate numbers of runways over 8000 and 10000 feet, an apparent testament to their extreme elevations throughout the countries. Chile, as usual, has some of the most infrastructure in place (proportionally speaking) in Latin America, followed by the generally well-developed Argentina. There is also no discernable difference between Central and South America, as indicated by the almost perfectly alternating green and orange down the tables. The laggards of this metric are Colombia, which is somewhat surprising given some of the elevations in the country; Brazil, for whom air transport is highly attractive for international trade because of how the Amazon isolates its coastal region; and El Salvador, which is easily explained by its extreme density and the fact that we are counting airports and not runways. (This can partially explain Brazil as well because it has some of the denser urban areas of Latin America.) To demonstrate how important air transportation has become to Brazilian supply chains, 68% of foreign trade through major exporting companies is via air.[1]

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[1] Source: Fleury 2007

Moving on to the quality of these airports, the GCI forces us to make a compromise. The survey question covering air is specifically targeting passenger transportation and incorporates frequency, which is not necessarily a direct substitute for airport quality as concerns logistics engineers. It is presented below much like the other modes have been, though it should be considered with the above qualification in mind. We will assume for now that relatively similar results would come from a more logistics-oriented survey, as they very well could. As usual, Chile and Panama overperform the region and Paraguay languishes with some of the worst infrastructure in the world. In general, Latin America's airports seem to be one of its better infrastructure features with much of the third quartile pressing in on the upper half. Panama and Mexico both make a play for top billing and inclusion in the first quartile and this is the only mode in which a majority of Latin American countries perform better than China.

Airports

Quartile	Country	Score	Rank
1st	Germany	6.7	3
	USA	6.3	9
	Chile	5.7	31
2nd	El Salvador	5.6	34
	Panama	5.4	38
	Mexico	4.8	60
	Colombia	4.7	62
	Costa Rica	4.6	66
3rd	Guatemala	4.5	67
	Honduras	4.5	69
	Ecuador	4.3	76
	Russia	4.2	79
	Nicaragua	4.1	80
	China	4.1	86
	Brazil	4.0	87
	Venezuela	3.8	93
	Peru	3.7	98
4th	Uruguay	3.3	110
	Argentina	3.2	113
	Bolivia	3.1	118
	Paraguay	2.6	129

Table 4-13. GCI airport quality rankings (mean 4.6)
Source: Sala-i-Martin, et al. 2007

5 CONCLUSION

We have now laid the foundation for a greater contextual understanding of Latin American transportation logistics. This chapter applies a holistic analysis to the information in the previous chapters to explore potential network configurations that can best serve Latin America for various types of products. We then briefly summarize this paper and discuss some related future research possibilities. Since companies often underestimate the costs, requirements, and nuances of entering and operating in new international markets, this chapter can help to shed light on at least the transportation aspect of operating in Latin America.

5.1   RESULTING NETWORK IMPLICATIONS

To address the network implications of what we've learned, we first briefly discuss differentiating products based on product value density (PVD). Third-party logistics providers adjust pricing levels according to weight-to-volume ratios, but product viability and the way a supply must be built to support products is contingent on the PVD and it is imperative that businesses know and apply this characteristic. Higher value density products (which can be measured as either value-to-weight or value-to-volume) can more feasibly utilize more expensive, and thus generally faster, transportation. Lower value density products therefore must use less expensive (slower) transportation in order to remain profitable product offerings.[1]

Also necessary to consider is the attractiveness of infrastructure investment within each country. In previous chapters we presented many of the considerations that would affect such attractiveness. Aggregating such information into a regional ranking is the World Economic Forum's IPIAI report. It considers the following eight factors in its scoring and draws from various sources, surveys, and statistics to create this metric.

- Macro environment
- Legal framework
- Political risk
- Access to information
- Financial market enablers
- Track record
- Government and society
- Government readiness for private investment

As with any dimensionless index, due to the arbitrary nature of its mathematical construction and chosen comparators, it should be considered a rough estimation and a first approximation for a general and basic regional understanding.

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[1] Source: Lovell, Saw, and Stimson 2005

Unfortunately, it only covers about two-thirds of the Latin American countries and is especially light on Central America. The results of the overall attractiveness score are presented in **Error! Reference source not found.**1. We will consider the results of this index in our determination of network implications. Concerning the unscored countries, we will assume that Panama and Costa Rica are relatively attractive because of Panama's historical pro-trade positions and ties to the United States and Costa Rica's popular FTZ. We assume Nicaragua and Ecuador to be very unattractive because of their political alignment with clear IPIAI laggards Venezuela and Bolivia. Paraguay and Honduras are assumed to be average.
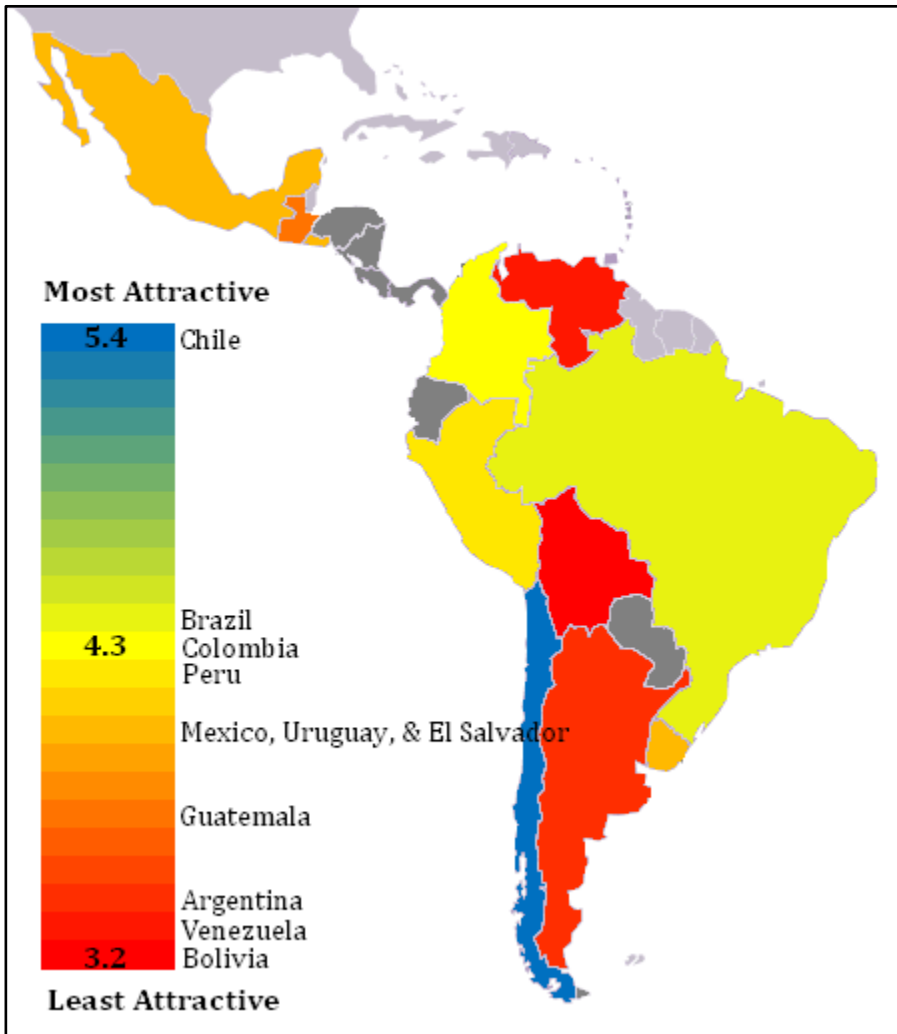

Figure 5-1. Map of infrastructure investment attractiveness in Latin America
Source: Mia, Estrada, and Geiger 2007

5.1.1 HIGH PVD – AIR

High PVD products are those with high values and low mass or volume, such as micro processors and electronics. These characteristics make air freight a feasible transportation option. Furthering their association with air freight is the fact that they also tend to be more fragile products with shorter life-cycles and require fast supply chain responses due to difficult forecasting circumstances and a demanding customer demographic. Air best meets these needs. Air transportation also enjoys the advantage of bypassing physical barriers such as the Andes and the Amazon, and administrative barriers such as numerous international crossings, simplifying hub selection.

To serve Latin America with high PVD products from a single warehouse/regional hub, the logical choices for most companies are:

- Mexico
- Colombia/Panama/Costa Rica
- Chile
- Miami, USA

If product is manufactured in Asia and brought in by sea, then Mexico has the proximity and port system to facilitate this efficiently. Product manufactured in the United States can easily be brought into a Mexican warehouse by any mode desired. European sources will also find Mexico easily accessible compared to Chile or Colombia. On the downside, Mexico is far removed from South America – especially the main population centers of Brazil, Chile, and Argentina.

Another option is somewhere in Colombia, Panama, or Costa Rica. These countries are also easily accessed from across the Atlantic. Products coming from Asia by sea have fewer Colombian port options than would be expected, but Panama offers the best ports of the region. Ocean freight from Asia is increasingly using Post-Panamax ships, so the Panama Canal is not yet a consistently available option. Goods originating in the United States no longer have the surface transport options

available that they had in Mexico. Colombia, Panama, and Costa Rica, however, are much more centrally located than is Mexico.

Chile is another potential Latin American hub. It is farther from Asia, the United States, and Europe (which would require a trip through the Panama Canal), but much closer to the Brazilian, Argentinean, and of course Chilean markets. Considering that there will almost certainly be a separate hub in the United States that could serve Mexico, that Central America has a relatively small population and generally low purchasing power and thus require less focus, that Chile is the IPIAI's most attractive country for investment by a wide margin, and that Chile's airports are the best in Latin America, a strong argument can be made on Chile's behalf.

Finally we consider Miami. Miami is obviously easily sourced by the United States and Europe. The rail and road situation in the United States also makes Miami very accessible to Asia. Miami has the same proximity issues with South America that Mexico has, but supply chain managers have the added benefit of a familiar regulatory and operational environment with Miami. Miami will also have much better infrastructure to work with. The proximity considerations are less impacting in this section since we are dealing with air. Distance will certainly impact cost – especially as the cost of fuel continues to rise, but achievable travel times will be almost universally consistent across the region due to the nature of air. Table 5-1 summarizes this section.

	Mexico	Colombia, Panama, or Costa Rica	Chile	Miami
Accessibility by potential product sources Asia, USA, & Europe	Very Accessible	Accessible *(excepting Colombia's Pacific coast)*	Somewhat Accessible	Accessible
Proximity and accessibility to major Latin American population centers	Far from south and east regions of South America	Centralized	Excellent if Mexico can be served by USA network	Far from south and east regions of South America
Airport infrastructure quality	High	High with Panama being Very High	Very High	World Class *(USA generalization)*
Private investment environment	Slightly Unattractive	Somewhat Attractive	Very Attractive	Most Attractive

Table 5-1. Matrix of network implications for air freight strategies

5.1.2 MEDIUM PVD – ROAD

Products with a mid-level PVD in the United States are good candidates for trucking freight. This offers both cost and time compromises between air (fast but expensive) and ocean/rail (inexpensive but slow). But despite Latin America's very low trucking costs, we found that its road quality, geographical and administrative barriers, and regulatory challenges make road transportation only regionally feasible. To move goods from Venezuela or Colombia to Argentina likely requires an impractically circuitous route forced along the western coast of the continent by the Andes Mountains and then across the mountains likely from Chile. Numerous international borders would be crossed, likely requiring numerous drivers, tractors, and cumbersome paperwork. Peru's exceptionally poor road connectivity and quality would add even more challenges to the route. Central America, on the other hand, is cut off entirely from South America and connectivity throughout Central America itself is sparse. Brazilian population centers (all along the eastern coast) are cut off almost entirely from the rest of the continent by the Amazon which, along with the

Andes Mountains, effectively cut South America in half down the center. Only a few connections, and of questionable quality, exist through the rainforest; otherwise road connectivity is directed entirely into the southern cone. These constraints on Latin American trucking make it practical only in a focused regional context. The independent micro-regions that most companies would need to place hubs in for effective trucking coverage are as follows:

- Mexico
- Central America
- Venezuela, Colombia, perhaps Ecuador
- Peru
- Bolivia, northern tip of Chile
- Chile, perhaps Argentina
- Argentina, Uruguay, southern Brazil
- Southeastern Brazil
- Northeastern Brazil

Maintaining so many hubs for a mid-level PVD product serving Latin American markets probably doesn't make much sense in most situations. Of course, different products have different characteristics beyond PVD and some might allow for longer lead times to customers and retailers than others, thus enabling a company to invest in fewer hubs. If a company cannot reduce the number of hubs needed by defining product characteristics or choosing to serve only particular markets, then the choice of road freight and even the product offering itself should be analyzed closely for viability in Latin America at all.

5.1.3 LOW PVD – OCEAN & RAIL

Raw materials such as steel, lumber, and coal are good examples of low PVD products. Products like this cannot use air freight from an economic and sometimes physical perspective and usually do not use trucks unless they need to make small journeys from rail depots and seaports to specific destinations. Therefore sea and rail freight are the ideal modes for these goods. Because of the difficulties Latin America

has with road transportation, mid-level PVD products that can reasonably tolerate longer lead times should consider ocean-based freight as well.

As discussed earlier, Mexico's rail network is relatively extensive, Central America's is non-existent, and South America's is generally somewhere in the middle with the southern cone offering its best combination of coverage and quality. The most logical places to place a hub are similar to what we considered for air freight and sometimes for similar reasons.

Mexico provides an excellent centralized location for Asia, the United States, Europe, and South America. In fact, the extreme congestion seen in the United States's west coast ports has begun to divert large amounts of United States-bound goods from Asia through Mexican ports which then go north by truck and rail.[1] This is leading Mexico to quickly and significantly upgrade its port capabilities and establish its status as a hemispheric hub. Its short distances from coast-to-coast give it reasonable accessibility to all of South America while bypassing the expensive and congested Panama Canal. Again, proximity to the southern and eastern regions of South America is a drawback, but the possibility of using the southern rail systems from Chilean ports is an ameliorating factor.

Looking closer to the center of Latin America this time leads us to focus more on Panama than Costa Rica or Colombia. The geographical advantages of these countries are obvious, but neither Costa Rica nor Colombia have rail or surface systems comparable to Panama's even though Panama's is but a single line. Panama also has the better ports. Due to the shape of South America by Panama, the proximity advantage of Panama over Mexico is real but usually not large (depending on what location in Mexico is chosen).

Chile is again considered because of its presence in the southern cone, its infrastructure leadership, and the attractiveness of its business environment.

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[1] Source: Macfarlan Capital Partners 2007

Argentina and even southern Brazil is accessible by rail, but the northeastern region of Brazil begins to stretch the limits of even the best Latin American rail systems. The shape of South America also turns northeastern Brazil into a significant voyage from Chile by sea considering that any products sourced from Asia, the United States, or Europe already had a long journey to Chile in the first place. A potential strategy for reaching northeastern Brazil would be to transport by rail to Buenos Aires or Montevideo, and then by sea up along the Brazilian coast. Chile also provides effective access to all Pacific countries and can reach Venezuela fairly well through the Panama Canal.

Miami again offers a good staging point for some of the same reasons as we saw in the air freight section – a stable regulatory and operational environment, quality infrastructure, and reasonable though not the best accessibility. Shipments from Miami have to use the canal to get to Ecuador, Peru, or Chile but can otherwise avoid the canal.

In addition, Brazil might be considered as well simply because of how strong of a proportion of Latin America's population it has. Its distance from most other countries mitigates its attractiveness but not entirely because Uruguay, Argentina, and possibly Chile are again accessible by rail. (Remember that gauge incompatibilities are sure to complicate rail transportation.) Table 5-2 summarizes this section.

	Mexico	Panama	Chile	Miami	Brazil
Accessibility by potential product sources Asia, USA, & Europe	Very Accessible	Accessible *(excepting Colombia's Pacific coast)*	Somewhat Accessible	Accessible	Slightly Unaccessible
Proximity and accessibility to major Latin American population centers	Very Good *except to the southern cone*	Excellent *except to SE Brazil*	Good *except to Mexico, Venezuela, and NE Brazil*	Good *except to the southern cone*	Mostly good for serving southern cone
Port infrastructure quality	Below Average	World Class	Very High	World Class *(USA generalization)*	Poor
Rail infrastructure quality	Below Average	Average	Average	World Class *(USA generalization)*	Poor
Rail infrastructure connectivity	Above Average	Just one route: between Atlantic and Pacific	Average *(w/ gauge inconsistency)*	World Class *(USA generalization)*	Average *(w/ gauge inconsistency)*
Private investment environment	Slightly Unattractive	Somewhat Attractive	Very Attractive	Most Attractive	Somewhat Attractive

Table 5-2. Matrix of network implications for ocean & rail freight strategies

5.2 SUMMARY

Despite Latin America's proximity and cultural similarities compared with Asia, China and India still receive the lion's share of attention from supply chain engineers exploring emerging market potential. The economic and geographical size of the United States has also meant that many countries can and have operated purely domestically with still plenty of room for growth. When a company decides to explore international operations, however, Latin America's geographical location, manageable cultural distance, and growth potential are all promising for United States-based companies and should be included in any new market analyses.

Latin America is not without transportation challenges, though. Administrative distances are evident in the constant churning of regional trade blocs. Differing customs procedures, corruption levels, transportation regulations, and security concerns can require new considerations in supply chain engineering compared to what is customary in the United States. Monetary, currency, and political stability are also factors that should not be ignored.

The geographical characteristics in Latin America present extremes not seen in the United States. Massive mountain ranges, dense rainforests, destructive landslides, and pervasive riverways provide challenges and possibilities unique to Latin America.

Infrastructure is central to any supply chain's needs and Latin American countries have substantial ground to cover if they want to enter the upper echelon of economic development or even keep pace with other strongly emerging markets such as China. Increased privatization and public-private partnerships are making progress in this regard, but progress is too slow. Surface transport is insufferable, especially in Central America, seaports are shallow and underdeveloped, and air freight is not always feasible due to product and market characteristics.

Of course, not every country in the region is created equal. The easiest countries to operate in considering all of the above factors are often Chile and Mexico. Paraguay and Bolivia are consistently the most challenging – not coincidentally the two landlocked countries of the hemisphere. Also not surprising is that the countries that have opened their markets the widest and worked the most to implement trade-friendly policies have the healthiest economies.

Supply chain engineers should ensure that they develop the proper knowledge and intuitive understanding for any market that they wish to enter before investing head-long into new and different business and operational environments. Understanding the differences between a new market and not only one's current logistics expertise,

but also the new market's surrounding region, is key to making good investment and operational decisions when developing new supply chain networks.

Latin America may currently be in China's and India's shadows, but the US companies that have the wisdom to intelligently penetrate Latin American markets will find themselves in excellent positions over both the short and the long term.

5.3   FUTURE RESEARCH

A natural next step stemming from this research would be a normalized metric measuring the logistical transportation "distance" between various Latin American and foreign cities.

Within the United States and the EU, companies are accustomed to certain logistical frameworks. Less sophisticated companies even manage to operate their supply chains by experience rather than analytics and models in many cases. To try and bring developed Western business perspectives and practices to non-Western or developing countries has the potential for disaster. Using China as an example, twice as many multinationals described their operations in China as "worse than planned" than described them as "better than planned" in a particular survey.[1] The good news is that Latin America has the potential to be an easier business climate in many ways, though its challenges and differences must still not be overlooked.

Much has been made of physical distances through applications of gravity models to such things as migration and trade. Pankaj Ghemawat wrote in the Harvard Business Review a description of the distances that separate countries today as pertains to international business ambitions. Despite increasing progress towards globalization and the reality of truly instantaneous communication anywhere in the world, he rebuts declarations of a new world without distances. He argues that in

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[1] Source: Ghemawat 2001

addition to the continued meaningful impact of geographical distances, there are other types of distance that continue to prevail as well. These distances are categorized as cultural, administrative, geographical, and economic. Many businesses overlook one or more of these types of distance between their currently comfortable country (or countries) of operation and the new markets to which they hope to expand. Cultural distances are created by different languages, ethnicities, religions, and social norms. Cultural distance often defines how effective a business is at managing local employees and the potential for its business model and product offerings in the first place. Administrative distances result from political, monetary, regulatory, institutional, and historical differences. The reduction of this distance is the primary goal of regional trade agreements and common markets. Geographic distance is the most obvious of the group and includes remoteness or country size, lack of cross-border infrastructure or waterway access, and climates. Finally, economic distances are captured by consumer incomes and the cost/quality of resources, infrastructure, and information.

Ghemawat's perspective on distances is meant to apply to the holistic business environment and operations. Although the scope of this thesis is decidedly narrower, many if not most of the concepts remain relevant, though often delineated by more focused definitions. The subjects covered in the ensuing chapters can be easily associated with Ghemawat's distance schema and are all direct influencers of logistics transportation. The only type of distance that does not apply directly to freight is that of cultural distance and has thus been ignored in the bulk of this work (though it can apply to operations).

Latin America's characteristics have here been described and compared primarily between Latin American countries and generalized against international examples. For United States companies, it is important to understand how the region's logistical landscape compares more specifically to that of the United States and what differences can be expected and hopefully mitigated. It is possible that the differences create an environment in which a business cannot successfully compete. It is important to be open to this possibility when evaluating new and emerging

markets and thus avoid believing that these markets are necessary at all costs because of the recent attention they've garnered. In this vein, any United States-based supply chain manager expecting similar levels of efficiency and transportability in Latin America will likely find himself ill-equipped to compete in the region. Those that are prepared to assume higher costs and accept less reliable transit times in order to serve markets with less buying power could still be surprised by the necessity of doing many things much differently. The United States relies on a very competitive and well-built ground transport network, so this surprise could manifest itself as a need to reorganize the supply chain around ocean and air freight due to Latin America's lack of maintained and connected surface infrastructure. Some simply do not comprehend the purely physical distances throughout the region as compared to the United States. Still others could be frustrated by the array of regulatory differences between the United States and Latin American countries despite alleged trading blocs.

Constructing a metric to convey the relative logistical transportation distances throughout Latin American cities was outside the scope of this thesis and will require comprehensive data collection.

WORKS CITED

Alicia Rivera, Sandra. *MOP recupera 525 rieles de antiguo ferrocarril.* February 2003. http://ediciones.prensa.com/mensual/contenido/2003/02/21/hoy/nacionales/884 959.html (accessed March 2008).

Alloway, J. Lance. *Pan-American Highway and the Environment (PANAM).* June 1994. http://www.american.edu/TED/PANAMA.HTM (accessed March 2008).

Andean Community. "Decision 613." Lima, July 2005.

Antonio Ocampo, José, María Angela Parra, and Ame Bergés. Oxford University. 2003. http://oxlad.qeh.ox.ac.uk/ (accessed March 2008).

Arvis, Jean-Francois, Monica Alina Mustra, John Panzer, Lauri Ojala, and Tapio Naula. *Connecting to Compete: Trade Logistics in the Global Economy: The Logistics Performance Index and Its Indicators.* International Trade, The World Bank, Washington, DC: The World Bank, 2007.

Augelli, John P. *Amazon (river).* 2007. http://encarta.msn.com/encyclopedia_761571466/Amazon_(river).html (accessed March 2008).

Balassa, Bela A. *The Theory of Economic Integration.* Homewood: RD Irwin, 1961.

Beaulac, Willard Leon. *The Fractured Continent: Latin America in Close-Up.* Stanford: Hoover Institution Press, 1980.

Bernanke, Ben S. *Bernanke Speech—Inflation in Latin America: A New Era?* Feb 2005. http://www.federalreserve.gov/BOARDDOCS/Speeches/2005/20050211/defaul t.htm (accessed March 2008).

Blanco, Edgar. *Success Factors in Emerging Markets | MIT Center for Transportation and Logistics:.* March 2008. http://ctl.mit.edu/index.pl?iid=7681 (accessed March 2008).

Boeing. "7474sec3." December 2002. http://www.boeing.com/commercial/airports/acaps/7474sec3.pdf (accessed March 2008).

Brinkhoff, Thomas. *Argentina - City Population.* June 2007. http://www.citypopulation.de/Argentina.html (accessed March 2008).

Butler, Rhett A. *Biogeographical Forest Realms—Where Rainforests are Located.*
http://rainforests.mongabay.com/0102.htm (accessed March 2008).

—. *Calculating Deforestation in the Amazon.* 2007.
http://rainforests.mongabay.com/amazon/deforestation_calculations.html
(accessed March 2008).

—. *Neotropical Realm: Environmental Profile.* February 2006.
http://rainforests.mongabay.com/20neotropical.htm (accessed March 2008).

—. *New map shows paths of historic hurricanes.* November 2006.
http://news.mongabay.com/2006/1107-nasa.html (accessed March 2008).

Caribbean Community (CARICOM) Secretariat. *The West Indies Federation.* March
2008.
http://www.caricom.org/jsp/community/west_indies_federation.jsp?menu=co
mmunity (accessed March 17, 2008).

Carranza Torres, Octavio Alberto. *Global Perspectives: Mexico.* Lombard: Council of
Supply Chain Management Professionals, 2007.

Chilean Government. *Chile and Panama to speed up free trade negotiations.* January 2006.
http://www.chileangovernment.cl/index.php?option=com_content&task=view
&id=543&Itemid=2 (accessed March 2008).

Choi, E. Kwan. *Other Customs Unions.* November 1998.
http://www.econ.iastate.edu/classes/econ355/choi/other.htm (accessed March
2008).

Cohen, Ligia. *Panama, Chile, U.S. Plan to Protect the Panama Canal.* June 2003.
http://findarticles.com/p/articles/mi_pnav/is_200306/ai_2602682571 (accessed
March 2008).

Comsat International. December 2006.
http://www.comsatint.com/noticias.php?lang_id=1&coun_id=1&n=533&sectio
n_id=6 (accessed March 2008).

Confederação Nacional do Transporte (CNT). *Pesquisa Rodoviária 2007.* November
2007. http://www.cnt.org.br/informacoes/pesquisas/rodoviaria/2007/ (accessed
March 2008).

Corwin, Jeff. *Hope, despair for Amazon rainforest's future.* February 2007. http://www.cnn.com/CNN/Programs/anderson.cooper.360/blog/2007/02/hope-despair-for-amazon-rainforests.html (accessed March 2008).

Dangl, Benjamin. *The US Military Descends on Paraguay.* July 2006. http://www.thirdworldtraveler.com/South_America/US_Troops_Paraguay.html (accessed March 2008).

de Neufville, Richard, and Amedeo Odoni. *Airport Systems.* New York: McGraw Hill, 2003.

Dean, Cornelia. *To Save Its Canal, Panama Fights for Its Forests.* May 2006. http://www.nytimes.com/2005/05/24/science/earth/24pana.html?_r=2&pagewanted=all&oref=slogin&oref=slogin (accessed March 2008).

Duffy, Gary. *Amazon river 'longer than Nile'.* June 2007. http://news.bbc.co.uk/2/hi/americas/6759291.stm (accessed March 2008).

El Universal. *Former Urugayan President Rejects Venezuelan Membership in MERCOSUR.* February 2008. http://english.eluniversal.com/2008/02/28/en_eco_art_former-uruguayan-pre_28A1393883.shtml (accessed March 2008).

Encyclopedia Britannica. *Columbia: Transportation.* September 2007. http://www.britannica.com/eb/article-25359/Colombia#293585.hook (accessed March 2008).

Encyclopedia Britannica Online. *Andes Mountains.* June 2007. http://www.britannica.com/eb/article-41657/Andes-Mountains#cite (accessed March 2008).

—. *Gauge.* July 1998. http://www.britannica.com/eb/article-9036208/gauge#196533.hook (accessed March 2008).

FedEx. http://www.fedex.com/us/national/main/ (accessed March 2008).

Fleury, Paulo. *Global Perspectives: Brazil.* Lombard: Council of Supply Chain Management Professionals, 2007.

Gaviria, Juan. "Port Privatization and Competition in Colombia." *The World Bank.* December 1998.

http://rru.worldbank.org/documents/publicpolicyjournal/167gavir.pdf (accessed March 2008).

Geobytes. *City Distance Tool.* August 2006. http://www.geobytes.com/CityDistanceTool.htm (accessed March 2008).

Ghemawat, Pankaj. "Distance Still Matters: The Hard Reality of Global Expansion." *Harvard Business Review*, September 2001: 137-147.

Global Insight, Inc. "The US Truck Driver Shortage: Analysis and Forecasts." *US General Services Administration.* May 2005. http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/ATADriverShor tageStudy05_R25-c-d_0Z5RDZ-i34K-pR.pdf (accessed March 2008).

Gumbel, Andrew. *Panama Canal: work begins on a $5bn project to widen the canal that revolutionised the transport of goods.* September 2007. http://www.independent.co.uk/news/world/americas/panama-canal-work-begins-on-a-5bn-project-to-widen-the-canal-that-revolutionised-the-transport-of-goods-401264.html (accessed March 2008).

Harri, Ardian. "Theoretical and Emprical Aspects of the Economic Integration and Trade Liberalization." *Albanian Centre for International Trade.* December 2003. http://www.acit-al.org/publications/Research_papers/dec_2003_A_Harri.pdf (accessed March 2008).

Rybaltovsky, Igor, ed. *Impregilo to Build New Railway Lines.* April 2006. http://home.nestor.minsk.by/build/news/2006/04/1405.html (accessed March 2008).

Initiative for the Integration of Regional Infrastructure in South America (IIRSA). *IIRSA.* March 2008. http://www.iirsa.org/acercadeiirsa_ENG.asp?CodIdioma=ENG (accessed March 2008).

Inter-American Development Bank: Integration and Regional Programs Department. *Periodic Note: ALADI.* March 1998. http://www.iadb.org/int/intpub/nota/aladi.htm (accessed March 2008).

International Center for Tropical Agriculture (CIAT). *Latin America and the Caribbean Population Database Documentation.* September 2005. http://gisweb.ciat.cgiar.org/population/report.htm (accessed March 2008).

International Labour Office. *Southern Common Market (MERCOSUR).* May 1999. http://www-old.itcilo.org/actrav/actrav-english/telearn/global/ilo/blokit/mercosur.htm (accessed March 2008).

International Monetary Fund. *Data and Statistics.* February 2008. http://www.imf.org/external/data.htm (accessed February 2008).

International Railway Journal. *World Market.* March 2008. http://www.railjournal.com/altworldmarket.shtml (accessed March 2008).

Kennedy, Alex. *Chavez Refuses Apology to Brazil to Join Mercosur (Update2).* July 2007. http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a5gJyj6G7j_E (accessed March 2008).

Kim, Jun Il, and Laura Papi. "Central America: Global Integration and Regional Cooperation: Regional Integration and Exchange Rate Arrangements." *The International Monetary Fund.* Edited by Markus Rodlauer and Alfred Schipke. July 2005. http://www.imf.org/external/pubs/ft/op/243/243ch5.pdf (accessed March 2008).

Klonsky, Joanna, and Stephanie Hanson. *Mercosur: South America's Fractious Trade Bloc.* December 2007. http://www.cfr.org/publication/12762/ (accessed March 2008).

Lambsdorff, J. Graf. "Corruption Perceptions Index." Transparency International, 2007.

Leitmann, Joseph. "Regional Integration in Central America." *International Relations Journal*, 1995.

Líneas Férreas Uruguayas. March 2008. http://members.tripod.com/~lfu1/ (accessed March 2008).

Lovell, Antony, Richard Saw, and Jennifer Stimson. "Product value-density: managing diversity through supply chain segmentation." *The International Journal of Logistics Management* (Emerald Group Publishing) 16, no. 1 (2005): 142-158.

Lydolph, Paul E. *The Climate of the Earth.* Rowman & Littlefield, 1985.

Macfarlan Capital Partners. *The Southwest Border Industrial Opportunity.* White Paper, Dallas: Internal, 2007.

Madsen, Poul Thøis. "Is Culture a major Barrier to a Single European Market? The Case of Public Purchasing." Edited by Staffan Zetterholm. *National Cultures and European Integration - Exploratory Essays on Cultural Diversity and Common Policies* (Berg Publisher), 1994.

Márquez, Humberto. "Activists back Venezuela-driven alternative integration." May 2007. http://www.bilaterals.org/article.php3?id_article=8085 (accessed March 2008).

McManus, Lowell G. *The Mexican Railways.* February 2008. http://www.mexlist.com/railways.htm (accessed March 2008).

Meléndez O., María Fernanda. *The Logistics and Transportation Problems of Latin American Integration Efforts: The Andean Pact, A Case of Study.* 2001.

Merrill, Tim. "Belize: Appendix C - Guyana and Belize." Federal Research Division, Library of Congress, 1992.

Merrill, Tim. "Honduras: Appendix B - Central American Common Market." Federal Research Division, Library of Congress, 1993.

Metzger, Bill. *Ferrovías Guatemala.* August 2006. http://www.rrdc.com/op_guatemala_fvg.html (accessed March 2008).

Mia, Irene, Julio Estrada, and Thierry Geiger. "Benchmarking National Attractiveness for Private Investment in Latin American Infrastructure." World Economic Forum, Geneva, 2007.

Moosmüller, Gertrud. "Bribe Payers Index." Policy and Research, Transparency International, Berlin, 2006.

Osava, Mario. *CHALLENGES 2007-2008: Mercosur Limps Slowly Along.* Inter Press Service. January 2008. http://www.ipsnews.net/news.asp?idnews=40672 (accessed March 2008).

Panama Canal Authority. *Tolls Assessment.* August 2007. http://www.pancanal.com/eng/maritime/tolls.html (accessed March 2008).

Panama Canal Railway Co. *Homepage.* July 2005. http://www.panarail.com/home.html (accessed March 2008).

Preston, Robert. *Work starts on trans-Andean link.* February 2005.
http://www.railwaygazette.com/news_view/article/2005/02/1065/work_starts_
on_trans_andean_link.html (accessed March 2008).

Railway Gazette. *Central America going nowhere.* August 2007.
http://www.railwaygazette.com/news_view/article/2007/08/7665/central_amer
ica_going_nowhere.html (accessed March 2008).

—. *Colombia to launch US$600m tender package.* October 2007.
http://www.railwaygazette.com/news_view/article/2007/10/7776/colombia_to_
launch_us600m_tender_package.html (accessed March 2008).

—. "Rail industry pointers November 2007." November 2007.
http://www.railwaygazette.com/news_view/article/2007/11/7905/rail_industry
_pointers_november_2007.html (accessed March 2008).

Sacco, Christopher. *The Ecuadorian Railway: The Most Difficult Train in the World.*
March 2008. http://www.ecuadorexplorer.com/html/train.html (accessed
March 2008).

Sala-i-Martin, Xavier, Jennifer Blanke, Margareta Drzeniek Hanouz, Thierry Geiger,
Irene Mia, and Fiona Paua. "The Global Competitiveness Report: The Global
Cometitiveness Index: Measuring the Productive Potential of Nations." Wold
Economic Forum, 2007.

Salazar-Xirinachs, José M., and Maryse Robert, . *Toward Free Trade in the Americas.*
Washington, D.C.: Brookings Institution Press, 2001.

Se Construye. *En julio se licitará tren Los Andes - Mendoza.* April 2006. (accessed March
2008).

Sharp, Richard. "Results of Railway Privatization in Latin America." *The World Bank.*
September 2005.
http://iris37.worldbank.org/domdoc/PRD/Other/PRDDContainer.nsf/DOC_VI
EWER?ReadForm&I4_KEY=0CAEAB9ED9D6672385256D8A004CDDD9F1F34
11D4CF5870D85256F8E00579905&I4_DOCID=2E119D7E01858E8785257090007
0FB7F& (accessed March 2008).

Strahler, A. N. "Hypsometric (area altitude) analysis of erosional topology." *Geological
Society of America Bulletin 63*, 1952: 1117-1142.

Strieker, Gary. *Pan-American Highway's missing link.* November 1997.
http://www.cnn.com/EARTH/9711/25/panama.darien.gap/ (accessed March
2008).

Suggett, James. *Venezuela renews diplomatic relations with Colombia.* March 2008.
http://www.venezuelanalysis.com/news/3258 (accessed March 2008).

Supply Chain Digest. *Global Supply Chain: Supply Chain Security is a Growing Issue,
Expert Says.* November 2007. http://www.scdigest.com/assets/On_Target/07-
11-06-5.php?cid=1338 (accessed March 2008).

Taylor, Bryan. "The Century of Inflation." *Global Financial Data.*
https://www.globalfinancialdata.com/articles/Century_of_Inflation.doc
(accessed March 2008).

The World Bank Group. *World Trade Indicators.* 2007.
http://info.worldbank.org/etools/tradeindicators/5a.asp (accessed March 2008).

Thomas, Daniel, ed. "Situation Report: Requiem for rail in Guatemala?" October 2007:
6-13.

United Nations. "Human Development Report." 2007/2008.

Urquidi, Víctor L. "Free Trade Experience in Latin America and the Caribbean."
Annals of the American Academy of Political and Social Science 526, Free Trade in
the Western Hemisphere (March 1993): 58-67.

US Bureau of Transportation Statistics. *Transportation Statistics Annual Report 1998.*
Edited by Wendell Fletcher. Darby: Diane Publishing Company, 1999.

US Central Intelligence Agency. *CIA Maps and Publications: Latin America.* March
2008. https://www.cia.gov/library/publications/cia-maps-
publications/Latin%20America.html (accessed March 2008).

US Central Intelligence Agency. "The World Factbook." 2008.

US Geological Survey. *Earth Resources Observation and Science.* August 2006.
http://edc.usgs.gov/products/elevation/gtopo30/gtopo30.html (accessed March
2008).

US Maritime Administration. "Containership Market Indicators." *Office of Statistical
and Economic Analysis.* August 2005.

http://www.marad.dot.gov/MARAD_statistics/2005%20STATISTICS/Container%20Market%20Indicators.pdf (accessed March 2008).

USA Today. "FIFA backs down from La Paz altitude ban." July 6, 2007.

Waters, Mark, ed. http://www.worldportsource.com/index.php (accessed March 2008).

Wikipedia. http://en.wikipedia.org (accessed December 2007).

WorldAtlas. *South America Landforms.* March 2008. http://www.worldatlas.com/webimage/countrys/salnd.htm (accessed March 2008).