Erasmus University Rotterdam

Msc in Maritime Economics & Logistics

2010/2011

The Effect of Brazilian Economic Growth on Trade and Maritime Transport Flows

by

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Acknowledgements

The seeds for this thesis were first planted almost a decade ago when I took a Portuguese language class as an elective during my undergraduate years at Harvard. These seeds were later nurtured while working on a Brazilian shipyard joint venture project for Daewoo Shipbuilding & Marine Engineering. This project took me to Brazil and allowed me to not only use my Portuguese but also learn a lot about the country.

My life has been an exciting adventure that has taken me from Mexico City, to New York City, to Seoul, and around the world on various trips and projects. There are many people who made this adventure possible but I would like to first thank the Lord my God; who has given me the serene strength to overcome the many challenges I've faced in my life and given the courage to go beyond my fears ad limitations.

I thank my lovely wife, Jungsu Kim, who has patiently stood by my side during this thesis writing period. Her jokes, affection, and assistance with thesis tasks, helped me to overcome some of the obstacles I faced during this thesis writing period. I would also like to express my sincerest gratitude to my thesis supervisor, Dr. Koen Berden, who patiently took the time to advise me on the methodology for this thesis and whose class on international economics was a key inspiration behind this thesis. I would also like to thank my other supervisor, Professor Ferreira from UNESP in Brazil for his feedback. I would also like to thank my classmates, Ms. Jessica Wang, and Mr. Ashish Panda who took the time to listen to my concerns and offered their help and advice. I would also like to acknowledge Mr. Jurgen Vermuellen and Ms. Pauline Vermeer who advised me on some of the finer points of the methodology. Special thanks to my former Daewoo colleagues and professional contacts, Mr. Kang Ilsuk, Mr. Kang Jong-soo, Mr. Lim Keun-mok, Mr. Jan Slabbert, Mr. Oak Seung-hee, Ms. Lee Ji-young, Ms. Hong Seung-hee, Mr. Lee Jae-won, Mr. Shin Jong-young, Ms. Anna Sawinska, Mr. Jan Johannessen, and Mr. Sergio Sias. Lastly, I would like to thank my parents, whose hard work and sacrifices over the years have allowed me to get to where I am to today, and my relatives and friends back in Korea who supported me during my studies with care packages from Korea.

Abstract

In its now famous 2001 “BRICs” thesis Goldman Sachs argued that Brazil along with Russia, India, and China would come to play an increasingly important role in the global economy due to demographic and other economic factors. Over the past decade Brazil has managed to achieve robust economic growth and has gained increasing attention and investment. Brazilian companies have also taken advantage of favorable global macroeconomic conditions to expand their operations across not only Latin America but the world. This thesis examines the impact of Brazilian economic growth on trade and maritime transport flows and makes projections of how Brazilian economic growth is likely to continue impacting trade and maritime transport flows over the next decade. This thesis aims to provide insight into the factors that drive Brazilian trade flows and how these factors are likely to impact the “geography of trade” through gravity analysis and use of the Global Simulation Model (“GSIM”). In doing so this thesis compares Brazilian trade patterns with global trade patterns in order to determine whether Brazil differs from global trends. This thesis argues that like global trade flows, Brazilian trade is mainly driven by GDP growth and that GDP is the most reliable predictor for Brazilian trade flows. It also argues that Brazilian trade flows will continue to experience a geopolitical shift towards Asia and other emerging markets leading to a more diversified pool of trading partners. Despite continued growth, however, Brazil is unlikely to have the same impact on maritime trade that the economies of East Asia have had.

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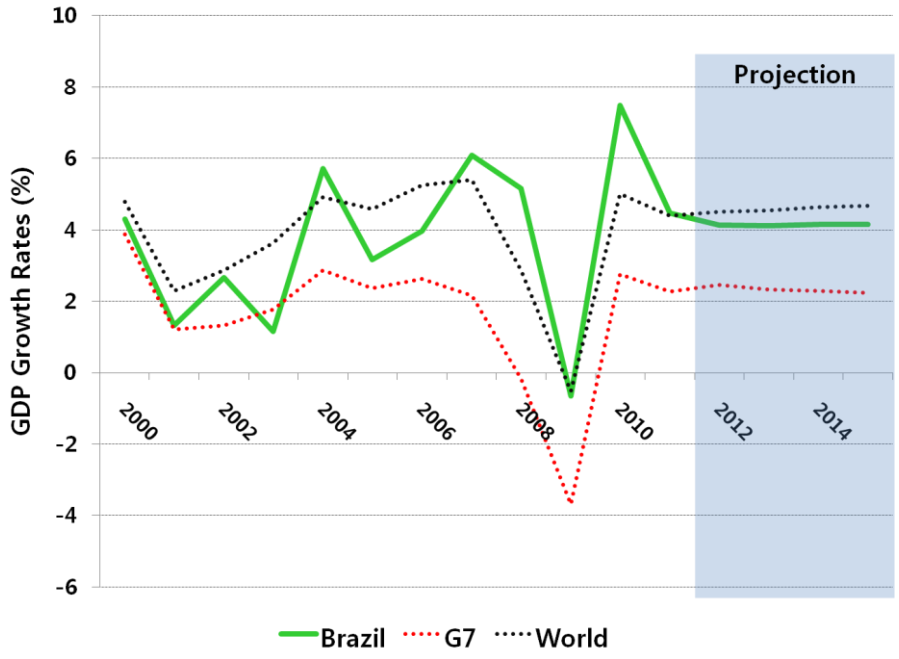
1. Introduction:

1.1 Objectives & Relevance

Over the past decade Brazil posted stronger economic growth than the G7 countries and also recovered much more quickly and robustly from the global economic crisis in 2008 than the G7 countries (Fig. 1). According to the IMF's estimates the country is expected to continue posting higher economic growth than the G7 countries for at least the next five years. Despite not having the high growth rates of China or India,

Fig. 1: Real GDP Growth Rate (%)

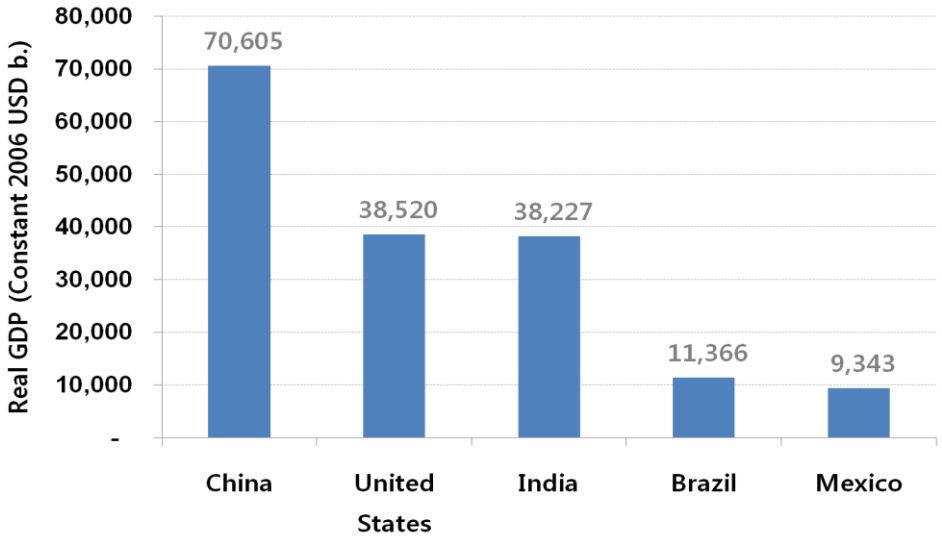


Source: compiled by author from IMF data

Brazil is nonetheless expected to play an important role in the global economy due to its stability, market size, and resources. By 2050, Goldman Sachs expects Brazil to be the world's 4th largest economy (Fig. 2).

Brazil's rise as a major global economy could have important implications for maritime trade and transport flows given the link between economic growth and trade. The relationship between trade and wealth is well known (Barro, 1995; Radelet et al, 1997; Radelet & Sachs, 1999; Stopford, 2008) and modern economic theory generally acknowledges that a country's standard of living depends on its ability to produce goods and services as well as by its ability to trade (Mankiw, 2008). Most world trade takes place among developed industrialized countries and according to Stopford seaborne trade and national wealth are correlated; countries with higher GDPs tend to generate more seaborne trade than countries with lower

Fig. 2: Five Largest Economies in 2050



Source: Goldman Sachs 2007

GDPs (Stopford, 2008). Furthermore, a look at the world's top 20 ports will reveal that most of them are in China with the remainder in Korea, Singapore, the US, northwestern Europe, and Japan. Brazil's participation in global seaborne trade is relatively small; in 2005 it accounted for only 3% of global seaborne trade, an amount (in tons) roughly equal to the Netherlands' share of seaborne trade that year despite being demographically and geographically much larger than the Netherlands[1]. Despite its relatively low seaborne trade intensity, Brazil nonetheless plays an important role in maritime trade; it is the world's second largest supplier of soybeans and iron ore. Given Brazil's potential and the link between economic growth and seaborne trade, how will Brazil's economic development affect seaborne trade? Will Brazil's economic growth eventually transform it into a major maritime trading nation like China? Will Brazil's economic development have the same impact on maritime transport flows in the eastern coast of South America that Asian economic development had on the Pacific Basin? In other words, could continued Brazilian economic growth change the "geography of shipping"?

In light of the aforementioned, this thesis will explore the relationship between trade flows and economic growth with regards to Brazil in order to forecast Brazil's potential trade and maritime transport flows so as to deduce the implications thereof for Brazil's policy makers. This thesis will therefore aim to answer the following main research question:

How has Brazilian economic growth affected global trade and maritime

[1] Estimates based on Martin Stopford's *Maritime Economics, 3rd Edition*, and UNCTAD's 2006 *Review of Maritime Transport*

transport flows and how is it expected to do so in the near future?

In order to address this question, this thesis will seek to answer the following sub-questions:

1. What are the factors driving Brazilian economic growth and how are they related to international trade?
2. Which factors best explain trade flows?
3. Do Brazilian trade flow patterns conform to global patterns or is Brazil different in some ways?
4. Which factors have the most impact on Brazilian trade flows and what are the implications thereof for policy makers?
5. How are Brazilian trade flows likely to evolve given expected GDP growth and potential policy options?
6. How are trade flows and maritime transport flows related?
7. How are domestic and international maritime trade and transport flows related?

Much has been said about Brazil's economic potential over the past decade and the country has indeed achieved a lot during these past 10 years. As Brazil continues on its path towards becoming a major economic power what role should international trade play in Brazil's economy and which policies are likely to be most beneficial for Brazil in achieving its potential? This thesis is relevant for trade policy makers as Brazil takes on a more important role in the global market place. This thesis aims to provide some insight into which trade policies are most likely to foster trade and provide an assessment of the welfare effects thereof on Brazilian society. Moreover, besides Brazil there are other countries that are emerging as important economic players. How should Brazil react towards these geopolitical changes and which countries should Brazil foster stronger ties with? This thesis aims at providing some insight into these geopolitical questions and the implications thereof for Brazil's maritime sector. The Brazilian maritime sector has received increasing attention over the past decade as way to generate jobs, increase engineering skills, harness the nation's resources, and promote trade.

1.2 Methodology

To analyze the relationship between Brazilian economic growth and maritime trade flows, the thesis will employ a three part quantitative methodology. First, correlation analysis will be employed to see whether there are linear relationships among the variables that will be taken into consideration such as exports, GDP, distance, and trade barriers. Secondly, two gravity models will be employed in order to identify the factors which have the strongest impact on trade flows. The first gravity model will look at global trade flows by looking at export flows between the world's 38 largest trading countries while the second gravity model will test to see if the relationships that apply on a global scale also apply with regards to Brazil. The basic objectives of

these two models are to determine which factors best explain trade flows, how much these factors matter, and whether Brazil differs in any way. Finally, the Global Simulation Model ("GSIM") will be used to forecast Brazilian trade flows over the next few years and to study the impact of potential policy options on forecasted trade flows and therefore derive implications for policy makers as well as to provide insight into how Brazil's geopolitical circumstances are likely to change.

1.3 Thesis Outline

This thesis begins with Chapter 2 which lays down the theoretical foundation for the subject topic and provides context by summarizing the existing academic literature on trade, transport costs, and economic development. Chapter 3 tracks Brazilian economic developments over the past sixty years in order to identify key issues and provide historical economic context before assessing Brazil's current situation. This chapter will identify the sources of Brazil's current economic growth and growth prospects while also outlining the challenges that Brazil faces in achieving sustainable growth. Additionally this chapter will examine Brazilian maritime transport flows over the past 60 years to determine the relationship between economic growth, trade, and maritime transport flows. The key questions this chapter will aim to address are; what makes the recent period of economic growth different from previous ones and what challenges does Brazil's economy face? How are Brazilian trade and transport flows related to Brazil's economy? Chapter 4 explains the quantitative methodology employed in this thesis namely the gravity and GSIM models, and describes the trade growth scenarios that will be analyzed. This chapter will also provide a description of the data used as well as the rationale for the data selection. Chapter 5 describes and analyzes the results of the quantitative methodology. Key questions addressed in this chapter are; which factors are responsible for driving trade and maritime transport flows? How important are income, GDP growth, and trade barriers to trade? Do Brazilian trade trends follow global trade trends? This chapter will also use the projections from the GSIM model to provide some insight on the effect of trade flows on Brazilian maritime transport flows. Finally, Chapter 6 will conclude this thesis by summarizing the results of the quantitative methodology and deduce the implications thereof on Brazil's maritime sector. The limitations encountered during the quantitative analysis will also be explained and areas for potential further research will be suggested.

2. Theoretical Background

2.1 Overview

It has long been acknowledged that maritime trade is a catalyst of economic development (Stopford, 2008). Adam Smith, writing in the late 18th century argued that the key to success in capitalist societies is the division of labor; in other words the development of diversified economies specializing in the production of the goods and services which a society is most adept at producing. According to Smith, maritime trade promotes economic development by providing a cheap form of transport which enables societies to trade thereby allowing them to focus their limited resources on producing those goods and services which they are most adept at; and by opening up new markets for local manufacturers. Smith saw that waterborne transport offered better economies of scale than land based transport modes because ships and barges could carry more goods than land based forms of transport and could take advantage of the fact that waterways are essentially free infrastructure which can in many cases accommodate rising volumes of goods. Evidence of this assertion was later provided by Limão and Venables who showed that land transport is significantly more expensive than seaborne transport; an extra 1,000 km by land increases transport costs by more than USD 1,300 whereas an extra 1,000 km by sea only increases costs by an extra USD 190 (Limão, Venables, 2001). The implication of this is that land-locked countries would face significant difficulties in achieving division of labor and economic diversification.

Despite the apparent importance of transport and in particular maritime transport to trade and economics, the relationship between transport and economics was largely under-researched and often poorly understood (Button, 2010). Developments over the past fifty years, however, began to change that. Trade liberalization, technological developments in maritime shipping, and the emergence of multimodal containerized transport along with the economic rise of East Asia, made the study of maritime trade, transport, and economic development more relevant.

2.2 Trade, Transport Costs & Economic Development

Trade and in particular trade in manufactured products has been a powerful catalyst of economic development in the 20th century. Seeking to explain East Asia's economic growth, Lee, Radelet, and Sachs conducted econometric analyses looking at data from 78 different countries over a 30 year period. They concluded that the "*countries which have been most successful in expanding manufactured exports are with a very few exception, the same countries that have [also] achieved the highest rates of economic growth over the past 30 years*" (Radelet, Lee, Sachs, 1997). Moreover, this relationship is stronger for countries which focused on non-resource based manufactured exports. The authors further explain that manufactured exports allowed countries to achieve high economic growth due to the following effects: First,

by focusing on manufactured exports countries can specialize in specific products thereby carving out a niche which allows them to connect to global manufacturing and logistics networks. This confirms Adam Smith's assertion that maritime transport would enable division of labor; second, through manufacturing and trade in manufactured products countries develop technological niches which give their products an edge in international markets; and third, manufactured exports bring in the foreign exchange that allows countries to import the raw materials and capital goods needed for further growth and development. Building on this topic, in 1999, Radelet and Sachs studied the relationship between shipping costs, manufactured exports, and economic development. As with their work on East Asian economic growth, they again argued that countries which have experienced fast manufactured export growth have also experienced the fastest rates of economic growth over the preceding 30 years but added, however, that access to the sea, proximity to major markets, and lower transport costs have played an important role in helping countries achieve high levels of manufactured export growth. Countries with high transport costs on the other hand, had to either compete by paying lower wages or unilaterally removing trade tariffs. More importantly they point out that controlling for other variables, there's a strong relationship between shipping costs and economic growth; doubling of shipping costs is associated with slower annual growth of slightly more than half a percent (Radelet, Sachs, 1999). In other words, high transport costs have a significant long term impact on economic growth.

Given the negative impact of transport costs on trade and development, there has been a lot of academic work done on the topic of transport costs. Transport costs in the academic literature are not just defined as freight rates but also as port costs and port inefficiency which is often modeled as a transport cost. Debates about the impact of transport costs revolve around distance to markets, connectivity to major maritime trade routes, and port costs, and port efficiency. Despite technological advances in transport infrastructure distance continues to have a significant effect on transport costs with a doubling thereof generating an 18% increase in transport costs (Clark et al, 2004). Distance, however, should not be used as a proxy for transport costs as each appears to have its own effect (Hoffman et al, 2003). According to another study, a route's proximity to a liner network is much more important than distance. In fact, the effect of being close to a liner network can be stronger than the effect of distance on shipping costs. Exporters located farther from liner routes experience a disadvantage (Martinez-Sarzoso, Wilmsmeier, 2009).

2.3 Economic Development & Maritime Trade

Stopford (1997, 2008) analyzed the relationship between economic development and maritime trade by looking at the determinants of maritime trade and the connection between a country's phase of development and the maritime trade flows that it generates. Stopford begins by using regression analysis to look at the relationship between a country's basic attributes and maritime trade. He identifies

four basic attributes: income (GNP), geographical area, population, abundance of natural resources, and shows that income is best able to explain which countries are likely to generate maritime trade flows. He also shows that wealthier countries have a tendency to generate more maritime trade since they are more likely to have depleted their resources, require more resources and goods, and have the income to afford more resources and products. For example the US is not only the world's largest economy but it also generates the most maritime trade.

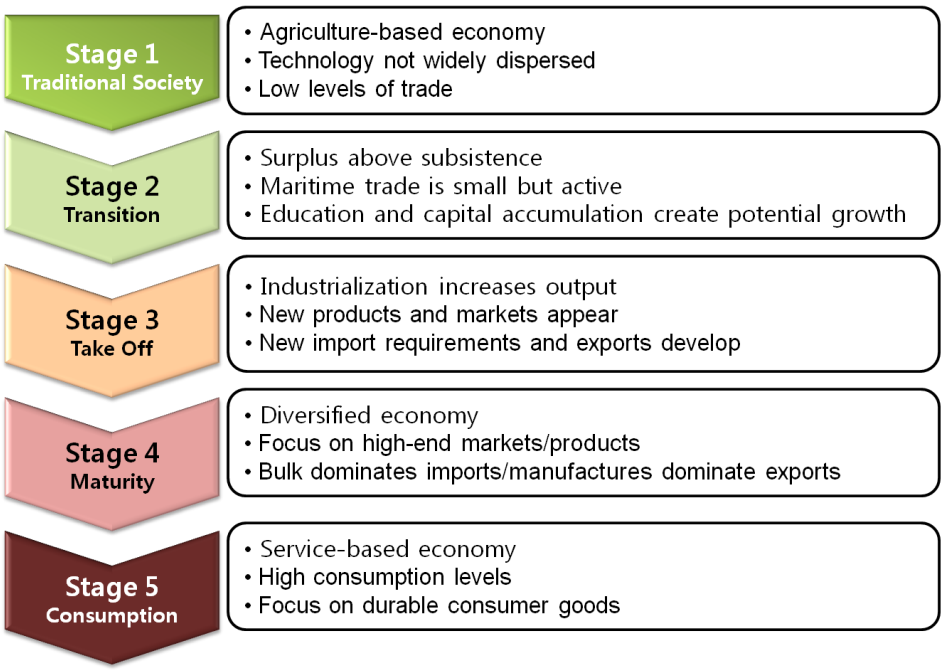
Fig. 3: Supply & Demand Factors in Maritime Trade

Demand	Supply
World Economy	World Fleet
Seaborne Commodities	Fleet Productivity
Average Haul	Shipbuilding Production
Random Shocks	Scrapping and Losses
Transport Costs	Freight Revenues

Source: Stopford, 2008

He then goes on to identify 10 factors that drive supply and demand for shipping and argues that among the demand factors, the world economy is the most important factor driving demand for shipping since demand for shipping is derived demand (Fig. 3). He then distinguishes between the short and long-term impact of the world economy on shipping and argues that in the short-term, business cycles drive demand for shipping and determine freight rates and shipping cycles while in the long-term demand for shipping is driven by "trade development cycles" which he defines as changes in the economic structures of the countries generating seaborne trade; in other words the evolution of countries from agricultural to service based economies. In the long-run, this evolution affects trading patterns and alters the "geography of shipping." For example industrialization in East Asia transformed the Pacific Ocean into a major trade route making the transpacific and intra-Asian maritime flows among the most voluminous in the world. This economic rise of East Asia transformed Los Angeles from a sleepy port into America's busiest port (Levinson, 2006).

Fig. 4: Rostow's Development Stage



Source: compiled by author from Stopford, 2008

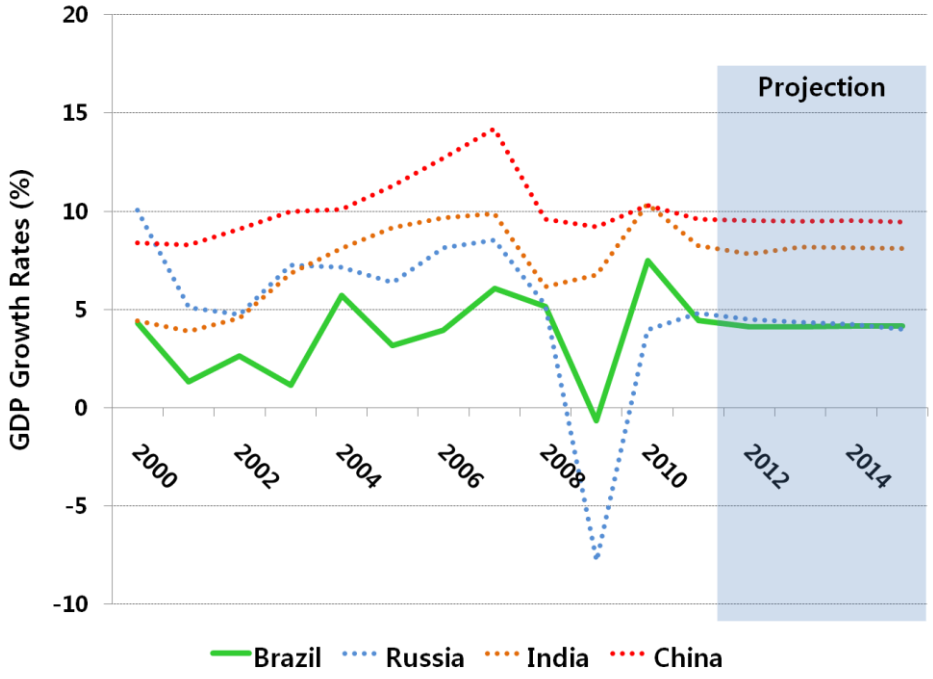
Building on this, Stopford makes the connection between a country's development phase and demand for shipping by making reference to Rostow's five stages of economic development (Fig. 4). At Stage 1 there's little seaborne trade as countries in this stage are mainly agricultural subsistence societies such as Gabon, Cambodia, and El Salvador. At Stage 3 trade begins to intensify as countries in this stage begin to shift from agriculture to industry thereby creating demand for raw materials and generating exports. Examples include China, Korea, and Malaysia. Finally at Stages 4 and 5 maritime trade growth rates begin to level off as countries transition from industrial to service sector based economies. From a shipping point of view, identifying stages 2 and 4 are important given the strong link between industrialization and rising demand for shipping. In countries with abundant natural resources, Stage 3 is likely to be deferred until depletion of natural resources. A good example of this is the Middle East where places like the UAE and Oman are diversifying their economies and encouraging the development of industry and logistics as a way to deal with the depletion of their natural resources. The basic premise behind all this is that economic activities differ in their level of maritime trade intensity; subsistence agriculture and finance generate very little maritime trade whereas manufacturing, construction, and industrial agriculture have a high maritime intensity. The more a country's economy relies on maritime intensive "industrial" sectors for growth, the more likely it will generate trade. The implication is therefore that in order to identify shifts in maritime trade and transport flows it is important to understand countries' stages of development and which sectors are driving economic growth.

3. BRAZILIAN ECONOMIC GROWTH

3.1 Overview

Why has Brazil's recent economic growth generated so much interest? After all, recent GDP growth rates are not as impressive as those of the "Miracle Years" or those of China and India over the past decade (Fig. 5). What makes Brazil's recent economic growth different from that of the "Miracle Years" of the 1970s when Brazil achieved impressive double digit real GDP growth? This chapter will address these questions thereby providing a historical overview of Brazilian economic growth over the past sixty years so as to identify key trends and compare Brazil's current situation with that of previous periods.

Fig. 5: BRIC Real GDP Growth Rates (%)

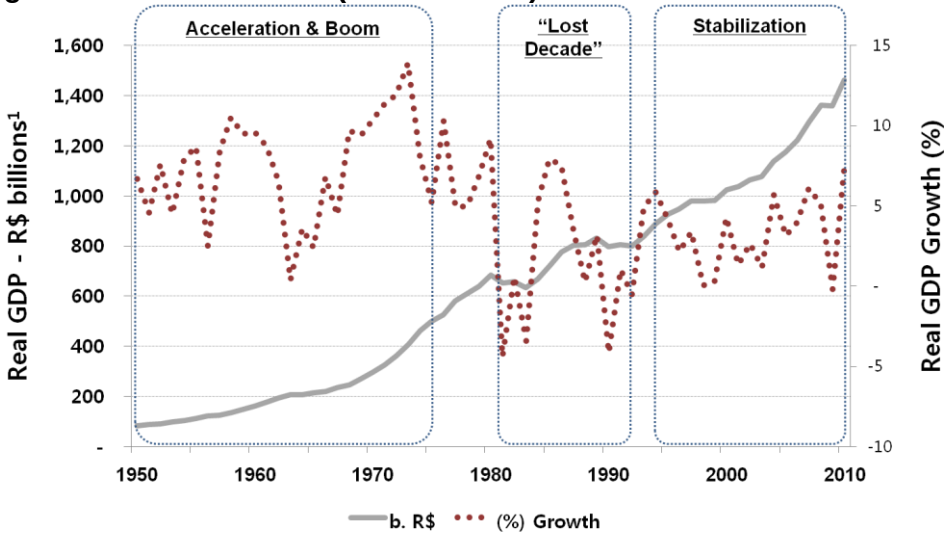


Source: compiled by author from IMF data

The last sixty years of Brazilian economic development can generally be broken down into roughly three major periods; the Acceleration & Boom Period, the "Lost Decade," and the Stabilization & Growth Period (Goldman Sachs, 2007; Baer, 2008; Brainard, Martinez-Diaz, 2009) (Fig. 6). What the proceeding summary of the aforementioned periods will show is that Brazilian economic policy has been largely driven by the desire to control foreign capital, protect the Brazilian economy from foreign shocks by making it more self-reliant, and develop domestic industries capable of supplying the country's needs (Baer, 2008). These three objectives explain the trade barriers, import substitution policies, and strong government involvement in the economy which were common features of the Brazilian economy

during the second half of the 20th century.

Fig. 6: Economic Periods (1950-Present)



Sources: IPEA and others

[1] Brazil has had several currencies since 1950. The data here is adjusted to current Brazilian Reais (R$).

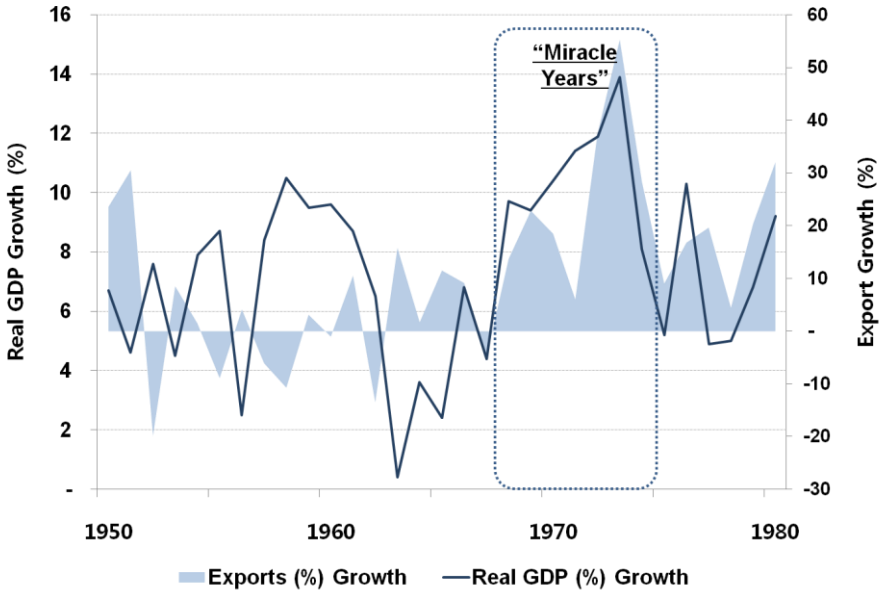
3.2 Acceleration & Boom (1945 – 1973):

During the beginning of this period the Brazilian government pursued a policy of import substitution and industrialization ("ISI") aimed at diversifying the country's economy and making Brazil less reliant on the global market. ISI's aims were to replace imports with domestically produced products thereby encouraging development of domestic Brazilian industries which would not only help to diversify the economy but would also make Brazil more self reliant and therefore less vulnerable to external economic forces. ISI had two elements – one which sought to discourage imports through protectionist measures and the other which sought to encourage development of domestic industries. With regards to the former, the government restrained demand for imports through a combination of tariffs, protectionist legislation (i.e. Law of Similars), and exchange rate mechanisms. The Law of Similars for example, allowed domestic manufacturers to register their products in a special "Register of Similar Products" which entitled these domestically produced products to protection from foreign competition through a mix of tariffs and special exchange rate treatment (Baer, 2008). Meanwhile, the Brazilian government aimed to actively promote development of domestic industries through a series of measures including waivers from import restrictions for Brazilian manufacturers to enable them to acquire necessary components for their products; local content commitments whereby Brazilian industries agreed to progressively replace foreign components with domestic produced ones; and assistance for Brazilian companies wishing to establish partnerships with foreign companies.

These policies had both positive and negative consequences. On the positive side, ISI resulted in robust GDP growth during the 1950s led by an expanding industrial sector which grew from 20% of GDP in 1947 to 32% by 1960; surpassing agriculture. Annual average real GDP growth averaged 7% during the 1950s. On the negative side, ISI resulted in high levels of debt since industrial growth was financed with foreign capital and loans which Brazil struggled to pay as a result of the fact that ISI failed to promote export competitiveness. ISI also exacerbated inequalities and led to rising inflation.

In 1964, a military regime took over the country and implemented a stabilization plan aimed at controlling inflation, eliminating price distortions, modernizing capital markets, increasing investment in targeted sectors, and diversifying exports so as to restore economic momentum. As part of this stabilization plan the government cut spending, raised taxes, tightened credit, eliminated price distorting mechanisms, and removed export barriers. These measures, combined with other factors such as favorable global economic conditions, increased investment, a rise in exports, and stronger consumer demand, led Brazil to enter a period of robust economic growth that has become known as the “Miracle Years.” During the “Miracle Years” which lasted between 1968 and 1973, annual real GDP growth averaged at 11% led by the industrial sector which grew at average rate of 12.6% (Baer, 2008). Industrial sector growth was led by transport equipment, machinery, and electric equipment. Exports meanwhile surged from USD 1.9 billion in 1968 to USD 6.2 billion in 1973; a marked contrast with the late 1950s and the 1960s when export growth was at best anemic and at worst negative (Fig. 7). Figure 7 seems to suggest that exports played little if any role in the economic growth of the late 1950s whereas there appears to be a significant correlation between GDP and export growth rates of the “Miracle Years.”

Fig. 7: GDP and Export Growth Rates (%)



Source: compiled by author from IGBE/IPEA data

3.3 Decline & The "Lost Decade" (1975-1994)

Brazil was unable to maintain the economic momentum of the "Miracle Years"; the oil shocks of the 1970s and rising inflation combined with growing political repression, socio-economic inequality, and debt fueled financial crises, ushered in the "Lost Decade" of the 1980s. During the "Lost Decade" average annual GDP growth dropped to 2.98% after averaging 8.79% during the whole of the 1970s. Brazil's long decline began after the first oil shock of 1973. At the time, Brazil relied on imports for 80% of its oil demand; the oil shock therefore had a significant impact on inflation which doubled from 15.5% in 1973 to 34.5% in 1974 as the costs of Brazil's oil imports also doubled (Baer, 2008). Rising inflation began to have a negative impact on GDP growth after a period of stable inflation rates during the "Miracle Years".

Brazil had two options for dealing with the first oil shock; it could either curtail aggregate demand so as to reduce Brazil's import bill or it could press ahead with high economic growth which would lead to higher debt. The government chose the latter as curtailing aggregate demand would lead to lower GDP growth which in the context of the time was seen as politically unacceptable especially in the aftermath of the "Miracle Years" and rising socio-economic inequality (Baer, 2008). The government therefore instituted the *Segundo Plano Nacional de Desenvolvimento* – 2nd National Development Plan ("PND II") in 1975 which aimed at protecting Brazil from external economic shocks through countercyclical investment in industry,

energy, and infrastructure so as to diversify Brazil's economic structure and provide lenders with a credible plan that would encourage them to continue financing Brazil's growing current account. Under PND II, the government invested in heavy industries, infrastructure, and alternative energy. PND II was essentially a continuation of Brazil's ISI policies first implemented under President Getúlio Vargas,[2] under whose administrations both Vale (1942) and Petrobras (1953) first emerged. In the years since Vargas the Brazilian government continued to take an active role in the economy and government spending as a percentage of GDP grew steadily from 1949 till 1990 reaching a maximum of 29% (Baer, 2008). PND II strengthened the government's involvement in the economy; particularly in industrial sectors. By the 1980s state enterprises accounted for either all or a majority of sales in various industrial sectors (Fig. 8). Additionally, the state had quasi-monopolies in the railroads, telecommunications, and it also controlled 70% of Brazilian shipping (Baer, 2008).

Fig. 8: Government Market Share per Industrial Sector (1980s)

20 largest firms per sector

Sector	Government Market Share
Public Utilities	100%
Steel	67%
Chemicals & Petrochemicals	67%
Mining	60%
Transport Services	35%
Gasoline Distribution	32%
Fertilizers	26%
Transportation Equipment	21%

Sources: Baer

To finance PND II the government turned to foreign creditors who were willing to provide credit as many international creditors at the time were awash with petrodollars and thus willing to make loans. The high level of debt was justified on the belief that PND II would help Brazil diversify its exports and thus help earn the foreign reserves necessary to pay back this debt. The second oil shock of 1979, however, followed by interest rate hikes in the 1980s derailed this plan. Moreover, by the 1980s public enterprises began facing increasing difficulties as they were encouraged to borrow more than they needed in order to provide the government with the foreign reserves necessary to pay for imports (Baer, 2008). As a result, public sector debt became a major problem for Brazil during the 1980s especially since Brazil financed the public sector through inflationary financing. By the mid

[2] Getúlio Vargas served as President of Brazil from 1930 to1945 and again from 1951 to 1954. His administration initiated import substitution policies aimed at industrializing the country.

1980s inflation had become a major problem as a result of the government's inflationary financing. The government attempted to deal with inflation through a series of plans in the late 1980s and early 1990s which implemented price and wage controls coupled with new currencies. These plans failed because they did not tackle the structural issues responsible for inflation. Furthermore, according to Baer, there were three main mechanisms embedded in the Brazilian economy which made it difficult to battle inflation. First, Brazil suffered from oligopolistic industrial sectors due to the closed protectionist nature of the Brazilian economy thus allowing the country's manufacturers and service providers to pass externally generated costs on to the customer. Second, manufacturers could obtain compensation for income erosion through indexed financial instruments and subsidized credit. Third, wages in Brazil were indexed which helped to further propagate inflation. All three mechanisms combined helped create and sustain an inflationary chain reaction which enabled concentration of political power and exacerbated socio-economic inequality. Moreover, since the government's plans relied on price and wage controls, they created price distortions which only worsened inflation and eventually led to hyperinflation; between 1988 and 1994 average annual inflation was 1,391% reaching a height of 2,708% in 1993. GDP growth rates were also very low during this period – averaging 1.51%.

3.4 Reform & Growth (1994- Present)

During the 1990s Brazil entered a period of reform which would lay the foundations for the recent economic growth which the country experienced. Brazil embarked on three types of reform: privatization, trade liberalization, and macroeconomic reform each of which is described herein.

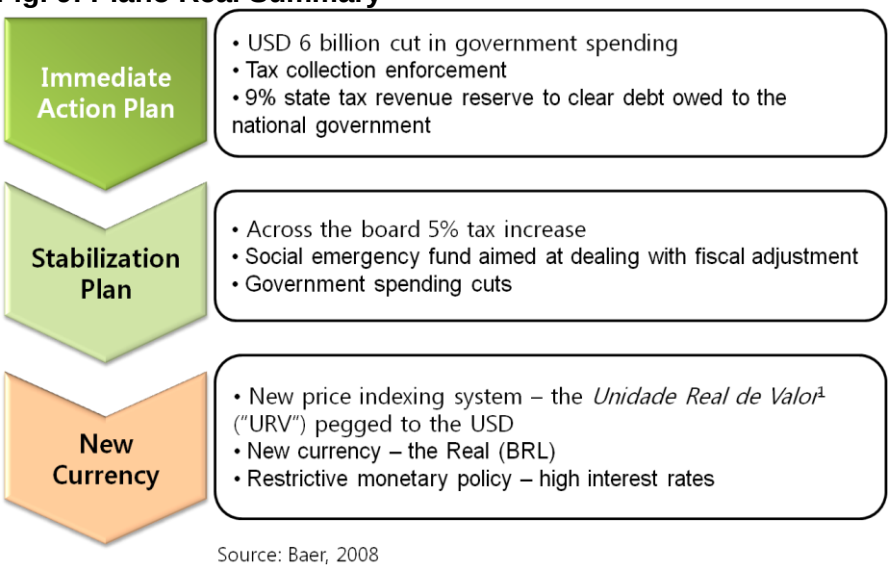
Military rule came to an end in 1985 and was followed with the implementation of a new constitution in 1988 which along with subsequent legislative reforms in the 1990s opened up certain sectors of the economy to private and foreign capital and enabled privatization of state firms as well as infrastructure. Prior to the aforementioned reforms not only did government enterprises have dominant positions in several industrial sectors but certain economic sectors were actually off-limits to private and foreign capital as per legislation in force at the time. Infrastructure, utilities, and the oil and gas exploration and production sectors were closed to foreign and private capital. In 1990, Law 8.029 abolished Portobras, a government entity which had been responsible for building, developing, and operating ports since 1975. Portobras's termination paved the way for increased port competition. In 1993, Law 8.630, known as the *Lei de Modernização dos Portos* – Port Modernization Law, was passed which established a new administrative framework for the port sector aimed at encouraging greater private participation in the port sector. In February 1995, the Brazilian government passed Law 8.987 granting private companies the right to operate some public utilities. Later that year, Constitutional Amendment No. 9 was approved which opened up the oil and gas exploration and production sector to both foreign and domestic private capital. In

1997, the Brazilian government went a step further and abolished Petrobras' monopoly in the oil and gas sector through Law No. 9.478 of 1997. Petrobras itself was subsequently partially privatized in 1997. Other major state enterprises such as Usiminas (1991), Telebrás (1998), Embraer (1994), and Vale (1997) were also either entirely or partially privatized. Between 1991 and 2005, a total of 120 state firms were either completely or partially privatized (Baer, 2008).

Amid the macroeconomic crisis of the 1990s, there was recognition that trade liberalization was needed in order to tackle inflation. To that end Brazil began a process of unilateral tariff reductions. Average trade tariffs dropped from 47% in the mid 1980s to 13% by the mid 1990s while effective rate of protection fell from 55.8% to 20% during the same period (Ferreira et al, 2007; Baer, 2008; Motta, 2009). Trade was also bolstered by the impact of the port privatization policies which increased private investment in ports, led to increased port productivity and reduced port costs. For example, between 1997 and 2004, average container handling costs dropped from USD 420 per container to USD 144. Port service costs during this period also dropped anywhere from 20% to as much as 70% (Pedreira, 2006).

During this time Brazil also laid the foundations of its current macroeconomic stability through the reforms of the *Plano Real* – the "*Real* Plan." The *Plano Real* was the 6th in a series of macroeconomic stabilization plans undertaken by several presidential administrations since the mid 1980s. The *Plano Real* was a series of fiscal and monetary measures which according to Baer succeeded where others had failed because they included a strong element of fiscal adjustment and did not rely on price controls (Fig. 9). The *Plano Real* had a strong positive impact on inflation. Inflation dropped from 1,093% in 1994 to 14.78% in 1995 and eventually 7.48% in 1997. The plan also had a positive impact on corporate balance sheets and purchasing power. The reforms of the *Plano Real* combined with lower import tariffs, and a strong *Real* helped control inflation at the turn of the century.

Fig. 9: Plano Real Summary



Source: Baer, 2008

[1] *Unidade Real de Valor* means "Unit of Real Value"

Despite the stability that the *Plano Real* brought about, it took some time for the Brazilian economy to regain momentum. With an annual average GDP of only 1.71%, the 1990s had the lowest annual average GDP of any decade during the second half of the 20th century. Despite strong GDP growth in the immediate aftermath of the *Plano Real*, high interest rates combined with poor export performance and failure to implement the fiscal reforms advocated under the *Plano Real* eventually resulted in declining GDP growth. The Asian (1997) and Russian (1998) financial crises put Brazil in a difficult situation as there were concerns that Brazil would face a similar financial crisis. To stem the outflow of capital, the Brazilian government responded by raising interest rates which failed to stem the outflow of capital but resulted in an increased the debt burden and poor GDP growth in 1998 and 1999 during which GDP grew at only 0.04% and 0.25% respectively. The IMF eventually had to step in to help and the crisis provided the kind of pressure President Cardoso needed to push through some of the fiscal reforms that had been advocated under the *Plano Real* as well as promote his re-election. Moreover, the government devalued the *Real* which helped Brazilian exports and led to higher GDP growth in 2000. The reforms of the 1990s helped usher in a new period of growth for Brazil and the country became the focus of increasing international attention.

In an influential paper from 2001, Goldman Sachs first coined the now famous "BRIC" thesis which argued that economic growth in Brazil, Russia, India, and China would exceed that of the G7 countries and that by the end of the decade, the economic weight of the BRIC countries would eventually increase to 23% of global GDP by the end of the decade from 8% in 2000. From the beginning, however, there was skepticism as to whether the "B" really belonged in BRICs. Despite the skepticism, over the past decade Brazil emerged from almost two decades of economic malaise and achieved an average annual GDP growth rate of 3.67%; it's

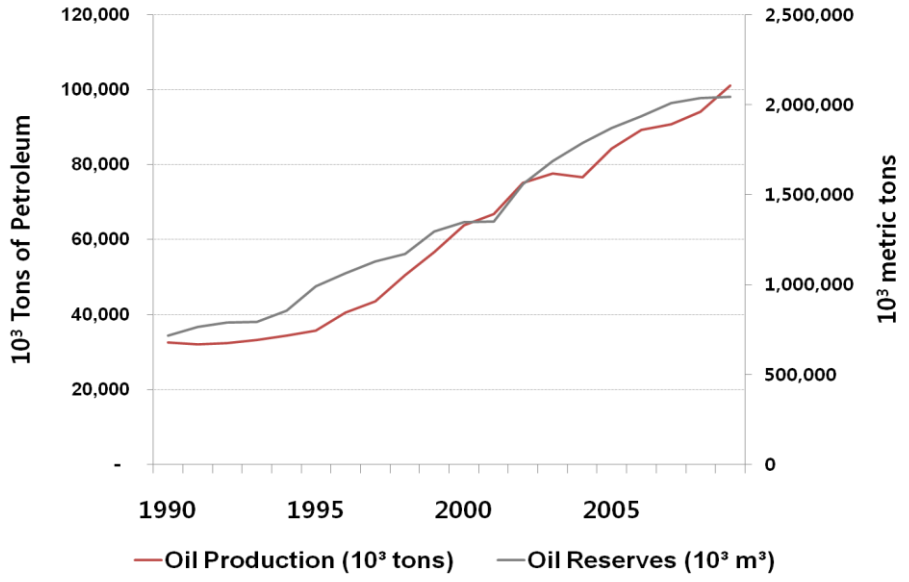
best decade average GDP growth rate since the 1980s[3]. Moreover, Brazilian outbound foreign direct investment ("FDI") exceeded inbound FDI, and some of the country's major firms began to emerge as global players. Brazil's GDP finally emerged from two decades of stagnation and rose faster than at any time since the 1970s. Furthermore, Brazil's poverty rate dropped from 35% in 1999 to 25% in 2007 (Salama, 2010). Brazil's growing momentum seems to be giving credence to Goldman Sachs' BRIC thesis but have things really changed in Brazil? Is this new economic momentum more credible and sustainable than that seen in the 1960s or 1970s? In explaining this momentum and why it differs from previous growth periods, recent scholarship has pointed to a mixture of internal and external factors which make Brazil more stable as well as better able to compete internationally (Goldman Sachs, 2001; Goldman Sachs, 2007; Mendoça de Barros, 2008; Brainard-Martinez-Diaz, 2009).

With regards to internal factors, recent academic literature identifies five internal factors that make this period of economic growth different from those of previous periods of economic growth. First, Brazil is more politically stable today than during the "Acceleration" or "Miracle Years." Since 1985, Brazil has had a stable democratically elected civilian government and the country has not experienced any serious political crises since that time. The country's military no longer meddles in politics and has respected electoral victories. Second, since the introduction of the *Plano Real*, subsequent Brazilian governments have continued to adhere to the basic principles of the *Plano Real* and abstained from such practices as price controls, inflationary financing, and large government spending programs. This commitment to macroeconomic stability has enabled Brazil to pay off its debts, build up reserves, and become a net creditor (Goldman Sachs, 2007). Third, Brazil is finally beginning to enjoy the benefits of ISI policies of the past. ISI policies laid the foundation for some of the largest industrial groups in Brazil today and also helped Brazil acquire the know-how that is helping make Brazil a more competitive economic player. Despite some problems with government interference in the economy, state involvement did produce some of today's biggest and most competitive Brazilian firms. Furthermore, some of the research institutes set up during ISI period have given Brazil an edge in markets such as biofuels, deep-sea offshore oil and gas, and agribusiness. The process of privatization reforms of the 1990s helped transform some of the former state-owned enterprises into the globally competitive firms that they are today. In the field of alternative energy Brazil today is a leader thanks to the government's efforts to protect Brazil from oil shocks and make it self-sufficient with regards to energy. Today 46% of Brazil's energy needs are generated using alternative fuels; this compares favorably with the world average of only 13% and the OECD average of 6% (Brainard, Martinez-Diaz, 2009). Brazil therefore has a competitive advantage in this field as global energy demand is expected to continue increasing and traditional resources become more scarce or difficult to access. Fourth, during the past decade Brazil has found substantial

[3] Based on figures from the Brazilian Statistical Institute (IGBE) and the IMF

offshore oil and gas reserves which may enable it to one day become an oil exporter.

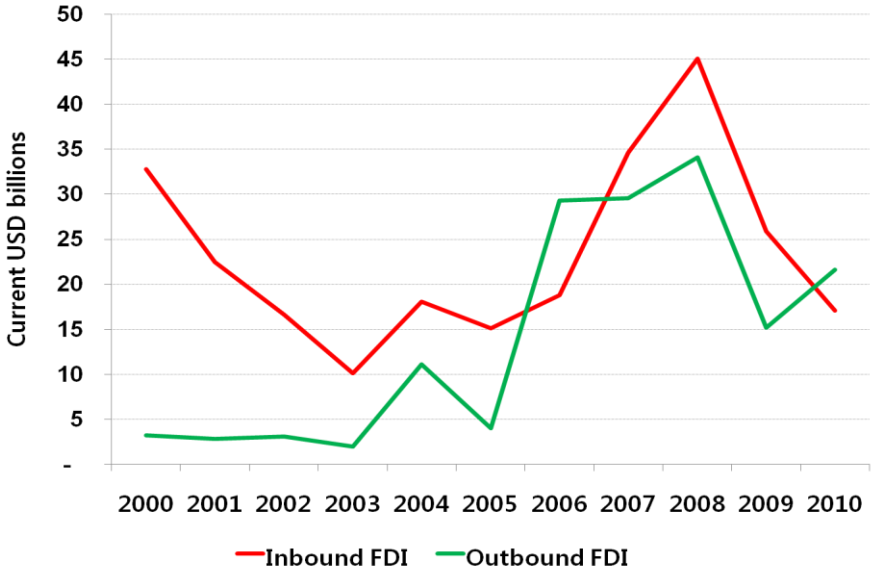
Fig. 10: Petroleum Reserves & Production (1990-2009)



Sources: Compiled by Author from MME data

Its oil reserves and oil production have increased steadily over the past 20 years (Fig. 10). Finally, over the past decade Brazilian corporations and conglomerates such as Petróbras, Embraer, Vale, Odebrecht, Gerdau, and Camargo Corrêa took advantage of favorable global macro-economic conditions to expand their operations across Latin America and the world. Some of these Brazilian firms further integrated themselves into the global markets by raising capital in foreign stock exchanges. Furthermore, outbound FDI grew rapidly and in some years even exceeded inbound FDI (Fig. 11).

Fig. 11: Brazilian Inbound/Outbound FDI



Sources: Compiled by Author from MDIC data

External trade-related factors have also been cited as playing a significant role in Brazil's recent economic growth. According to Mendonça de Barros, the dynamism of the Brazilian economy is tied to changes in the Asian economy and in particular to the integration of billions of Asians (mainly Chinese) into the global economy which has changed the price relationship between industrial products and agricultural commodities in favor of the latter (Mendonça de Barros, 2008). This trend is expected to continue; over the next 12 years 1.8 billion additional people are expected to achieve middle class living standards which will fuel demand for the kinds of commodities which Brazil is well suited to supply. Brazil for example is the world's second largest supplier of iron ore and is a key supplier of various agricultural commodities such as soy, ethanol, and coffee (Fig. 12). It was the world's third largest supplier of agricultural commodities in 2007. The country is uniquely well suited to continue playing an important role as a food and commodity provider in relation to its competitors given its geographical size, population density, and natural attributes. Moreover, trade plays a much more important role in the Brazilian economy trade (exports and imports) as the percentage of GDP has averaged 21% over the past 10 years; the highest percentage since the 1950s. The country achieved impressive export growth growing at 20% between 2003 and 2005 (Zendron, Catermol, 2006). Brazil's export growth outpaced world export growth for most of the decade (Fig. 13). In this regard, Brazil seems much more linked to the global economy than before. Moreover, higher levels of imports have helped promote macroeconomic stability by helping to keep inflation under control.

Fig. 12: Brazilian Agribusiness Export 2007

Item	Exports (USD m.)	Brazil/World (2005)	
		Share (%)	Ranking
Soy	11,386	38	2
Sugar/Ethanol	6,770	29	1
Chicken	4,626	29	1
Beef	4,232	20	1
Coffee	3,887	29	1
Tobacco	2,262	23	1
Orange Juice	2,252	82	1
Corn	1,943	2	8
Pork	1,209	16	4
Fruits	717	N/A	N/A
Cotton	507	5	4
Powder Milk	225	1	14
Others	7,061	N/A	N/A
Total	**47,078**	**4**	**3**

Source: Brainard, Martinez-Diaz

Fig. 13: Export Growth

Source: MDIC

3.5 Future Prospects & Challenges

Given its stability, attributes, and global demand trends, Brazil is expected to continue posting healthy economic growth but to achieve its potential it needs to implement additional reforms and tackle issues which hinder its competitiveness.

According to Goldman Sachs, the Brazilian economy has the potential to achieve 5% average annual growth over the long-run but to do this it must increase savings and investment, open its economy further, improve the quality of its education, and implement reforms to improve institutional performance. Another major problem the country faces is infrastructure. For all of Brazil's impressive achievements and global stature, Brazil's infrastructure ranks among the worst in the world. For example Brazil has approximately 1.7 million km of roads of which only 12.5% (218,000km) are paved[4]. Moreover, according to the World Economic Forum's 2010-11 Global Competitiveness Report, Brazil's road infrastructure ranked 105 out of 139 countries; placing it among countries such as Madagascar, Tanzania, and Mali (Zepeda, 2010). Also, despite unilateral trade liberalization, Brazil still practices protectionism. Certain economic sectors such as automobiles, electrical equipment, plastics, and clothing continue to enjoy protectionist measures (Motta, 2009). Onerous local content requirements remain in the shipbuilding and offshore oil and gas engineering sectors. Brazil has yet to fully abandon the ISI policies of the past and in fact seems to be determined to maintain elements of these policies in light of the challenge that Brazilian manufacturers face from Chinese competition.

3.6 Maritime Transport Flows

The discussion in this chapter has thus far focused on explaining Brazilian economic developments over the past 60 years and identifying some of the opportunities and challenges which Brazil faces in achieving its potential as a major global economic power. This section seeks to draw the connection between Brazilian economic trends and maritime transport flows in order to understand the relationship between the two. This section will therefore provide a historical overview of Brazil's maritime trade flows and use simple regression analysis to establish some relationships between Brazilian economic developments and maritime trade.

[4] Figure calculated by author using statistics from ANTT and the Brazilian Ministry of Transport

Fig. 14: Total Maritime Transport Flows (Tons)

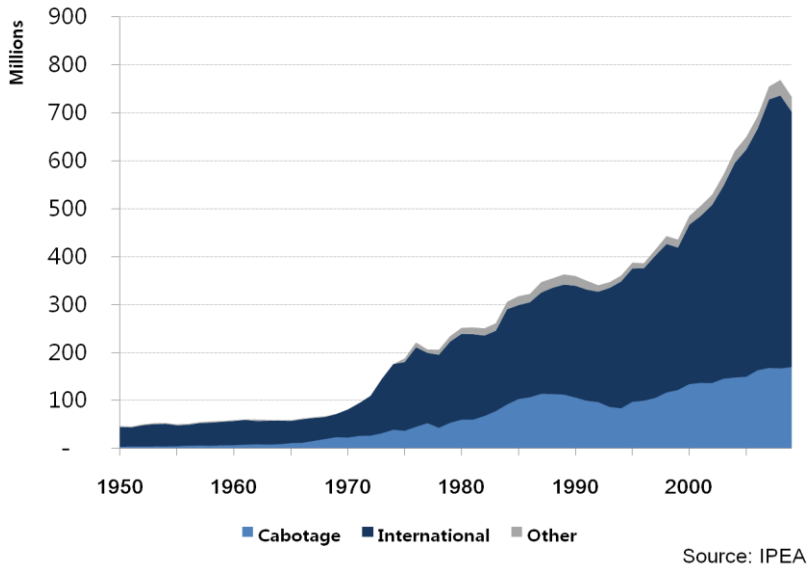
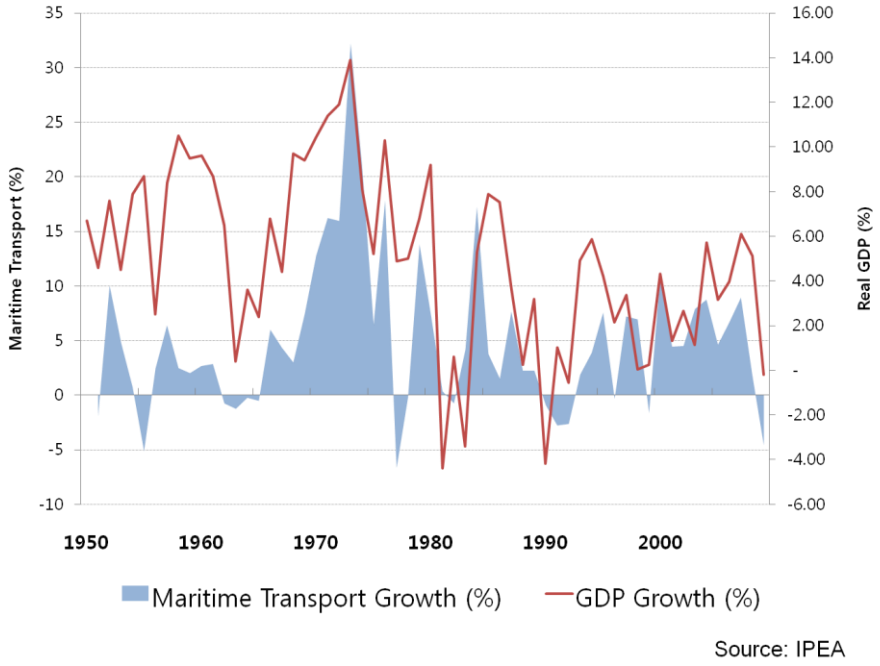


Fig. 15: GDP & Maritime Transport Growth (1950-2009)



Given Brazil's extensive coastline and the fact that most of its population lives along the coast, maritime transport has long played an important role in Brazil. Over the past 60 years, Brazilian maritime transport flow volumes have traditionally been driven by international shipping flows (exports and imports) which have accounted for 60% to 80% of Brazilian seaborne cargo (Fig. 14). Brazilian maritime transport flows have also mirrored developments in the Brazilian economy; maritime transport flow growth rates, for example have generally mirrored the country's real GDP growth rates over the past 60 years (Fig. 15). Moreover, Figures 14 and 15 show

that during the acceleration period of the 1950s maritime transport flows were rather stagnant because international trade did not play a significant role in economic growth during that time. Maritime transport flows began taking off during the “Miracle Years” of the late 1960s and early 1970s when international trade played a more significant role in the country’s economic growth. After the oil crisis of 1973 maritime transport flows slowed but continued growing, albeit at lower rates, even during the “Lost Decade” of the 1980s. Maritime trade began to accelerate again in the mid 1990s and took off steeply during the first decade of this century driven by the economic reforms of the 1990s and the rise of Asia in the beginning of this century. Maritime transport nearly doubled during the past decade from 430 million tons of seaborne cargo in 1999 to 732 million tons in 2009. Another interesting thing to notice regarding Figure 14 is that even though Brazilian maritime transport flows also experienced rapid growth during the “Miracle Years” when Brazil’s economy grew at double digit rates, the cargo volumes at that time were lower. Although economic growth rates during the past decade were not as high as those of the “Miracle Years” the cargo volumes are much higher which seems to reflect the overall “globalization trend” of increasing international trade. These higher cargo volumes are also facilitated by port infrastructure and technological developments since the 1970s.

To better understand what drives Brazilian maritime transport flows, statistical analyses were conducted using time series data for the value of Brazilian trade flows, international maritime transport flows, and cabotage transport flows from 1950 to 2009. The statistical data for these analyses was obtained from the *Instituto de Pesquisa Econômica Aplicada* – Institute for Applied Economic Research (“IPEA”), a Brazilian government research institute. First correlation analysis was employed to determine whether linear relationships exist among these variables. Second, four regression analyses were conducted to analyze the relationship between international maritime transport flows (in tons) and international trade (aggregated exports and imports in millions of USD FOB), international maritime transport flows and export values (in millions of USD FOB), international maritime transport flows and import values (in millions of USD FOB), and cabotage transport flows (in tons) and international trade (in millions of USD FOB). These regressions are based on the natural logs of the variables. The detailed results of these analyses can be found in Appendices 1 and 2.

The correlation analyses revealed strong linear relationships between international maritime transport flows and both exports and imports. There was also a strong linear relationship between exports and imports. Cabotage shipping also showed strong correlation with both international maritime transport flows and both exports and imports suggesting that cabotage shipping plays a role in international commerce (Fig. 16). The results of these correlation analyses were significant with each having a p-value of 0.

Fig. 16: Correlation - International Maritime and Trade Flows

	L(International)	Exports (USD m.) FOB	Imports (USD m.) FOB	Cabotage
L(International)	1			
Exports (USD m.) FOB	0.993836372	1		
Imports (USD m.) FOB	0.987771991	0.9866826	1	
Cabotage	0.955641114	0.9589492	0.944708	1

Source: Author's calculations

Fig. 17: International Trade & Maritime Transport - Key Regression Results

	International Maritime Transport			Cabotage Shipping		
Variable	Adjusted R2	Coefficient	P-value*	Adjusted R2	Coefficient	P-Value*
Total Trade	0.99	0.53	1.443E-58	0.91	0.72	1.1788E-32
Exports	0.99	0.52	4.142E-57			
Imports	0.98	0.53	1.62E-48			

*Significant at 1% level

Source: Author's calculations

The regression analyses likewise showed strong relationships among the aforementioned variables (Fig. 17). With regards to international maritime transport flows and aggregate international trade, the regression results reveal that there is, as expected, a strong relationship between international trade and transport flows and that international trade flows can explain almost all the variation in international maritime transport flows (Adjusted R^2: 0.99). The results of the regression are significant with a very large F value (5,240), and very low F-Significance (1.44323E-58), and p-value for the international trade coefficient (1.44323E-58). The equation derived from this regression is as follows:

$$\ln Y = 0.53 \ln X - 0.365 \qquad \text{(Equation 3.1)}$$

Where:
lnY = is the natural log of international transport flows (exports and imports) in tons; and
lnX = the log of international trade flows in USD millions (FOB).

What this equation implies is that an additional USD 1 million in international trade yields approximately 690,000 tons of maritime cargo. This result can be calculated by taking the natural log of 1 million, multiplying this by the x coefficient (0.53) and subtracting the y-intercept. For Brazilian international trade in 2000 (USD 110.8 billion) the predicted y value of this equation was 329 million tons of cargo which is close to actual volume of international maritime trade (332 million tons) recorded in 2000.

With regards to international maritime transport flows and exports and imports, the regression results reveal that exports (R^2 = 0.99) appear to have a stronger influence on international maritime transport flows than imports (R^2 = 0.98). With

regards to exports the regression equation is as follows:

$$\ln Y = 0.522 \ln X + 0.038 \qquad \text{(Equation 3.2)}$$

Where:
lnY = is the log of international maritime trade flows in millions of tons; and
lnX = is the natural log of the value of Brazilian exports in millions of USD (FOB).

The regression between international maritime transport flows and imports yields the following equation:

$$\ln Y = 0.533 \ln X + 0.023 \qquad \text{(Equation 3.3)}$$

Where:
lnY = is the log of international maritime flows in millions of tons; and
lnX = the natural log of the value of imports in millions of USD (FOB).

What the regression results seem to suggest is that exports can account for slightly more of the variation in maritime transport flows than imports but the coefficients seem to suggest that both exports and imports yield roughly the same amount of maritime transport flows. According to equations 3.2 and 3.3 above one USD 1 million worth of exports yields slightly more international maritime cargo (1.04 million tons) than USD 1 million worth of imports (1.02 million tons) thereby implying that exports appear to have greater influence on the volume of international maritime cargo generated. This makes sense given the fact that Brazil has typically had trade surpluses.

As mentioned earlier, cabotage shipping also seems to be strongly influenced by international trade and transport flows. Therefore, a regression analysis of cabotage and international trade (exports and imports) flows for the period between 1950 and 2009 was conducted. As with the previous regressions the data is expressed in natural log form. The regression results show that a large percentage of the variation in cabotage transport flows appears to be influenced by international trade with R^2 of 0.91 but the regression appears to be less significant than the regressions for international trade and international transport flows. The regression yielded the following equation:

$$\ln Y = 0.722 \ln X - 3.51 \qquad \text{(Equation 3.4)}$$

Where:
lnY = the log of cabotage transport flows in millions of tons from 1950 to 2009; and
lnX = the log of the value of international trade (imports plus exports) in millions of USD FOB.

According to equation 3.4 above, USD 1 million of international trade (exports and

imports) should yield approximately 30,000 tons of cabotage cargo. For international trade flows in 2000 (USD 110 billion) this equation predicted that this amount of trade would generate 131 million tons of cabotage cargo which is close to actual recorded volume of 134 million tons recorded that year.

In general the Brazilian maritime transport flow data conforms to generally held assumptions about maritime trade in that it is strongly correlated with GDP and international trade. Interestingly, cabotage shipping also appears to be strongly influenced by trends in international maritime shipping suggesting that cabotage plays an important role in domestic distribution of exports and imports despite the fact that it accounts for only about 10% of domestic freight cargo.

4 Theory & Methodology

4.1 Overview

In light of the theoretical background on maritime economics and the description of Brazil's economic growth in the previous chapters, this chapter introduces the quantitative methodology that will be used to analyze the relationship between trade flows and economic growth and development. This chapter therefore marks the beginning of the quantitative analysis of this thesis. The basic economic premise of the quantitative analysis conducted herein is that demand for transport is derived demand in that demand thereof depends on demand for other factors such as supplies or leisure (Button, 2010). Maritime transport flows are representations of this type of derived demand in that they are contingent upon demand for commodities and goods, demand for which in turn depends on national income, economic growth, and trade barriers. The quantitative analysis will therefore focus on value based trade flows given that they are the underlying demand for maritime transport.

The basic objectives of this chapter are to describe the quantitative methods used in this thesis, describe the purpose of each method with regards to the quantitative analysis herein, and describe the data that will be used. This chapter is therefore divided into four parts; the first will discuss the correlation analysis, the second will describe the gravity analysis, the third will describe the GSIM model that will be used to project trade flows given Brazil's expected trade flows, and finally the data that will be used for the quantitative analysis will be described.

Given that the objective of this thesis is to analyze the impact of Brazilian economic growth and development on Brazilian trade and transport flows, it is necessary to first understand the relationship between economic factors and trade flows, and then based on an understanding of this relationship, project Brazilian trade flows in light of Brazil's expected economic growth. The methodology employed herein can therefore be broken down into two approaches; a "historical" approach that uses available statistical data in order to explain the relationship between economic factors and trade and a "forward-looking" approach to project trade flows given Brazil's expected growth and development. The former consists of correlation and gravity analysis while the latter consists of the GSIM model. Aside from explaining Brazilian trade flows, the methodology used in the "historical approach" will also compare Brazil to other countries in order to see whether Brazil differs from its peers with regards to the relationship between economic forces and trade flows.

4.2 Correlation Analysis

Correlation analysis is a statistical method which measures whether there a relationship exists between two variables, whether that relationship is positive or negative, and the strength of any existing relationship between two variables. Correlation analysis takes the covariance between two variables and divides them by the product of the standard deviations of thereof in order to produce the coefficient of correlation as shown below:

$$\rho = \frac{\sigma_{xy}}{\sigma_x \sigma_y} \qquad \text{(Equation 4.1)}$$

Where:
ρ = the coefficient of correlation;
σ_{xy} = the covariance between variables x and y which measures the type (i.e. positive, negative, non-existing) of linear relationship between the two variables;
σ_x = the standard deviation of variable x; and
σ_y = the standard deviation of y

The coefficient of correlation varies between -1 and +1 where -1 indicates a negative linear relationship in which variables move in opposite directions and +1 indicates a positive linear relationship in which variables move in the same direction. A coefficient of 0 indicates that there is no linear relationship. The coefficient of correlation, however, should not be interpreted as an indication of causation; if two variables are correlated it does not mean that variable *x* causes variable *y* since the correlation between two variables could be an indication that both variables are being caused by another variable (Keller, 2008). Moreover, although the coefficient of correlation helps determine whether a linear relationship exists and the strength of that linear relationship, it does not tell us how much of the variation in one variable is caused by variation in the other variable. As such, it cannot be used to determine which variable(s) x has the most impact on variable y. The coefficient of correlation is also unable to tell us how a change in one variable will impact another variable. For these reasons, the correlation analysis in this thesis will be used simply to verify whether there is a relationship between the aforementioned economic factors and trade.

4.3 Gravity Models

A Gravity Model, also commonly referred to as a “Gravity Equation” is an econometric method whereby trade flows are modeled as a function of factors such as GDP, distance, and population among others; the aim of which is to explain how the aforementioned factors affect trade flows. As the name of this econometric method implies, a gravity model basically applies Sir Isaac Newton’s Law of Gravity

to explain bilateral trade flows. The basic gravity equation (4.2) stipulates that the gravitational force between two objects *i* and *j* (F_{ij}) is a function of the product of their masses (M_i, M_j) divided by the distance between the two objects where G is a gravitational constant.

$$F_{ij} = G \frac{M_1 M_2}{D_{ij}} \qquad \text{(Equation 4.2)}$$

The application of gravity theory in economics has its roots in work done by Tinbergen (1962) and Pöyhönen (1963) who provided evidence that bilateral trade is proportional to the economic masses of the bilateral trade partners and inversely related to the distance between the two trade partners. According to Bergstrand (1985) the gravity equation is typically a "log-linear equation [which] specifies that a [trade] flow from origin *i* to destination *j* can be explained by economic forces at the flow's origin (i.e. natural resources, labor, capital, etc.), economic forces at the flow's destination (i.e. high income, strong economic growth, tariffs, trade barriers, etc.), and economic forces either aiding or resisting the flow's movement from origin to destination (i.e. logistics costs, distance, common language, common culture, etc.)." In international trade analysis, aggregate bilateral trade flows are commonly explained using the following basic equation:

$$X_{ij} = \beta_0 Y_i \beta_1 Y_j \beta_2 D_{ij} \beta_3 A_{ij} \beta_4 U_{ij} \qquad \text{(Equation 4.3)}$$

Where:
X_{ij} = is the aggregate USD valued trade flow from country *i* (origin) to country *j* (destination);
Y_i = is the origin country's GDP;
Y_j = is the destination country's GDP;
D_{ij} = is the distance between the two countries; this can either be the distance between the two countries' capital cities, ports, or major economic centers;
A_{ij} = represents factors aiding or hindering the flow of trade and can include anything from transport costs, tariffs, poor infrastructure, political stability, or any other factor deemed significant;
U_{ij} = is log normally distributed error term with $E(\ln U_{ij}) = 0$ (Bergstrand, 1985; Anderson, 2003).

Despite the Gravity Model's ability to explain trade flows, its ability to predict trade flows is limited by the lack of strong theoretical foundations (Bergstrand, 1985). For the purpose of this thesis two gravity models are used and are described herein.

4.3.1 Model 1: Global Trade Flows

The first model will analyze trade flows at a global scale by looking at export flows between 1999 and 2009 among 38 of the world's largest trading countries. The

basic objective of this model is to explain global trade flows thereby seeking to verify the notion that distance and trade barriers inhibit trade while national income drives trade flows. The model has three types of variables; exogenous economic and geographic variables expressed in natural log form, dummy variables for various aspects affecting trade (i.e. common language, country-specific effects, etc.), and endogenous multilateral resistance ("MR") terms whose purpose is to account for the "gravity" exerted by other trading partners upon bilateral trade partners. The model equation is structured as a log-linear equation as follows:

$$\mathbf{lnX_{ij}} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln D_{ij} + \alpha_4 \ln TF_j + \alpha_{5\ldots10} DU_{1\ldots6} + \alpha_{11..49} C_{1\ldots38} + \alpha_{50\ldots57} MR_{1\ldots8} + U_{ij} \quad \text{(Equation 4.4)}$$

Where:
$\mathbf{lnX_{ij}}$ = the log of the value (in USD) of trade flows from origin country *i* to destination country *j* among the 38 countries in the data set;
$\mathbf{lnY_i}$ = the log of the origin's nominal GDP for each year of data;
$\mathbf{lnY_j}$ = the log of the destination's nominal GDP for each year of data;
$\mathbf{lnD_{ij}}$ = the log of the distance between the origin's capital city and the destination's capital city in kilometers;
$\mathbf{lnTF_j}$ = the log of the destination country's Trade Freedom Index as an indication of trade barriers;
$\mathbf{DU_{1\ldots6}}$ = six dummy variables indicating whether a bilateral pair are parties to a free trade agreement, share a common border ("contiguity"), share a common official language, once had a colonial relationship, whether the bilateral pair were once part of the same country (i.e. Czech Republic and Slovakia), and whether at least one of the bilateral trade partners is landlocked;
$\mathbf{C_{1\ldots38}}$ = 38 dummy variables for each of the countries in the data set aimed at capturing country specific effects; and
$\mathbf{MR_{1\ldots8}}$ = eight MR terms for each of the aforementioned dummy variables and distance (D_{ij}). These terms measure the resistance that bilateral trade partners face as a result of their propensity to trade with other countries due to the geographical, historical, and cultural factors represented by each of the dummy variables.

4.3.2 Model 2: Brazil Gravity Model

The second gravity model employed in this thesis will aim to explain Brazilian trade flows using the same equation used for the first model above as follows:

$$\mathbf{lnX_{ij}} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln D_{ij} + \alpha_4 \ln TF_j + \alpha_{5,6,7} DU_{1,2,3} + \alpha_{7..54} C_{1\ldots48} + \alpha_{55,56} MR_{1,2} + U_{ij} \quad \text{(Equation 4.5)}$$

Although equation 4.5 is basically the same as 4.4 there are number of differences with regards to the variables. In equation 4.5 $\ln X_{ij}$ represents the log of the value of

trade flows between Brazil and 48 of its main export partners and is therefore symmetrical as equation 4.4 but does not take into consideration trade flows between Brazil's trade partners such as trade between Germany and the United States. Equation 4.5 also differs from equation 4.4 in that excludes dummy variables for free trade agreements, and colony. The aforementioned variables were deemed irrelevant for Brazil's case for several reasons. With regards to free trade agreements, Brazil is not party to any bilateral or multilateral free trade agreements aside from MERCOSUR with a few of its South American partners, the effects of which can be captured by country specific variables. The main of objective of this second gravity model is to explain Brazil specific trade flows and determine whether Brazilian trade patterns differ in any way from global trends.

4.4 Trade Projections

This next part of the methodology aims to use the insights gathered from the gravity models to project the growth of Brazilian trade flows from 2010 to 2016 so as to assess whether current trade patterns are likely to persist and derive policy implications for Brazil over the this next decade as the country aims to build on the economic momentum of this past decade. Although the Gravity Model has been widely used to explain bilateral trade flows, it is no widely used to forecast trade flows due to the difficulty of modeling the effect of structural changes in the economy. Since gravity models are linear equations, using them to forecast trade flows simply leads to a projection based on the assumption that the long-term linear trend will continue. Gravity models are unable to capture "structural breaks," in other words the emergence or decline of certain trends in trade and are therefore not well suited forecasting trade flows. For these reasons, the Global Simulation Model ("GSIM") will be used to project trade flows over the next decade.

4.4.1 GSIM Model Description

GSIM is a multi-region, partial equilibrium model that allows for simultaneous assessment of trade policy effects on a global, national, or regional level (Francois, Hall, 2003). The model assumes national product differentiation implying that imports may be imperfect substitutes for each other and that consumers have homothetic preferences. The model calculates the welfare effects on consumers, producers, and governments thereby making it possible to not only measure the effect of trade policy changes on trade but also assess who is likely to benefit or lose from such policies. The model requires a relatively limited amount of input data and is therefore a flexible model and useful tool for policy analysts.

The model contains 12 main elements which are described below and cover supply, demand, welfare effects, and elasticity (Mutambatsere, 2006). In the model import demand is structured as a function of the internal price for a particular product *i* in

destination country *v* ($P_{(iv)r}$), the price of other varieties of that same product from other supplier countries ($P_{(iv)s \neq r}$), and the proportion of income spent in country *v* on product *i* ($y_{(iv)}$) as shown in equation 4.6 below:

$$M_{(iv)r} = f\left(P_{(iv)r} P_{(iv)s \neq r} y_{(iv)}\right) \quad \text{(Equation 4.6)}$$

Where:
$M_{(iv)r}$ = is the demand for product *i* from origin country *r* in the Destination Country; and
s,r= are the origin countries supplying product *i*

The export supply meanwhile is modeled as a function of the world price for the Product from Origin country *r* as shown in equation 4.7 below:

$$X_{ir} = f(P_{ir}^{w}) \quad \text{(Equation 4.7)}$$

Where:
X_{ir} = is the supply of product *i* from origin country r; and
P^{w}_{ir} = is the "world price" of product *i* from country *r*

The cross price elasticity ($N_{(iv)rs}$) is modeled as a function of the expenditure share of imports of product *i* from origin country *s* in country *v* ($\theta_{(iv)s}$), the composite demand elasticity of destination country *v* (E_m) and the elasticity of substitution (E_s):

$$N_{(iv)(rs)} = \theta_{(iv)s}(E_m + E_s) \quad \text{(Equation 4.8)}$$

Equation 4.8 therefore represents the elasticity of product *i* from country *r* with regards to product *i* from country *s* in destination country *v*. It represents the elasticity of demand for one variety of product *i* over another variety of product *i* from another supply country and therefore represents an income effect.

The own price elasticity ($N_{(iv)(rr)}$) represents the substitution effect due to changes in the price of product *i* in the origin country *r*. This elasticity is a function of the expenditure share of imports of product *i* from origin country *r* in country *v* ($\theta_{(iv)r}$) and the demand elasticity of destination country *v* and the elasticity of substitution as in the previous equation:

$$N_{(iv)(rr)} = \theta_{(iv)r} E_m - (1 - \theta_{(iv)r}) E_s \quad \text{(Equation 4.9)}$$

The price of product *i* in country *v* ("consumer price") is a function of the world price for product *i* (P^{w}_{ir}) and the tariff which origin country *v* imposes on that product ($t_{(iv)r}$) as expressed in equation 4.10 below:

$$P_{(iv)r} = (1 + t_{(iv)r}) P^{W}_{(ir)} \quad \text{(Equation 4.10)}$$

The change in consumer price is expressed as a function of the change in the world price for product *i* divided by the world price and the change in tariffs divided by the tariff rates in the destination country as expressed in equation 4.11 below:

$$\frac{\Delta P_{(iv)r}}{P_{(iv)r}} = \frac{\Delta P^{w}_{(ir)}}{P^{w}_{(ir)}} + \frac{\Delta T_{(iv)r}}{T_{(iv)r}} \qquad \text{(Equation 4.11)}$$

The percentage change in export supply is expressed as a function of the export supply elasticity ($E_{x(ir)}$) and the proportional change in the world price which the origin country receives for product *i* as expressed in equation 4.12 below:

$$\frac{\Delta X_{ir}}{X_{ir}} = E_{x(ir)} \left(\frac{\Delta P^{w}_{(ir)}}{P^{w}_{(ir)}}\right) \qquad \text{(Equation 4.12)}$$

The proportional change in import demand meanwhile is a function of the own price elasticity, the proportional change in the price of product *i* in destination country *v*, and the sum of the cross price elasticity for all varieties of product *i* times the proportional change in the price of product *i* from origin country *s* in destination country *v* as shown in equation 4.13 below:

$$\frac{\Delta M_{(iv)r}}{M_{(iv)r}} = N_{(iv)(rr)} \left(\frac{\Delta P_{(iv)r}}{P_{(iv)r}}\right) + \sum_{s,r} N_{(iv)(rs)} \left(\frac{\Delta P_{(iv)s}}{P_{(iv)s}}\right) \qquad \text{(Equation 4.13)}$$

The market clearing condition for origin country *r* is modeled as a proportional change in product *i* from country which is a function of the proportional change in exports of product *i* from origin country *r* as expressed in equation 4.14 below:

$$\left(\frac{\Delta M_{ir}}{M_{ir}}\right) = \frac{\Delta X_{ir}}{X_{ir}} \qquad \text{(Equation 4.14)}$$

Where:
M_{ir}= the sum of the quantity of product *i* exported to all destination countries.

As mentioned earlier the model also measures the welfare effects on producers, consumers, and governments. To that end the model contains three equations to measure the welfare effect for each of the aforementioned parties. The consumer surplus ("CS") is modeled as a function of the the initial expenditure on product *i* from origin country *r* in each of destination markets and proportional changes in the internal price of product *i* in each of the destination markets:

$$\Delta CS_{(iv)} = \sum_{r} \left(R^{0}_{(iv)r} T^{0}_{(iv)r}\right) * \left(\frac{1}{2} E_{m\,(iv)r} \left(\frac{\Delta P_{(iv)}}{P_{(iv)}}\right)^{2} - \left(\frac{\Delta P_{(iv)}}{P_{(iv)}}\right)\right) \qquad \text{(Equation 4.15)}$$

Where:
ΔCS_{iv} = is the change in consumer surplus;
$R^{0}_{(iv)r}$ = is the initial expenditure on product i in country v at world prices ($R^{0}_{(iv)r} = P^{w}_{ir}$

* $M^{o}_{(iv)r}$):
$T^{0}_{(iv)r}$ = the initial tariff placed in destination product *v* on product *i* from country *r*;

The producer surplus ("PS") is modeled as a function of initial export quantities, changes in the world price of product i from origin country r, and changes in the quantity of product i from country r as shown in equation 4.16 below:

$$\Delta PS_{ir} = X^{0}_{ir}\Delta P^{w}_{ir} + \frac{1}{2}\Delta P^{w}_{ir} * \Delta X_{ir} \quad \text{(Equation 4.16)}$$

Where:
ΔPS_{ir} = is the change in producer surplus; and
X^{0}_{ir} = is the initial quantity of product *i* from origin country *r* supplied.

Finally, the change in government revenue (ΔGR_{iv}) is modeled as a function of the change in revenues obtained from an initial tariff on product *i* from country r and the new revenues obtained from new tariffs on product *i* from country *r* as shown in equation 4.17:

$$\Delta GR_{(iv)} = \left(\sum_{r} R^{1}_{(iv)r} * T^{1}_{(iv)r} - \sum_{r} R^{1}_{(iv)r}\right) - \left(\sum_{r} R^{0}_{(iv)r} * T^{0}_{(iv)r} - \sum_{r} R^{0}_{(iv)r}\right) \quad \text{(Equation 4.17)}$$

4.4.2 GSIM Inputs

As mentioned earlier, the model requires relatively little input; only bilateral trade flow values, initial tariff rates, final tariff rates, demand elasticity, supply elasticity, and substitution elasticity. For the tariff rates needed to assess the impact of policy options, two measures were taken into account. The first measure is the World Bank's "Overall Restrictiveness Trade Index" ("OTRI"); a trade barrier index which takes into account tariff rates as well as the ad-valorem equivalent cost of non-tariff measures. This index is calculated as of 2008 and is calculated for both applied and Most Favored Nation ("MFN") tariff rates. OTRI "captures the distortions that each country imposes on its own bundle of imports" (Kee et al., 2009). The second measure taken into account is the average ad-valorem equivalent of "core" non-tariff barriers ("NTB") across all tariff lines as calculated by Kee et al. "Core" NTBs refer to non-tariff trade barriers such as non-automatic licensing, quotas, voluntary export restraints, and price control measures (Mold, 2005). The demand, supply, and substitution elasticities are "standard" elasticities found in the model itself. The bilateral trade flow input is described in more detail below.

4.4.3 Scenario Description

As the title of this thesis implies, the main objective of this thesis is to assess the impact of Brazil's economic growth on trade. To that end this thesis looks at both the country's recent past in order understand how the relationship between Brazilian economic growth and trade has evolved and also looks forward, especially in light of

Brazil's rising global status, to get an idea of how the country's trade flows are likely to develop given the country's expected GDP growth. In looking forward this thesis also aims at assessing the likely impact of policy on Brazilian trade and maritime transport flows; does policy matter and if so what is the likely impact of policy on trade and maritime transport flows? To this end, three trade projections will be made and among these projections the most likely projection will be chosen against which the impact of three different policy options will be assessed (Fig. 18).

Fig. 18: Policy Scenarios - Overview

Sources: Author

A modified version of the GSIM model will be used to create these three trade projections. This modified GSIM model is structured to measure the impact of both demand and supply shocks on trade flows rather than tariffs. These demand and supply shocks will be modeled based on IMF real GDP growth rate estimates for Brazil and five regional trading blocs. Given that the modified GSIM model measures the impact of demand and supply shocks, rough assumptions regarding the nature of GDP growth will be made for each of the three trade projections.

Scenarios 1 and 2 are centered on trade policy and seek to assess the impact of unilateral (Scenario 1) and multilateral (Scenario 2) trade liberalization. These two scenarios will make use of OTRI for the tariff inputs needed in GSIM. Under Scenario 1 Brazil reduces its tariffs and non-tariff measures but its trading partners make no significant reform. In Scenario 2 Brazil's trading partners reduce their trade barriers while Brazil makes no significant trade barrier reforms. Scenarios 1 and 2 seek to shed light on whether it would be more beneficial for Brazil to continue reducing its own trade barriers unilaterally or whether it should instead push for its partners to reduce their trade barriers. This is of particular relevance for Brazil given its status as a major supplier of agricultural commodities and the fact that many countries use subsidies and barriers to protect their agricultural sectors. It has been suggested that global liberalization of the agricultural sector would be very beneficial

for Brazil (Meloni Nassar, 2009). Moreover, within Brazil there has been discussion regarding trade barriers. As mentioned earlier, despite liberalization in the 1990s, elements of Brazil's protectionist past remain in the form of various non-tariff measures such as local content regulations. Those in favor of continued protectionist measures invoke the "infant industry" argument that Brazilian manufacturers need protection in order for them to be able to compete with Chinese and other Asian manufacturers. Without protection, it is argued, local Brazilian manufacturers would not be able to compete against their Asian counterparts and Brazil would therefore be flooded with Asian products. Already, the fast rise of Asian and in particular Chinese imports has led to calls to increase tariffs against Chinese products[5]. *Containerisation International* reported that due to the rapid rise in Chinese imports Brazilian industrial lobbies were lobbying for tariffs and other anti-dumping measures against Chinese products (Containerisation International, May 2011)

The final scenario is domestic in nature and seeks to assess the impact of liberalizing Brazil's cabotage restrictions. It has been suggested that liberalizing or removing cabotage restrictions would help reduce transport and logistics costs for Brazil in several ways. First, removing cabotage restrictions would reduce capital costs for Brazilian cabotage service providers by making it possible for them to acquire foreign built ships which are often cheaper than Brazilian built ships; Brazilian built vessels are approximately 20% to 30% more expensive than ships built in Korea – the current leading shipbuilding nation[6]. Moreover, Brazilian shipbuilding capacity is heavily geared towards meeting the needs of the country's offshore oil and gas industry thereby leaving limited capacity for construction of other types of commercial vessels. Cabotage shipping could also have a positive effect on international freight rates as it would allow international shipping companies to better utilize the ship capacity deployed on routes to and from Brazil. At the moment for example, many container routes between Brazil and East Asia stop at several Brazilian ports before returning to Asia. These vessels, however, are not allowed to transport cargo between Brazilian ports despite having available capacity (Lacerda, 2004). By enabling these vessels to offer available tonnage on domestic routes it would allow foreign shipping companies to increase their economies of scale thereby bringing down freight rates and would perhaps even encourage them to deploy more tonnage on routes to and from Brazil which would have a positive impact on international freight rates for Brazil. Given that cabotage is a NTB, the average ad-valorem equivalent for NTBs across all tariff lines will be used for the tariff inputs needed to analyze the impact of cabotage liberalization on Brazilian trade flows.

Another objective of these scenarios, in particular Scenarios 1 and 2 is to assess how the geopolitics of trade is likely change for Brazil. This is particularly relevant for

[5] http://www.bbc.co.uk/news/business-14383554

[6] Estimates based on the author's professional experience in a shipyard joint venture project in Brazil.

Brazil given the fact that over the past decade China went on to surpass the United States as Brazil's biggest trading partner. China's economic growth over the past decade has created demand for Brazilian commodities which has in turn had a positive impact on Brazilian economic growth over the past decade and stimulated Brazilian international trade. Trade with China is expected to intensify and by 2020 trade with China could account for as much as 68% of Brazil's exports as Brazil continues to be an important source of raw materials for China (Medianu, Whalley 2010). Given the distance between Brazil and East Asia, rising trade with China and other distant Asian countries would increase the average shipping haul demand thereby increasing demand for shipping on routes to and from Brazil. Moreover, it has been suggested that Brazilian trade policy has focused more on promoting "South-South" trade with emerging markets such as South Africa and India, at the expense of promoting trade with Brazil's larger and more important markets in Europe and North America (Brainard, Martinez-Diaz, 2009). Should Brazil really be focusing on "South-South" trade? Is Brazilian trade likely to increase significantly with other emerging markets and are the expected benefits thereof significant enough to merit fostering further trade ties with these emerging markets?

In assessing the changing geopolitics of trade for Brazil, it is not practical to project Brazilian trade with each of the 48 countries in the data set. Therefore, the set will be divided into five major "trading partners": NAFTA, China, the EU, the "Developing/Emerging Markets", and Rest of World ("ROW"). NAFTA will aggregate Brazilian trade flows with the NAFTA members: Mexico, the United States, and Canada. North America, and in particular the United States, has traditionally been a major market for Brazil as well as a major source of imports. China consists of trade flows with both the People's Republic of China and Hong Kong. The main objective of looking at trade with China is to determine whether the current trend is likely to continue. The EU will consist solely of the EU member states in the data set; countries such as Greece, Malta, and Romania will therefore be left out. As with NAFTA, Europe has traditionally been a major trading partner for Brazil. The "Developing/Emerging Markets" category will consist of Argentina, Bolivia, Chile, Colombia, India, Indonesia, Nigeria, Paraguay, Peru, Russia, South Africa, Thailand, Turkey, Uruguay, and Vietnam. The purpose behind this group is to assess whether Brazil should be focusing on what is often called "South-South" trade among developing nations. The countries in this category were chosen either because they are part of what Goldman Sachs has dubbed the "Next-11[7]" economies (Vietnam, Turkey, Indonesia, and Nigeria) that are likely to dominate the world economy along with the BRICs, are members of the G-20 Group of Developing Nations established under the Brasilia Declaration of 2003, or are members of MERCOSUR along with Brazil. The "Rest of World" category comprises those countries which do not fall into the aforementioned categories.

[7] South Korea was left out of this grouping because it is more of a high income industrial economy

4.5 Data

Fig. 19: Global Gravity Trade Data

	Group Trade (USD 000)	World Trade (USD 000.)	(%) of Total
1999	4,240,980,229	5,253,446,557	80.73
2000	4,817,724,430	5,997,577,765	80.33
2001	4,612,022,769	5,784,729,364	79.73
2002	4,846,687,215	6,083,896,420	79.66
2003	5,644,527,364	7,127,309,041	79.20
2004	6,771,933,214	8,606,862,001	78.68
2005	7,572,654,574	9,705,736,825	78.02
2006	8,697,016,214	11,363,192,367	76.54
2007	9,914,919,174	12,916,774,849	76.76
2008	11,097,133,835	14,912,028,119	74.42
2009	8,672,048,660	11,552,216,200	75.07

Source: WITS/UN COMTRADE

The quantitative analyses conducted herein are based on data from 48 countries which jointly account for almost 80% of global trade over the 10 year period under consideration and 90% of the world's GDP (Fig. 19). Most of these countries were chosen for analysis because they are among the world's 40 largest trading nations while others such as Bolivia, Argentina, and Nigeria were chosen because they are important trading partners for Brazil. With regards to Brazil, these 48 countries account for almost 90% of the value of Brazilian exports and almost 100% of the value of goods exported to Brazil (Fig. 20).

Fig. 20: Brazilian Trade

	Exports (USD '000)			Imports (USD '000)		
	Group	Total Exports	Group (%)	Group	Total Imports	Group (%)
1999	43,229,114	48,011,411	90.04	44,987,813	46,035,734	97.72
2000	50,226,459	55,118,914	91.12	52,306,365	53,261,361	98.21
2001	51,824,669	58,286,593	88.91	51,891,541	52,917,964	98.06
2002	53,493,388	60,438,650	88.51	44,813,444	45,798,616	97.85
2003	64,683,457	73,203,222	88.36	44,008,133	46,076,642	95.51
2004	84,060,796	96,677,246	86.95	55,124,205	56,806,967	97.04
2005	101,487,101	118,528,688	85.62	66,317,420	69,436,685	95.51
2006	117,325,725	137,806,190	85.14	84,605,755	88,074,256	96.06
2007	138,087,033	160,648,870	85.96	108,248,105	111,329,895	97.23
2008	166,452,363	197,942,443	84.09	153,936,771	159,326,021	96.62
2009	128,731,754	152,994,743	84.14	115,385,198	117,833,349	97.92

Source: WITS/UN COMTRADE

Fig. 21: World Trade & Real GDP

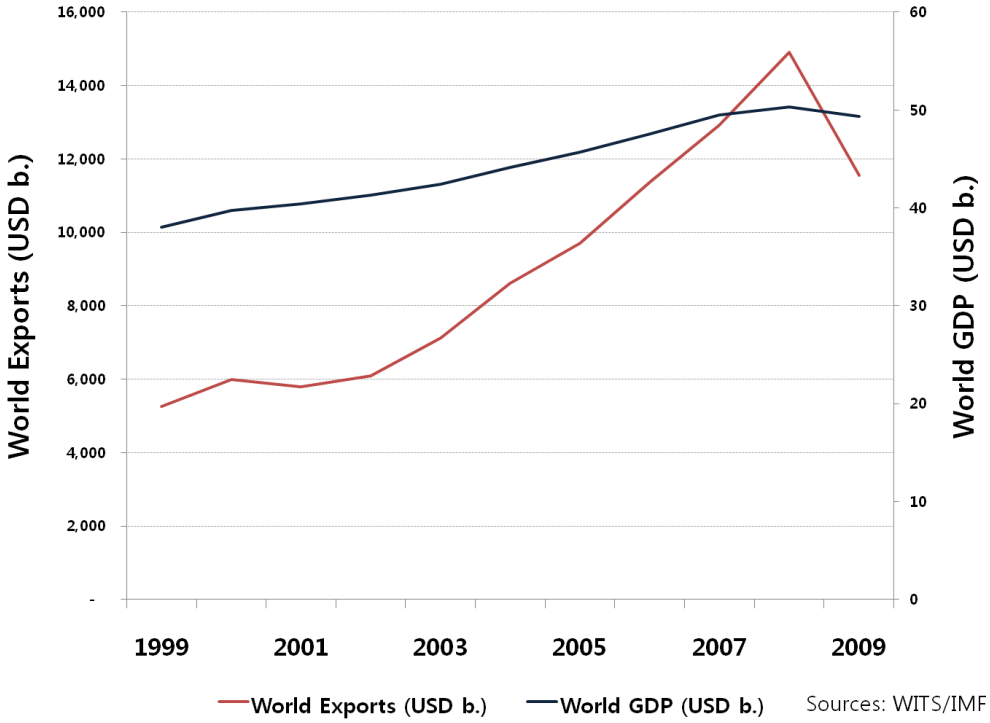
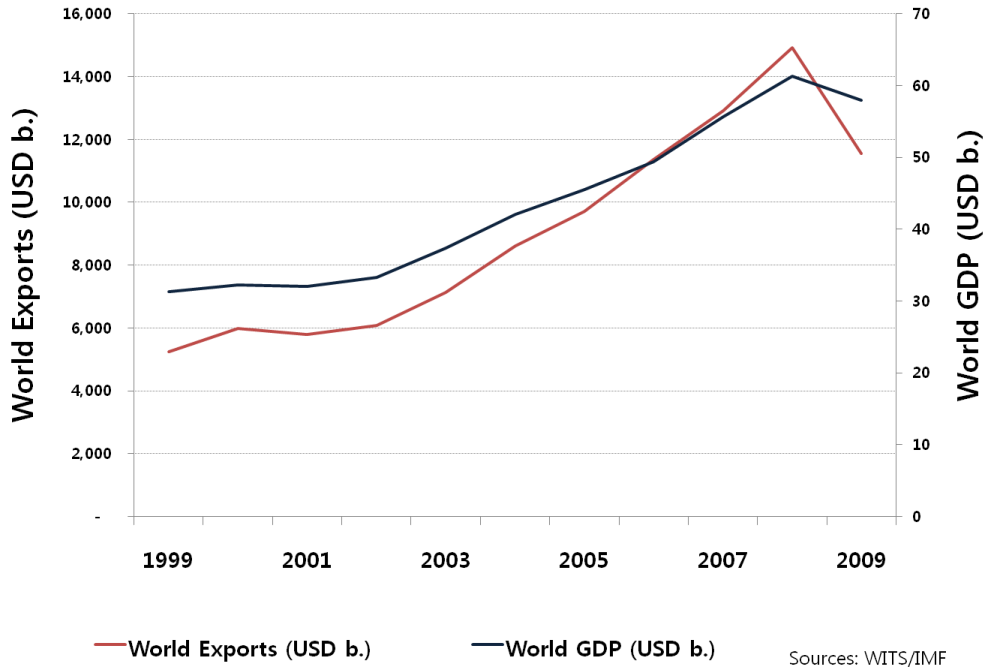


Fig. 22: World Trade & Nominal GDP



For each country, data was collected for each of the variables mentioned in equations 4.3 and 4.4 above such as bilateral export value, GDP, and distance among others. Trade data was compiled from the UN COMTRADE/WITS using the HS 1988/92 nomenclature while GDP data was compiled from UNCTAD Statistics website while GDP growth projections were gathered from the IMF database. With regards to the GDP data, nominal GDP data was chosen over real GDP data for two reasons. First, the WITS trade data appears to be in nominal terms as plotting it against nominal GDP data yields a better fit than plotting against real GDP data (Fig. 21 and 22). Secondly, use of nominal data appears to be common practice in gravity analysis (Bergstrand, 1981; Baier et al. 2001; Anderson, Van Wincoop, 2003; Baier, Bergstrand, 2009). Furthermore, the coefficient of correlation between nominal GDP and UN COMTRADE bilateral trade data (0.98) is marginally higher than the coefficient of correlation between real GDP and UN COMTRADE (0.97). Distance data was gathered from the CEPII database while two sets of data are used to measure the effect of trade barriers or lack thereof; the Trade Freedom Index and whether trading partners are party to the same free trade agreement or not. The Trade Freedom Index is one of the 10 Economic Freedom Measures that make up the Economic Freedom Index compiled by the Heritage Foundation; a foundation which a conservative American think tank. The Trade Freedom Index was chosen as a measure of trade barriers due to the lack of data on non-tariff measures. Unlike tariffs which restrict trade by imposing an explicit tax on traded goods, non-tariff measures restrict trade through less explicit technical, legislative, foreign exchange, environmental, and other regulatory restrictions, the effect of which is harder to

quantify. The Trade Freedom Index evaluates countries based on trade weighted average tariff rates and non-tariff barriers as indicated in the equation below:

$$\text{Trade Freedom}_{\text{i}} = \left(\left(\frac{\text{Tariff}_{\text{max}} - \text{Tariff}_{\text{i}}}{\text{Tariff}_{\text{max}} - \text{Tariff}_{\text{min}}}\right) \text{x } 100\right) - \text{NTB}_{\text{i}} \qquad \text{(Equation 4.18)}$$

Where:
Trade Freedom$_{i}$ = is the trade freedom index for country *i* based on a scale between 0 and 100 where 0 indicates an economy completely closed off to trade and 100 indicates an economy without any trade restrictions;
Tariff$_{max}$ = is the upper bound for tariff rates in country *i*;
Tariff$_{min}$ = is the minimum tariff rate for country *i*;
Tariff$_{i}$ = is the weighted average tariff for country *i*; and
NTB$_{i}$ = is a non-tariff barrier penalty on a scale of 0 to 20 points whereby a 20 point penalty indicates that non-tariff barriers are extensively used across a wide array of goods and services and 0 indicates that non-tariff barriers are not used at all.

In compiling this index, the Heritage Foundation uses data from the World Bank, the WTO, the Economic Intelligence Unit, and the US Department of Commerce. The problem with this index, however, is that it is difficult to divide the impact of tariffs and non-tariff barriers. Finally, information regarding free trade agreements was compiled from the WTO's Regional Trade Agreements database. This thesis only considered bilateral/multilateral free trade agreements and economic integration agreements. Partial scope agreements as well as free trade agreements that came into force within the past two years were excluded from the analysis conducted herein.

Given the methodological approach described earlier in this chapter, the compiled data was divided into sets; one set for the global trade gravity model (Model 1) and another set for the Brazilian trade gravity model (Model 2). The 38 countries selected for Model 1 were selected on the basis of being the 38 biggest trading countries and for having either completely or mostly complete trade data. Some major trading countries like Iran and Saudi Arabia were excluded due to significant gaps in available bilateral trade data. The same 38 countries used in Model 1 are also used for Model 2 but for Model 2 an additional 10 countries were added because some of Brazil's major trading partners are not major trading nations on a global scale. Most of the additional countries chosen for Model 2 are South American countries.

5. Results & Analysis

5.1 Overview

This chapter describes and interprets the results of the quantitative analyses conducted herein. It will first describe the correlation analysis conducted on the data for the gravity models. It will then describe the results of the gravity models described in the preceding chapter and will finally discuss the results of the forecasts and policy scenarios.

5.2 Correlation

The correlation analysis was conducted using the natural log of the data for the variables in Model 1 (Fig. 23). The results of this correlation analysis show that exports are positively correlated with GDP (both destination and origin), trade freedom ("TFI"), language, colony, common history ("Smctry"), contiguity, and FTA as expected. Among these exports showed the strongest correlation with origin GDP. Sharing a common border and being parties to the same FTA also showed relatively strong correlations with exports. Moreover, as expected, exports are negatively correlated with distance and being landlocked ("Landl"). The coefficient of correlation was stronger with distance. Furthermore, FTA and distance exhibited a strong negative correlation.

Fig. 23: Correlation Results

	Exports	Source GDP	Dest. GDP	Distance	FTI	Lang	Colony	Landl	Smctry	Contig	FTA
Exports	1										
Source GDP	0.488427	1									
Dest. GDP	0.452273	0.039229	1								
Distance	-0.32165	0.101164	0.076877	1							
FTI	0.123393	0.052589	0.033651	-0.10544	1						
Lang	0.186507	0.045979	0.052211	-0.0273	0.000952	1					
Colony	0.112385	0.076755	0.076755	0.029105	0.002918	0.293069	1				
Landl	-0.23987	-0.2427	-0.2427	-0.23273	0.08229	-0.09071	-0.09332	1			
Smctry	0.121617	-0.08855	-0.08855	-0.33009	0.001246	0.124304	0.080598	0.02021	1		
Contig	0.282031	0.017326	0.01976	-0.44443	0.006275	0.214931	0.039398	0.061677	0.444439	1	
FTA	0.254143	-0.06263	-0.05953	-0.68749	0.201869	-0.00547	-0.03088	0.23538	0.120458	0.268772	1

Source: Author

5.3 Gravity Model Results

The Global gravity model looked at bilateral trade flows between 38 of the world's biggest trading nations for a period of 10 years between 1999 and 2009 generating a total of 15,428 dependent variable observations, 1,444 bilateral trade flows, and 371,150 data points. The Brazilian gravity model looked at bilateral trade flows between Brazil and 48 of its major trading partners for a period of 10 years between 1999 and 2009 yielding a total of 1,056 dependent variable observations, 96 bilateral trade flows, and 60,192 data points (Figure 24).

Fig. 24: Gravity Model Results - Comparison

Dependent Variable: ln_Exports		
Model	**Model 1 Global**	**Model 2 Brazil**
Constant	**-7.198074*** **	**37.55316*** **
	(0.000)	*(0.008)*
ln_Origin GDP	**0.6954777*** **	**0.7808129*** **
	(0.000)	*(0.000)*
ln_Destination GDP	**0.6203471*** **	**0.6315175*** **
	(0.000)	*(0.000)*
ln_Distance	**-0.5197512*** **	**-6.430499*** **
	(0.000)	*(0.000)*
ln_TFI	**0.492645*** **	**0.7334297*** **
	(0.000)	*(0.000)*
Language	**0.2645541*** **	**3.26142**
	(0.000)	*(0.364)*
Smctry	**0.6600029*** **	*n/a*
	(0.000)	*n/a*
Contiguity	**0.534252*** **	**2.13022** **
	(0.000)	*(0.035)*
FTA	**1.061076*** **	*n/a*
	(0.000)	*n/a*
Landlocked	**-0.8398397*** **	**-6.70309*** **
	(0.000)	*(0.007)*
Observations	15,466	1,056
Adjusted R2	0.7499	0.7641
Significance F	844.32	63.14
Probability F	0.0000	0.0000

Notes: Source: Author

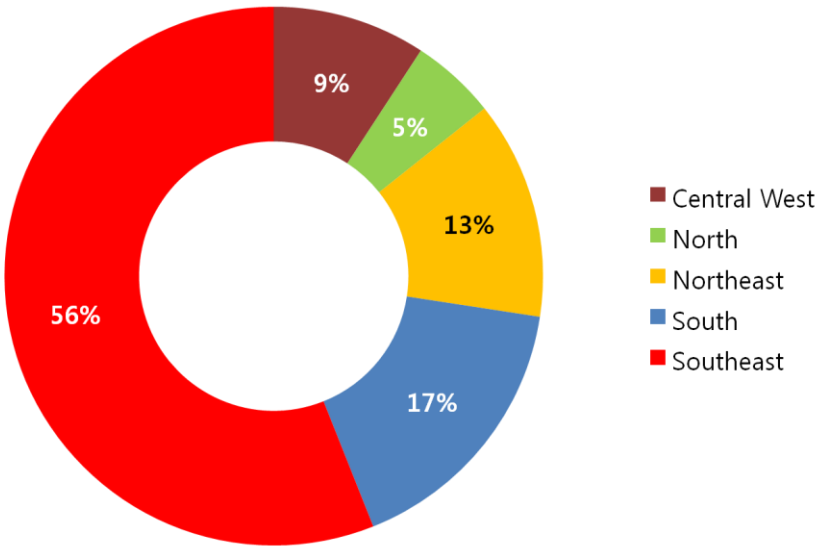
p-values shown in parentheses
***significant at 1% level
**significant at 5% level
*significant at 10% level
n/a - not applicable

As expected GDP is a very significant determinant of trade flows with the origin country's GDP having a stronger impact than the destination country's GDP in both models. With regards to Brazil the results of the gravity model reveal that origin GDP seems to have a stronger impact on trade flows than the global norm. In Brazil's case a 1% increase in the origin country's GDP leads to a 0.78% increase in trade whereas on a global level a 1% increase in the origin country's GDP only leads to 0.68% increase in trade. With regards to the destination country's GDP, Brazil conforms more to the global trend. As with GDP, the Trade Freedom Index also had a positive coefficient suggesting that as expected, the higher a destination country's Trade Freedom Index is the more likely it is to generate trade. Moreover, since the

Trade Freedom Index data used in these models captures the effects of reforms it suggests that lowering trade barriers generates more trade. The results of the gravity models suggest that this positive effect is stronger for Brazil than the world average.

In both the global and Brazilian cases, distance has a detrimental effect on trade flows. Distance, however, appears to have a significantly stronger detrimental impact on Brazilian trade flows than the global norm; the distance coefficient for Brazilian trade flows (-6.43) is approximately 12 times greater than the coefficient for global trade flows (-0.51). What this means is that on a global scale a 1% increase in distance can be expected to reduce trade by roughly half a percent (0.52%) but in Brazil's case a 1% increase in distance decreases trade flows by 6.8%. With regards to other variables; contiguity, a common official language, a common colonial or historical heritage, and being parties to the same free trade agreement all had positive impacts on trade flows on a global level. Meanwhile, trade with a landlocked partner faced additional difficulty as indicated by the negative coefficient. With regards to Brazil, language was not a significant variable while contiguity had a strong positive effect but was only significant at the 5% level; in other words for Brazil the effect of sharing a common border is less significant than the global norm. Furthermore, as with the global norm, the effect of trading with a landlocked partner (i.e. Hungary) had a negative effect on Brazilian trade flows but unlike the global norm the coefficient for Brazil was much higher than the global norm suggesting that it is more difficult for Brazil to trade with a landlocked country such as Bolivia or Slovakia than the global norm.

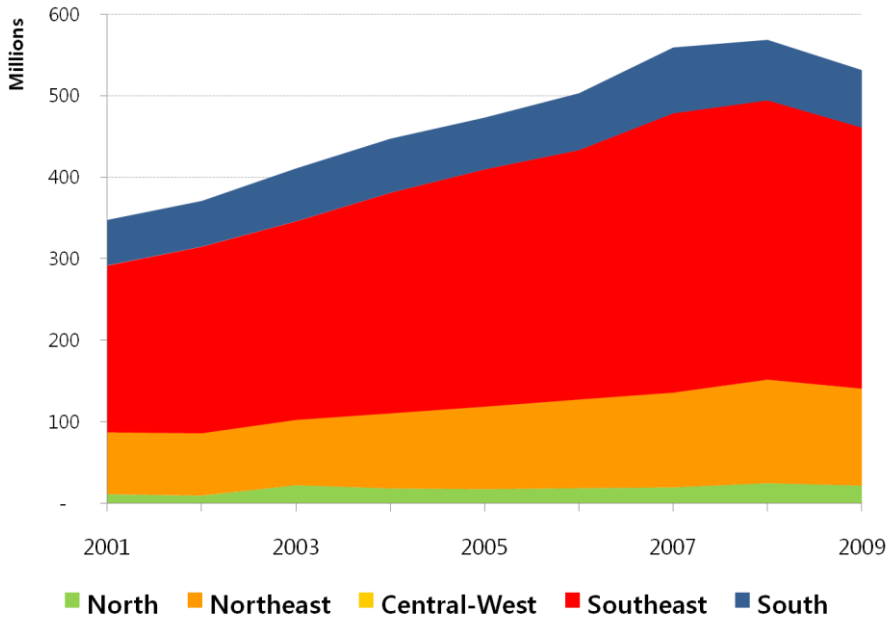
Fig. 25: Real GDP per Region (2008)



Sources: Compiled by Author from IPEA

How should the differences between Brazilian and global trade patterns be interpreted? What do the differences in the coefficients suggest or reveal about Brazilian trade flows? The stronger negative impact of distance on Brazilian trade flows can be explained by several demographic, geographic, and logistical factors. Although Brazil is a big country most of the country's population, wealth, and therefore economic activity are concentrated in the Southeast and Southern regions of Brazil which together account for 56% of the Brazilian population and approximately 70% of Brazilian real GDP (Fig 25). The South and Southeast are home to 6 of the 10 largest cities in Brazil including São Paulo (Pop. 19.6 million), Rio de Janeiro (Pop. 11.7 million), and Belo Horizonte (Pop. 5.4 million). These two regions account for 80% of the value of Brazilian exports and likewise most of its

Fig. 26: International Maritime Trade by Region (Tons)



Sources: Compiled by Author from ANTAQ

maritime trade flows; Brazil's biggest port, Santos, is in located in the state of São of Paulo (Fig. 26). Northern and Northeast Brazil, which lie closer to Brazil's main trading partners in Europe and North America, are sparsely populated and do not play a very strong role in international trade. As such, Brazil's main economic "engine" lies far from its main markets. Unlike economically dynamic regions such as northwestern Europe or northeast Asia, Southeastern/Southern Brazil lies far from other major economic centers; aside from Buenos Aires, there are no other major economic centers in the vicinity. Moreover, Brazil's neighbors are not major trading nations and Brazil's urban centers lie separated from other major cities in South America such as Santiago de Chile, Bogota, and Lima by mountains, jungle, and poor infrastructure. Furthermore, Brazil does not lie on the major East-West container routes. In fact according to Stopford maritime trade along the east coast of South America only accounts for approximately 8% of global maritime trade.

Moreover, given the relatively low volumes of trade and the limitations of Brazilian ports, routes to and from Brazil were traditionally served by smaller ships which offer lower economies of scale. As Hummels pointed out, the effect of being far from major shipping routes can be more detrimental than the effect of distance itself. Although shipping service data such as the container connectivity index was not used in the gravity models, perhaps the distance variable in the models captures some of the effect of distance from major trading routes. With regards to trade barriers, the stronger effect of lower trade barriers on Brazilian trade flows might be the result of the fact that Brazil is a major supplier of agricultural commodities and liberalization of agricultural sectors in Europe and North America along with the removal of subsidies would probably have a strong positive effect on Brazilian exports to these two regions.

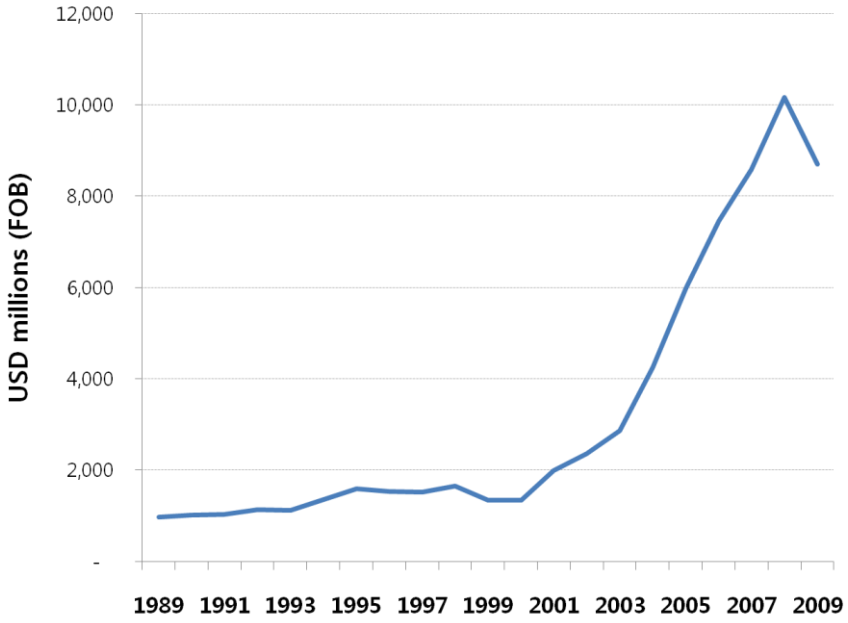
5.3.1 Testing the Brazil Gravity Model

Given that the Brazilian gravity model results in Figure 24 showed some differences from the global norm, the author decided to further test the results of the Brazilian gravity model by adding data to the Brazilian data set. To that end, an additional 24 countries were added including Mozambique, Angola, Cape Verde, Egypt, Israel, Ecuador, and Suriname among others. Moreover, additional dummy variables were added yielding the following gravity model (Model 2a):

$$\mathbf{lnX_{ij}} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln D_{ij} + \alpha_4 \ln TF_j + \alpha_{5\ldots9} DU_{1\ldots9} + \alpha_{10..80} C_{1\ldots71} + \alpha_{81..85} MR_{1\ldots5} + U_{ij} \quad \text{(Equation 5.1)}$$

Two additional dummy variables were added to this equation; one measuring the impact of MERCOSUR whereby 1 equals membership in MERCOSUR, and a dummy for continent whereby 1 means that a country is in South America. The aim of these additional dummies was to further test the effect of distance as well as to measure the impact of MERCOSUR on Brazilian trade flows. Furthermore three additional Portuguese speaking countries were added to further test whether a common language had any impact especially since Brazil has been keen to promote trade ties with Portuguese speaking countries in Africa and competes with Portugal for commercial and cultural influence in Lusophone Africa. Moreover, trade with Africa grew rapidly over the past decade; exports to Africa grew from USD 1.3 billion in 1999 to USD 10 billion by 2008 (Fig. 27).

Fig. 27: Brazilian Exports to Africa: 1989-1999



Sources: Author/IPEA

Fig. 28: Brazil Gravity Results - Comparison

Dependent Variable: ln_Exports		
Model	**Model 2a Brazil Extended**	**Model 2 Brazil**
Constant	**-1.945901**	**37.55316*** **
	(0.942)	*(0.008)*
ln_Origin GDP	**1.25758*** **	**0.7808129*** **
	(0.000)	*(0.000)*
ln_Destination GDP	**0.5632382*** **	**0.6315175*** **
	(0.000)	*(0.000)*
ln_Distance	**-1.504647**	**-6.430499*** **
	(0.576)	*(0.000)*
ln_TFI	**-0.1826681**	**0.7334297*** **
	(0.406)	*(0.000)*
Language	**-3.417795**	**3.26142**
	(0.313)	*(0.364)*
Continent	**-2.542413**	*n/a*
	(0.495)	*n/a*
Contiguity	**-0.744267**	**2.13022** **
	(0.582)	*(0.035)*
MERCOSUR	**-0.9132675**	*n/a*
	(0.653)	*n/a*
Landlocked	**4.168176*** **	**-6.70309*** **
	(0.000)	*(0.007)*
Observations	1,562	1,056
Adjusted R2	0.7907	0.7641
Significance F	74.72	63.14
Probability F	0.0000	0.0000

Notes: Source: Author

p-values shown in parentheses

***significant at 1% level

**significant at 5% level

*significant at 10% level

n/a - not applicable

The results of Model 2a show that with additional countries added to the model, the distance coefficient remains negative but it is no longer statistically significant as indicated by the p-value (Fig. 28). Likewise, the coefficient for Trade Freedom Index is no longer significant. Likewise, the coefficient for contiguity becomes statistically insignificant. The MERCOSUR, Continent, and language coefficients are also statistically insignificant. Both origin and destination GDP remain significant but the coefficients have changed; the coefficient for origin GDP is now larger and implies that a 1% increase in origin GDP leads to 1.25% more trade whereas a 1% increase in destination GDP leads to half a percent increase in trade. The results of Model 2a seems to suggest that among the variables considered, GDP appears to be the

most significant with the other variables being rendered either insignificant or unreliable indicators of trade.

How should these discrepancies in results be explained? Perhaps the answer lies in the fact that Brazil's geopolitical focus has begun to shift partially away from Europe and North America as will be shown in the next section. Trade flows with China and developing/emerging markets in other parts of the world have increased substantially over the past decade which has perhaps dampened the impact of distance; an effect which seems to become more evident when data from more developing/emerging countries such as Qatar, Angola, Ghana, and the Philippines is added as was the case in Model 2a. In some cases, trade with some of these additional countries has risen steeply as Brazil had little if any trade with some of these countries in 1999. Perhaps the impact of distance on trade flows would be more evident if only the value of seaborne trade were analyzed rather than total trade. Furthermore, over the past decade private sector investment in ports has increased which led to improvements in port performance. For example at the TECON Rio Grande terminal productivity improved from 14% to 46% between 1999 and 2004 (Pedreira, 2006). Moreover, as mentioned earlier, container handling costs have dropped in Brazil and rising middle classes in developing/emerging markets have created healthy demand for Brazilian commodities.

5.4 Trade Projections

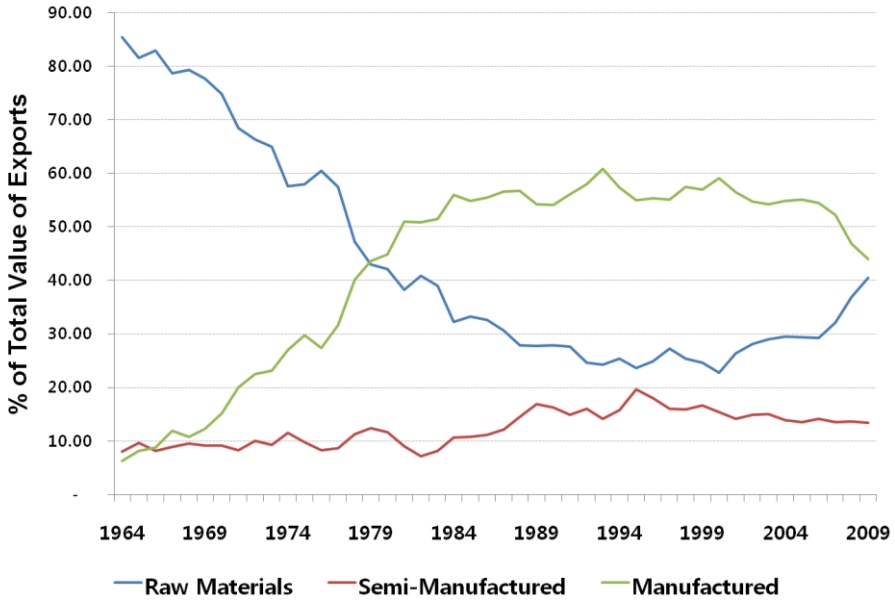
Three different trade projections for bilateral trade flows were drafted using GSIM based on GDP growth rate estimates by the IMF for Brazil, China, NAFTA, the EU, Developing/Emerging Markets, and ROW. The projections stretch till 2016, the last year for which the IMF provides GDP growth estimates. The three growth estimates are based on assumptions regarding the nature of GDP growth namely; demand led growth, supply led growth, and supply and demand led growth. The assumptions regarding supply and demand growth were made such that the average of the two would be equal to the expected GDP growth rate. The trade data for these projections comes from the trade data used for gravity Models 1 and 2. The projections therefore do not reflect Brazil's total trade with all its trading partners.

5.4.1 Background & Overview

Brazilian trade flows grew steeply during the past decade; according to statistics from the Brazilian Ministry of Development, Industry and Foreign Commerce, Brazilian exports rose from USD 48 billion in 1999 to USD 197 billion by 2008 while imports rose from USD 49 billion in 1999 to USD 173 billion by 2008. The global financial crisis of 2008 had a substantial negative impact on trade flows; exports declined from USD 197 billion in 2008 to USD 153 billion in 2009 while imports dropped to USD 127 billion from USD 173 billion in 2008. Another trend over the past decade has been the increasing importance of raw materials as a percentage

of the value of Brazilian exports (Fig. 29). The value of raw materials as a percentage of the total value of Brazilian exports increased from approximately 25% in 1999 to just over 40% in 2009. This trend can be explained by rising Asian demand for Brazilian commodities such as iron ore and soy beans. Increased global demand for Brazilian commodities appears to be reversing a long term trend of manufactured product led export growth. This creates concerns for Brazilian manufacturers especially in light of the fact that Brazil has worked so hard over the past half century to develop a manufacturing base and diversify its economy away from commodities. It can be assumed that continued growth in Asia will only help continue this trend.

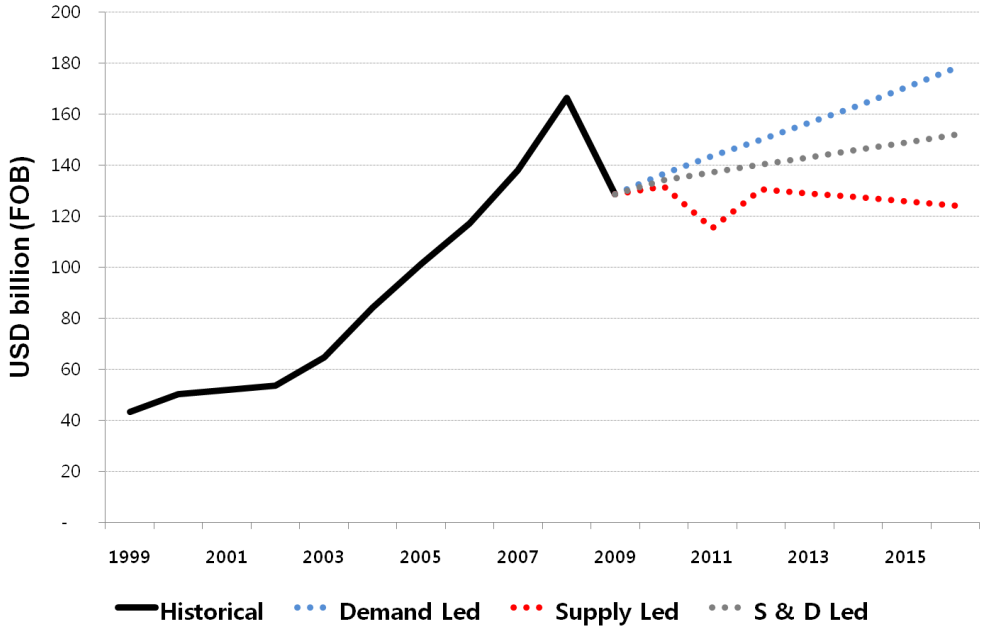
Fig. 29: Brazilian Export by Type - % of Total Value (1964-2009)



Sources: MDIC

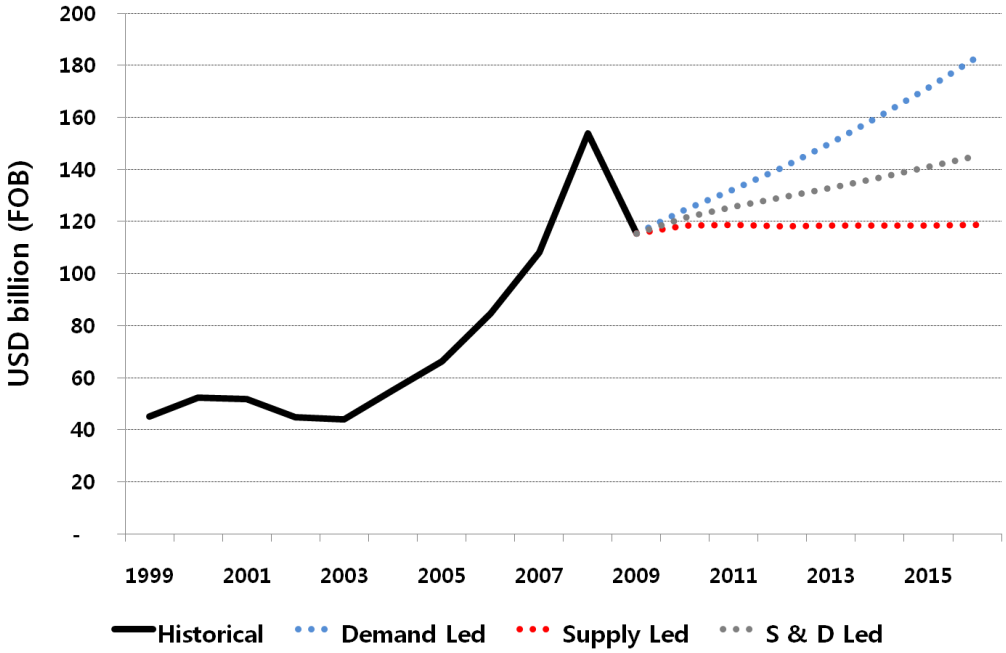
The trade flow forecasts reveal that trade growth is expected to be strongest under a demand led GDP growth scenario whereas a supply led GDP growth scenario is likely to result in stagnant or even declining trade flows (Fig. 30 and 31). The supply led growth scenario, however, seems unlikely. Export led Asian economies are likely to deal with continued anemic demand in European and North American markets by boosting domestic consumption thereby creating demand for imports and especially commodities. Moreover, Brazil will be hosting two major global sporting events this decade, the FIFA World Cup in 2014 and the Summer Olympics in 2016. These two events are likely to increase demand growth especially as Brazil invests in new sporting facilities and infrastructure in the run up to these events. Moreover, rising purchasing power has been one of the factors driving Brazilian growth over the past decade. In fact, according to Goldman Sachs (2007) Brazilian savings and investment as a percentage of GDP is rather low compared with other BRIC economies. These factors suggest that a demand led GDP growth is more likely.

Fig. 30: Export Growth Projections



Sources: Author

Fig. 31: Import Growth Projections



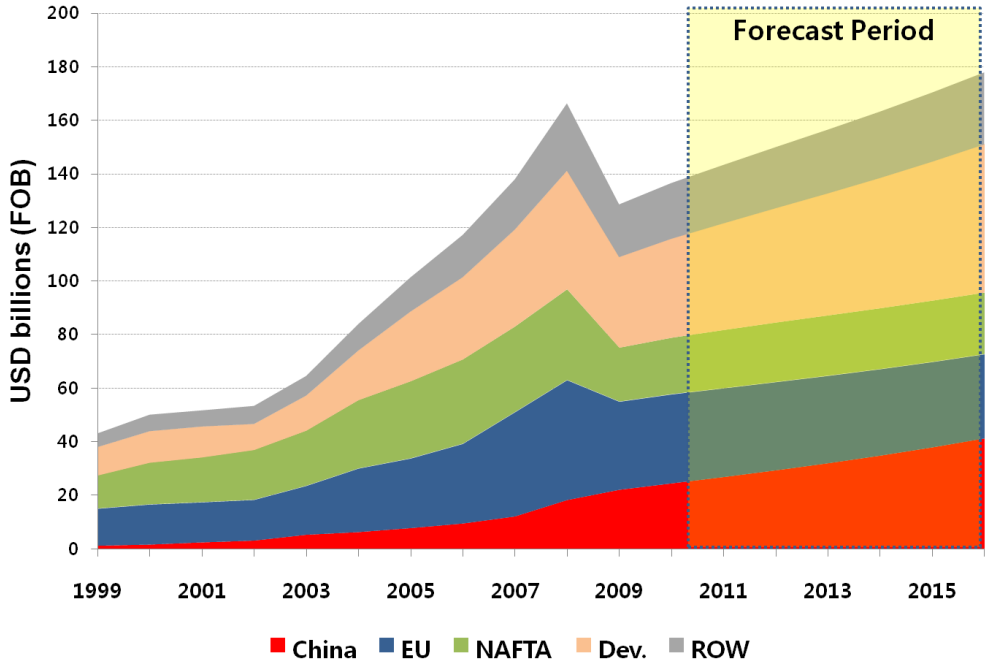
Sources: Author

5.4.2 Demand Led Growth Forecasts

The demand led GDP growth forecast is the most optimistic of the three trade forecasts (Fig. 32 and 33). Under this forecast, trade flows recover from their 2009

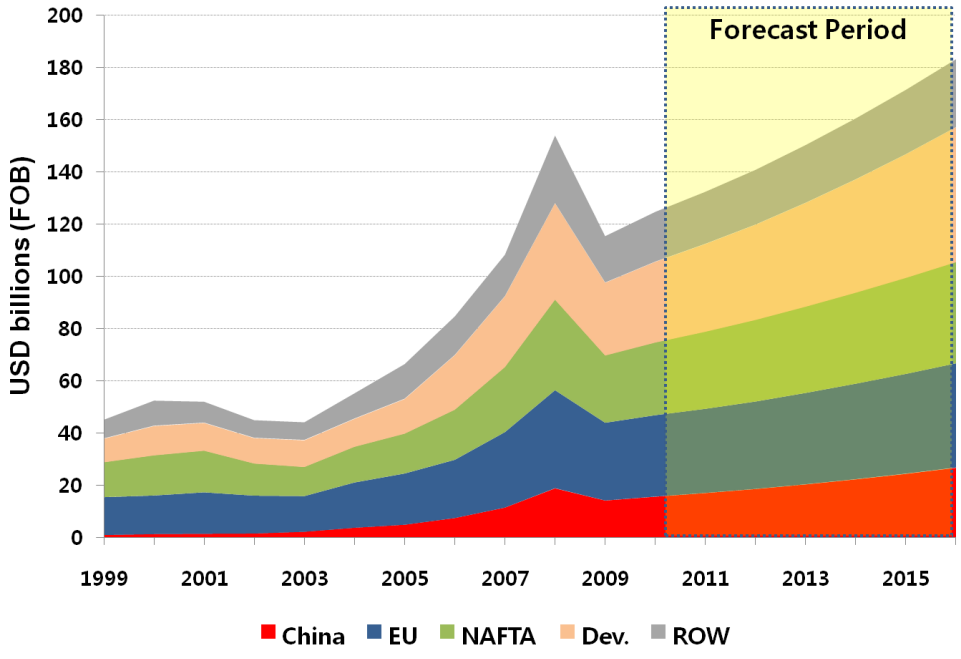
lows quickly and trade continues to grow but less steeply than in the 2003-2008 period. Exports recover to their pre-crisis 2008 height (USD 166 billion) by 2014 and imports recover to their 2008 height (USD 153 billion) by 2013. Exports eventually rise to USD 178 billion in 2016 but imports rise faster than exports creating a trade deficit by 2015; this is the first trade deficit since 2001. Under this trade forecast China and developing markets become even more important markets for Brazil accounting for 54% of Brazilian exports whereas the EU and NAFTA only account for approximately 30% of all Brazilian exports. This is a continuation of a trend which is seen over the past decade; in 1999 exports to the EU and NAFTA accounted for roughly 60% of Brazilian exports but by 2009 they only accounted for 41% of Brazilian exports. As with exports, China and developing markets continue to become increasingly important source markets for Brazil. In 1999 China and the Developing markets accounted for roughly 22% of the value of Brazilian imports by 2009 they accounted for 36% of Brazilian imports and by 2016 they could account for as much as 43% of Brazilian imports. Imports from both the EU and NAFTA will continue to rise but their market share will decrease from 62% in 1999 to roughly 43% in 2016. As of 2009 their market share had declined to 48%.

Fig. 32: Export Growth Projections - Demand Led GDP Growth



Sources: Author

Fig. 33: Import Growth Projections - Demand Led GDP Growth

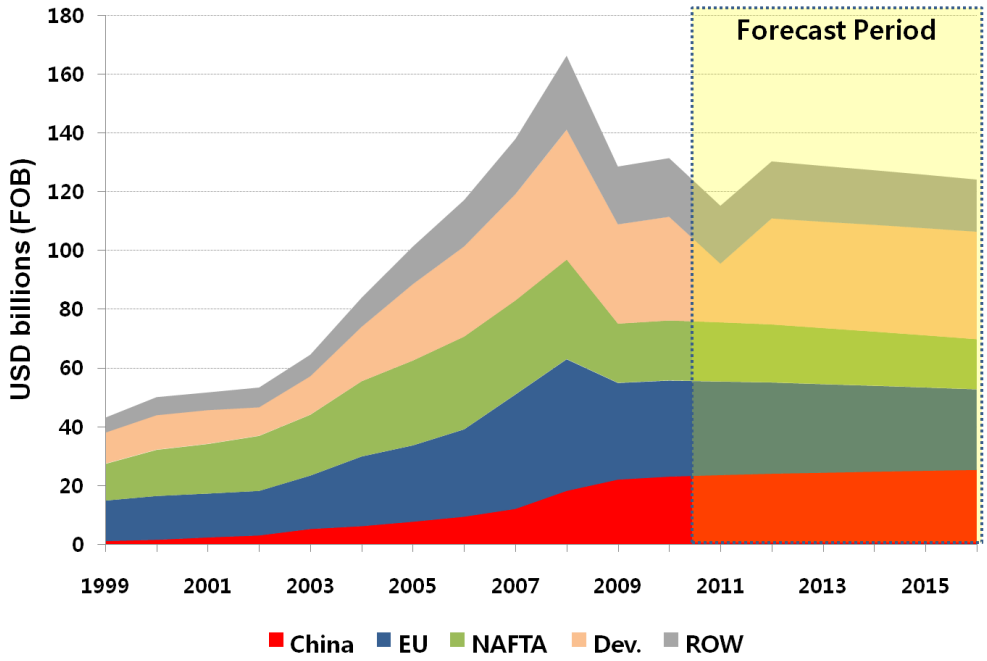


Sources: Author

5.4.3 Supply Led Growth Forecasts

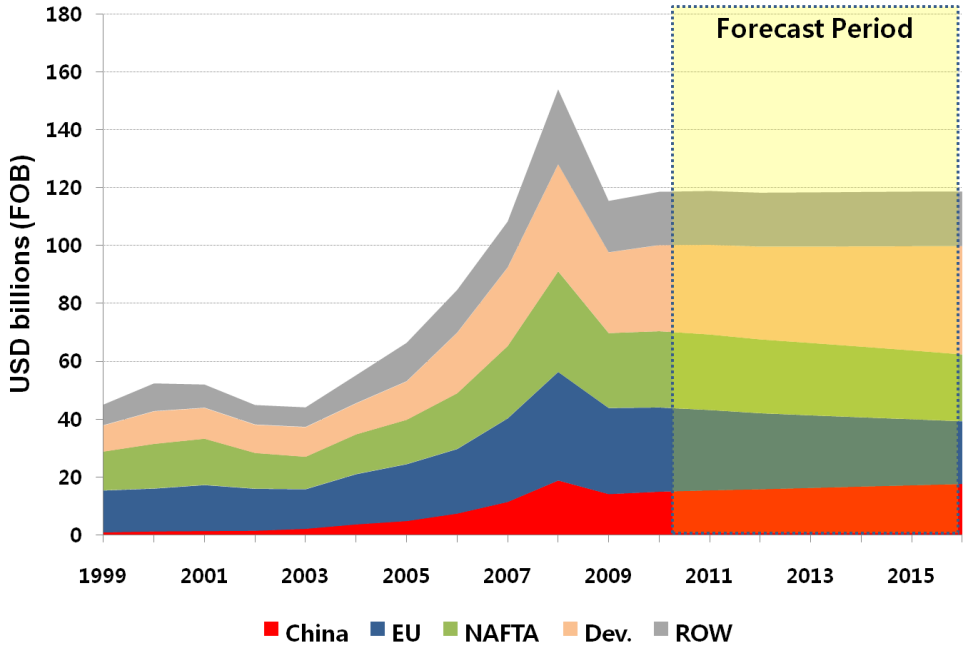
Under a supply led GDP growth scenario, exports decline and imports stagnate (Fig. 34 and 35). According to this forecast exports decline again in 2011 falling even lower than in 2009 to USD 115 billion before rising again to USD 130 billion in 2012 and beginning a slow gradual decline. Exports to the EU and NAFTA both decline while exports to China and Developing markets stagnate. Imports likewise stagnate with imports from NAFTA and the EU decreasing. Imports from China continue to increase but much more slowly than in the period between 2003 and 2008. Imports from developing markets however, increase substantially from USD 27 billion in 2009 to USD 37 billion in 2016. As with the demand led GDP growth forecast, in the supply led GDP growth forecast, China and Developing markets become more important for Brazil as these markets are estimated to account for 50% of Brazilian exports and 46% of Brazilian imports. Under this forecast, Brazil is expected to post trade surpluses except for 2011 when it is expected to post a USD 3 billion trade deficit.

Fig. 34: Export Growth Projections - Supply Led GDP Growth



Sources: Author

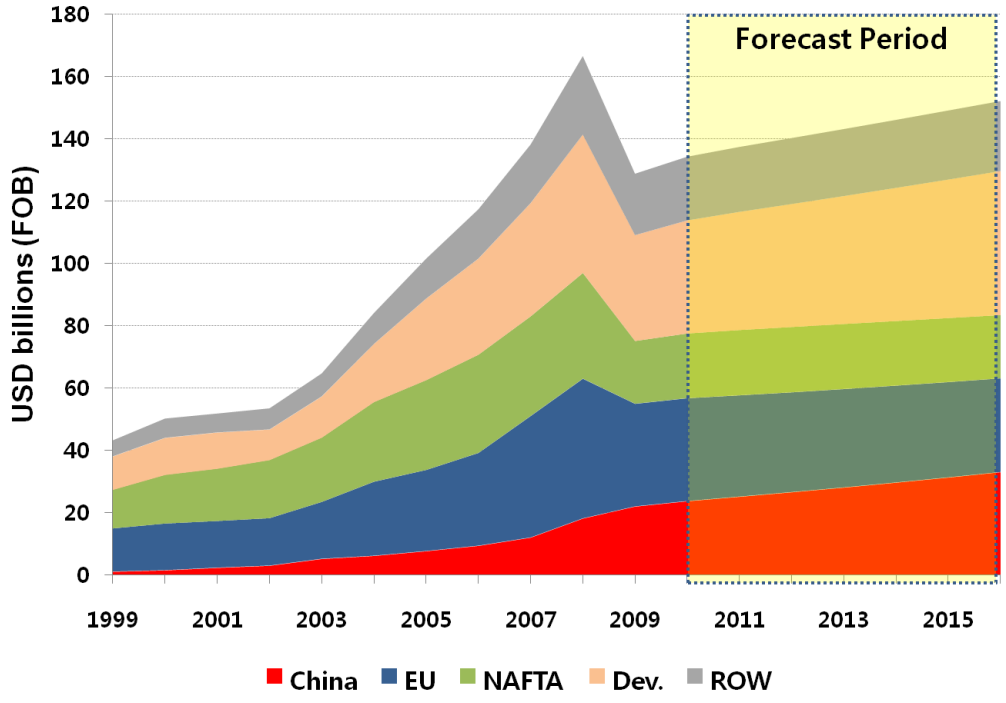
Fig. 35: Import Growth Projections - Supply Led GPD Growth



5.4.4 Supply & Demand Led Growth Forecasts

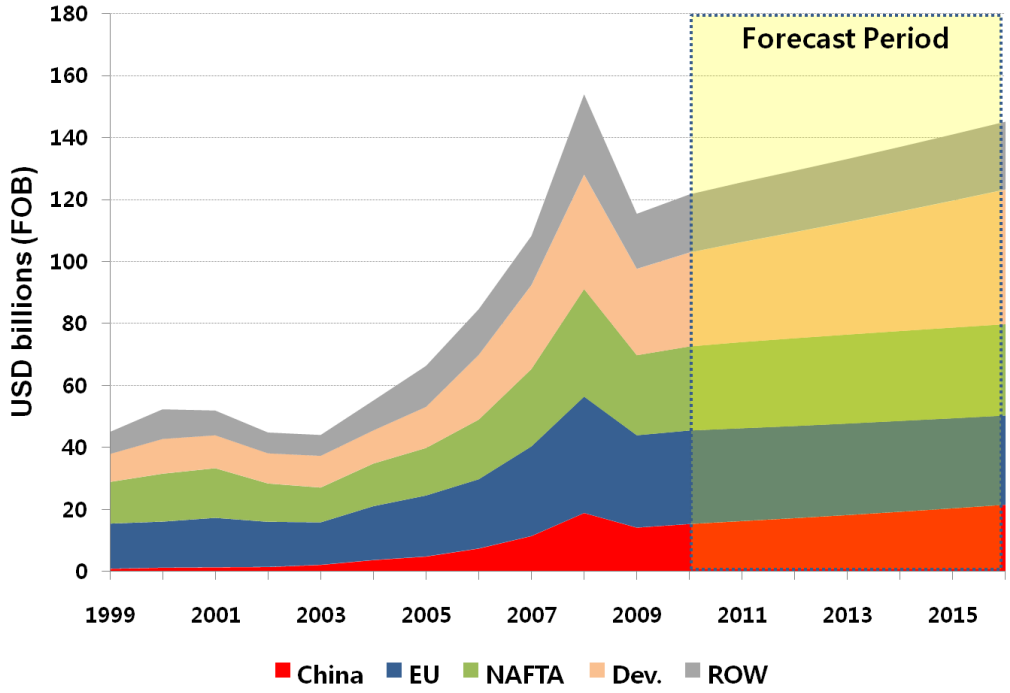
In this forecast it was assumed that GDP growth in Brazil and the trading blocs under consideration was led by equal measures of demand and supply growth such that the average of the two growth rates equals the estimated GDP growth rate by the IMF. In comparison with the other two scenarios, this scenario lies in between; both exports and imports grow but not as steeply as in the demand led GDP growth forecast (Fig. 36 and 37). In fact under this scenario exports and imports don't recover to their 2008 heights during the period under consideration. As in the other two previous forecasts, exports to China increase but not to the same extent as in the demand led scenario. Exports to the EU decline slowly while exports to the NAFTA countries stagnate. Exports to developing markets continue to increase at roughly the same pace as exports to China. Therefore as with the previous two scenarios, China and the developing markets become more important for Brazil and are forecasted to account for 52% of the value of Brazilian exports. Imports from China continue to increase but much more slowly than in a demand led forecast; by 2016 imports from China are forecasted to amount to USD 21 billion. Imports from the EU and NAFTA both decline slowly while imports from developing markets continue to increase but also more slowly than in a demand led growth scenario. Under this forecast, no trade deficits are forecasted as the value of the country's exports continues to exceed the value of imports.

Fig. 36: Export Growth Projections - Supply & Demand Growth



Sources: Author

Fig. 37: Import Growth Projections - Supply & Demand Growth



Sources: Author

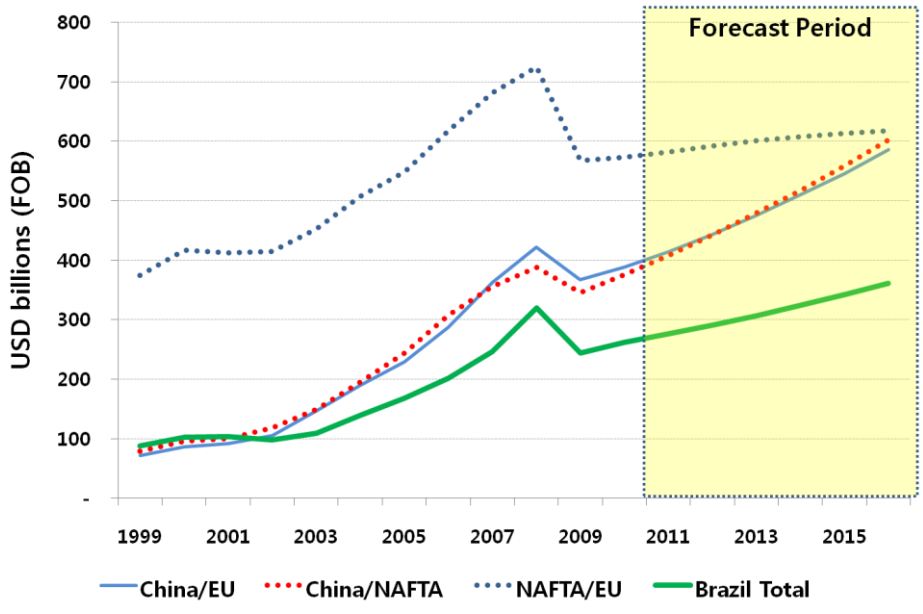
5.4.5 A Changing Geography of Trade?

The three trade forecasts described above seem to suggest that regardless of the nature of GDP growth over the next few years, Brazilian trade growth will become more dependent on China as well as developing markets. The trade forecasts seem to suggest that Brazilian trade will become less centered on the EU and North America, traditionally Brazil's main trading partners. All three scenarios show that trade with these two regions will at best grow slowly and at worst decline while trade with China and developing/emerging markets will continue to increase. These forecasts suggest that GDP growth rates for the EU and NAFTA countries over the next few years will dampen demand for Brazilian products in these markets. They also suggest that these two trading blocs will face increasing competition from other countries in the Brazilian market as exports from the EU and NAFTA are only expected to increase in a demand led GDP growth scenario. The EU and North America remain important trading blocs under all three forecasts but their share of Brazilian trade is smaller; under all three scenarios their share of Brazilian trade drops down to 37% from roughly 60% in 1999 and 45% in 2009. Under all three forecasts trade with China is expected to continue increasing, however, Medianu and Whalley's (2010) assessment that China could account for 68% of the value of Brazilian exports seems a bit unrealistic given that according to the forecasts above, China will account for at most 24% of the value of Brazilian exports in 2016. Therefore in order for China to account for 68% of the value of Brazilian exports,

trade with other parts of the world would have to stagnate or Chinese demand would have to be significantly stronger than that assumed in the forecasts above. The forecasts therefore suggest that the "geography of trade" will continue to change for Brazil; a trend which was already underway since the beginning of the previous decade.

Several sources (Hoffmann, 2002; Hummels, 2007; Lacerda, 2004; Gonzalez, 2008; World Bank, 2008) have pointed out that Brazil has traditionally suffered from high transport and logistics costs due to being on a "peripheral" container freight route (Hummels 2007). Being a peripheral trade route has a greater impact on transport costs than distance itself (Hummels, 2007; Wilmsmeier, 2010). How will Brazil's "geography of trade" affect global trade flows? Is Brazil's Atlantic Coast likely to become another major shipping hub like East Asia or northwestern Europe? Besides providing forecasts of Brazil's likely trade flows, the GSIM model simulation also yielded rough trade flow forecasts among Brazil's trade bloc partners (i.e. China/EU, NAFTA/EU, etc.). What forecasts reveal is that while total Brazilian trade flows due indeed grow enormously, Brazil's total trade flows are still expected to be smaller than the East-West trade flows among the EU, NAFTA, and China. Figure 38 below shows the historical and forecasted bilateral trade flows along three major trade routes; China/EU, China/NAFTA, and NAFTA/EU, and compares these trade flows with Brazil's total trade flows with all the countries in the data set.

Fig. 38: Brazil & Major Trade Routes



The trade flows are the sum of both exports and imports between the respective partners on each route. What they show is that in 1999 total Brazilian trade flows were roughly equal to either the EU/China or China/NAFTA trade flows; in other words, in 1999 Brazil's total trade flows with all the trading partners in the data set were roughly half of China's trade flows with NAFTA and the EU. Moreover, in 1999,

Brazilian trade flows were only about a quarter the size of EU/NAFTA trade flows. The size of these trade flows reveals that at that time Brazil was indeed a peripheral trade route. By 2009 Brazilian trade flows had more than doubled to USD 244 billion but this is still only 34% of the value of China's trade with both the EU and NAFTA (USD 713 billion) that year or 26% of the value of the EU's trade with China and NAFTA (USD 935 billion). Under a demand-led GDP growth forecast, Brazil's total trade flows are expected to reach USD 360 billion which is impressive especially when compared with its total trade flows in 1999 but this amount will still only be approximately 30% of EU trade with both China and NAFTA. According to the GSIM projections by 2016 EU-China bilateral trade could reach up to almost USD 600 billion whereas EU-Brazil bilateral trade is forecasted to reach USD 71 billion; only 12% of EU-China bilateral trade. NAFTA-China bilateral trade is forecasted to reach USD 600 billion by 2016 whereas NAFTA-Brazil bilateral trade is only forecasted to reach USD 61 billion; only 10% of NAFTA-China bilateral trade flows despite the fact that Brazil is closer to North America than China. Therefore, even though Brazil will continue to grow, the forecasts seem to suggest that East-West trade flows will continue to be significant.

5.5 Policy Scenarios

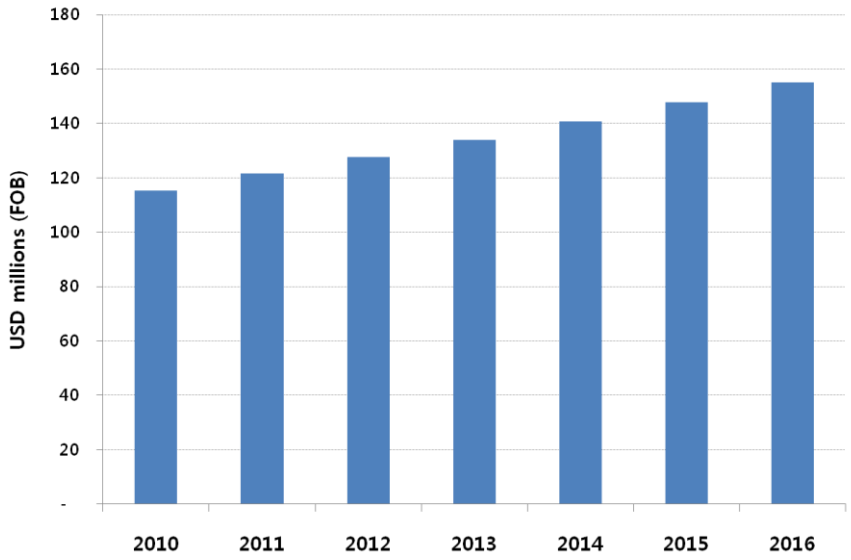
This section describes the results of the three possible policy scenarios described in Chapter 4 and the implications thereof for producers, consumers, and for Brazil in general. One of questions which this section aims to answer is whether policy matters in determining trade and transport flows and if so which policies are most beneficial? As Brazil's international profile changes should its trade policy also change? Brazil today remains retains several protectionist measures as has been mentioned before; do these measures still have relevance as Brazil's geopolitical focus shifts in a dynamic international environment?

In two of the three policy scenarios both NTBs and tariffs are taken into account. According to Kee et al. (2009) NTBs add on average 87% of the level of trade restrictiveness imposed by tariffs. In the third policy scenario only NTBs and in particular one NTB, cabotage regulations, are taken into consideration. All policy scenarios are based on the demand based trade forecast as this appears to be the most realistic forecast in light of preliminary Brazilian government trade figures for 2010 which show Brazilian trade flows returning close to their 2008 heights. Finally, the tariff data for NAFTA, Developing/Emerging markets, and ROW is based on an average of the OTRI and NTB average ad-valorem costs for the respective countries in these categories. Therefore for NAFTA, the tariff rate is based on the average OTRI index rate for Mexico, the US, and Canada. For the EU, the OTRI rate was already provided while ROW comprises all countries in the data set which do not fall into the aforementioned categories.

5.5.1 Scenario 1: Unilateral Liberalization:

In this scenario it is assumed that Brazil reduces its tariffs and NTBs such that its OTRI score equals that of the EU which has the lowest OTRI score of the trading blocs under consideration at 1.05. Under this scenario the general geographic shift in trade for Brazil does not change; trade with China and emerging markets grows while trade with NAFTA and the EU stagnates or slows. Unilateral liberalization has a positive effect on both exports and imports. This policy scenario results in an additional USD 118 million in exports in 2010 as compared with the demand led GDP growth forecast (Fig. 39). Over the years, the export gap between the demand led GDP growth scenario and unilateral liberalization scenario increases incrementally. By 2016 there is already an additional USD 150 million in exports as a result of this policy

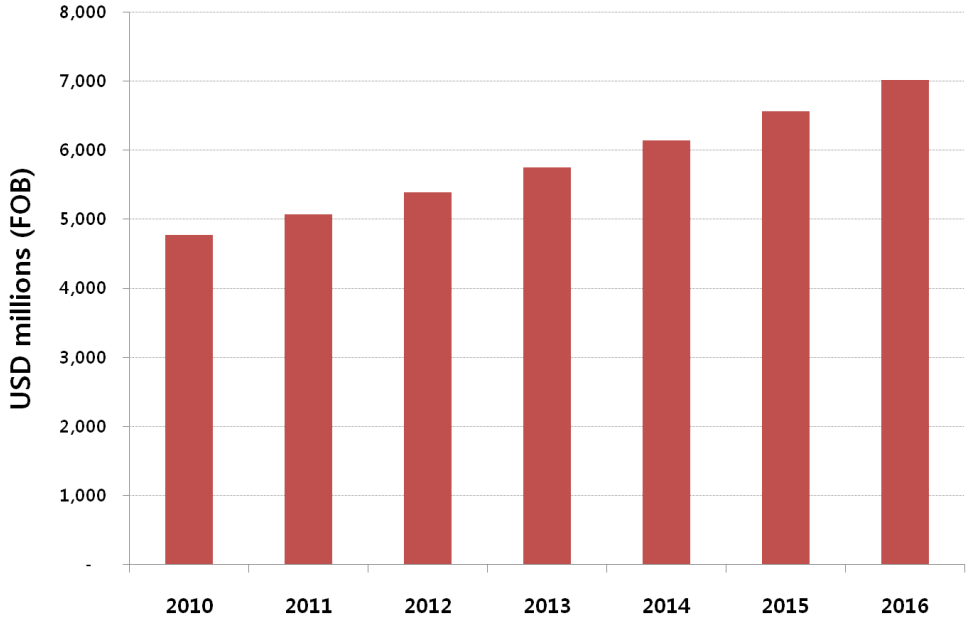
Fig. 39: Additional Export Resulting from Unilateral Liberalization



Sources: Author

The impact of unilateral liberalization however is significantly higher on imports than exports. Unilateral liberalization results in billions of dollars worth of additional imports into Brazil resulting in a trade deficit by 2014 and by 2016 imports reach a total of USD 190 billion; approximately USD 7 billion more than that forecasted in the demand led GDP growth forecast (Fig. 40)

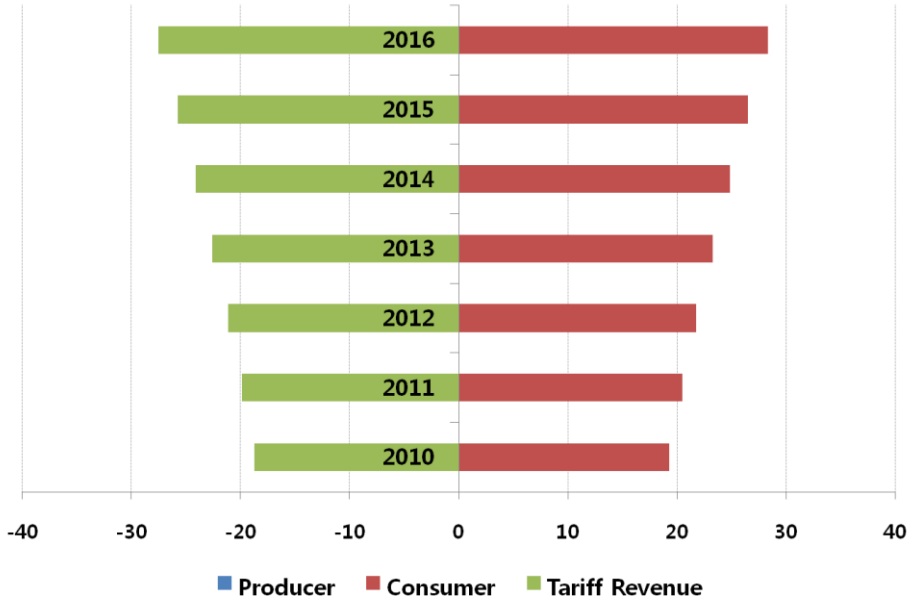
Fig. 40: Additional Imports Resulting from Unilateral Liberalization



Sources: Author

As expected, unilateral liberalization results in high consumer surpluses amounting to billions of dollars per year. Producers also enjoy a surplus but it is significantly smaller than the consumer surplus. Government tariff revenue losses are proportional to the consumer surplus; however, since OTRI measures both tariffs and NTBs some of those of tariff measures should perhaps be seen more as loses for producers since they will enjoy less protection from foreign competition (Fig. 41).

Fig. 41: Welfare Effects of Unilateral Liberalization (USD b.)

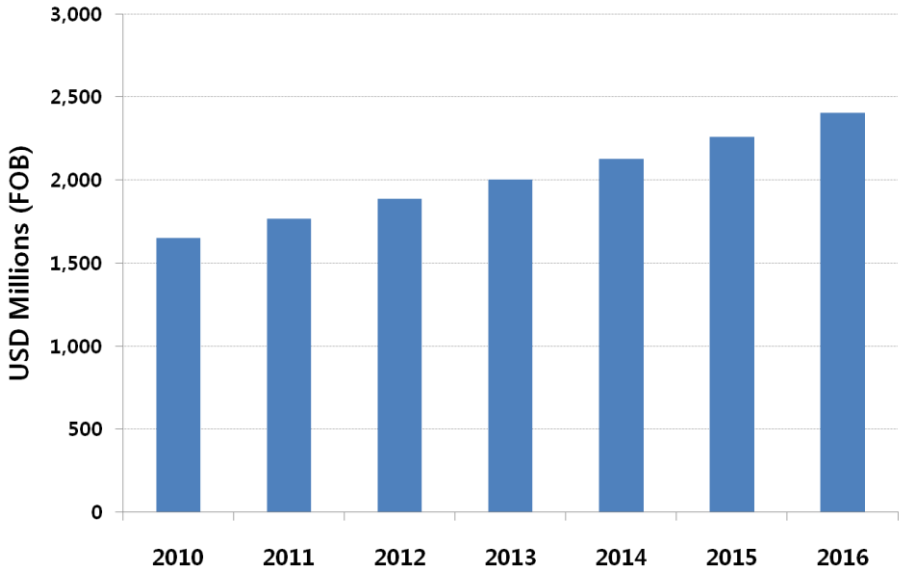


Sources: Author

5.5.2 Scenario 2: Multilateral Liberalization:

In this scenario it is assumed that all of Brazil's trading partners reduce their tariffs and NTBs to the level of the EU while Brazil retains its current tariffs and trade barriers. As with unilateral liberalization, multilateral liberalization does not lead to geographic shifts in Brazil's trade flows. Under this scenario there's a positive impact on both exports and imports but the impact is stronger on exports than imports as expected. This scenario results in billions of dollars worth of exports per year (Fig. 42).

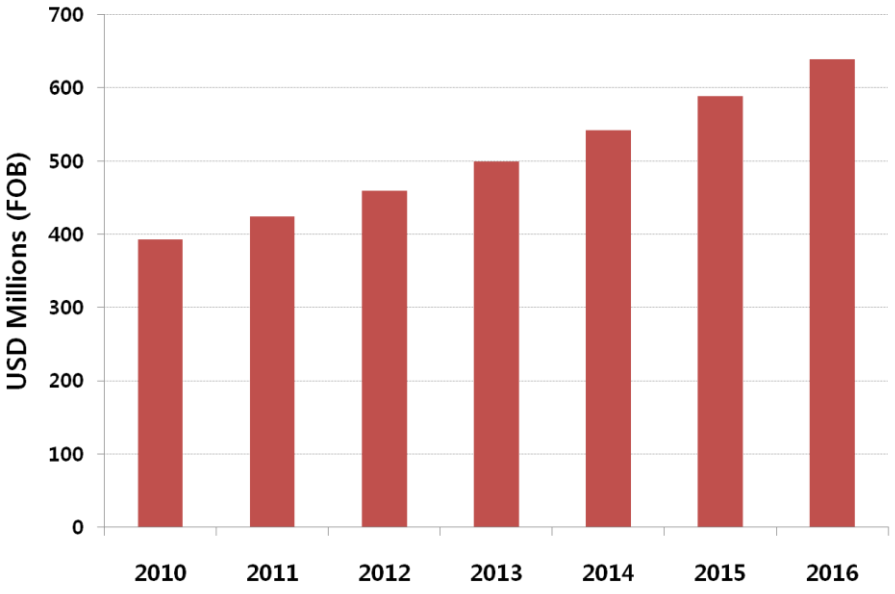
Fig. 42: Additional Exports Resulting from Multilateral Liberalization



Sources: Author

Multilateral liberalization also leads to an increase in imports when compared with the demand driven GDP growth forecast but the effect on imports is not as strong as the impact on exports. The impact of multilateral liberalization on Brazilian trade flows is more balanced than under unilateral liberalization. For example, multilateral liberalization would result in roughly USD 2 billion worth of additional exports in 2013 and USD 500 million worth of additional imports that same year. In comparison unilateral liberalization would result roughly USD 6 billion worth of additional imports in 2013 but only USD 130 million in additional exports (Fig. 43).

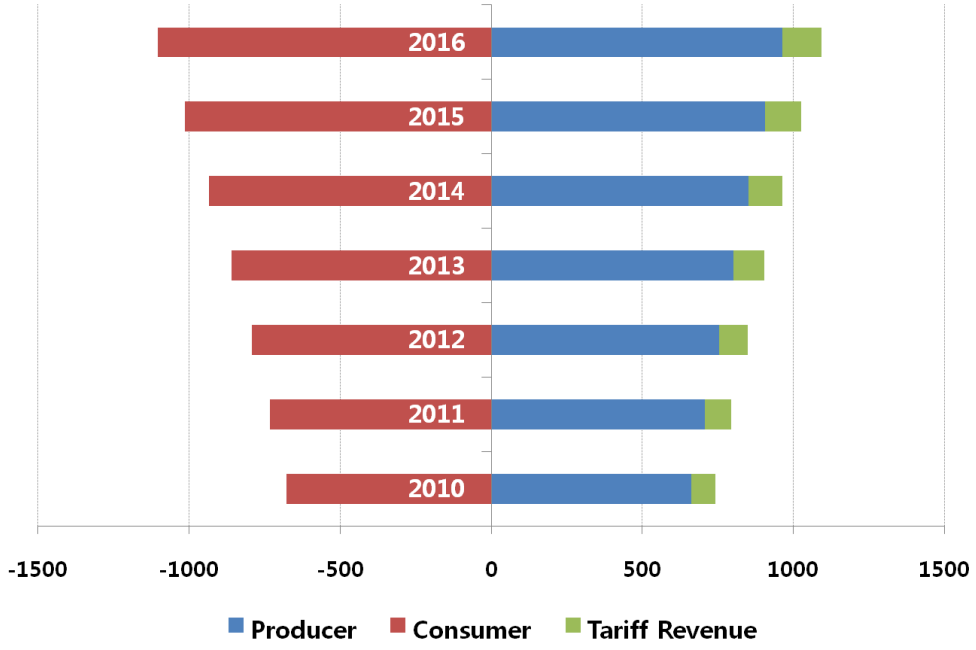
Fig. 43: Additional Imports Resulting from Multilateral Liberalization



Sources: Author

Under this scenario, Brazil would likely be able to maintain a trade surplus. With regards to welfare effects, this scenario would mainly benefit producers resulting in hundreds of millions of dollars of additional revenue for producers at the expense of consumers (Fig. 44). In this scenario Brazilian manufacturers would enjoy better access to foreign markets while continued Brazilian protectionism would deprive consumers of the benefits of greater market competition. The government would also benefit with additional tariff revenue.

Fig. 44: Welfare Effects of Multilateral Liberalization (USD m.)



Sources: Author

A comparison of the welfare effects of unilateral and multilateral liberalization seems to suggest that Brazil would benefit most from a policy of pursuing multilateral liberalization while also reducing Brazil's own trade barriers resulting in a more balanced welfare effect for producers, consumers, and government.

5.5.3 Scenario 3: Cabotage Liberalization

As mentioned earlier, cabotage is loosely defined as maritime transport that covers short distances and connects ports within a country or defined coastal area (i.e. the Caribbean, East Coast of South America, Scandinavia etc.) and is sometimes referred to as "coastal shipping" or "short-sea shipping" (Sanchez et al. 2005). It is not transoceanic and generally doesn't connect continents (Krause, et al. 2007). Under Brazilian legislation, cabotage refers strictly to maritime transport between two Brazilian ports. Like many countries such as the United States, Brazil restricts cabotage shipping to domestic companies and vessels but unlike some other countries with similar cabotage restrictions, Brazilian cabotage policy mandates that cabotage vessels should be built in Brazil. Brazilian law only allows exceptions to this when domestic shipping companies cannot find available domestic tonnage, have placed orders with Brazilian shipyards, or have a substantial Brazilian built fleet. According to Lacerda, there are two conflicting elements in Brazilian cabotage policy: accessible services (i.e. low transport costs), and promotion of Brazilian shipbuilding. To further incentivize Brazil's shipbuilding sector and finance the development of Brazil's merchant marine, a 10% tax over the value of a freight rate

is imposed known as the "*Adicional de Frete Para Renovação da Marinha Mercante*[8]" ("AFRM"). The end result is that cost of the AFRM and the insistence on Brazilian built vessels gets passed on to the end user. This element of Brazilian cabotage policy therefore conflicts with the provision to promote affordable, accessible cabotage shipping. The rationale behind using cabotage shipping to stimulate demand for Brazilian shipbuilding is based on the concept that cabotage needs to be protected in order to ensure adequate supply of tonnage capacity for Brazilian cabotage. This rationale is based on the assumption that if foreign ships and/or foreign shipping companies were allowed to provide cabotage services, it would leave Brazil vulnerable to international freight rate fluctuations; if freight rates on other routes offered higher freight rates than Brazil; shipping companies would shift tonnage capacity away from Brazil leading to higher freight rates in Brazil. By reserving cabotage for domestic companies and ships, the Brazilian government aims to ensure freight rate stability (Lacerda, 2004a). The problem with this rationale, however, is that cabotage restrictions distort the market balancing mechanism. While cabotage regulations do not prevent Brazilian ships from being redeployed on international routes they do not allow much room for foreign vessels to be redeployed on Brazilian cabotage routes during times of high demand for cabotage services in Brazil (Lacerda, 2004b). Therefore, Brazilian cabotage shipping rates are not necessarily protected from volatility. Although cabotage is widely practiced there is little evidence that it is crucial to ensure maintenance of domestic transport capacity (Sanchez et al, 2005). As mentioned earlier, eliminating or liberalizing cabotage restrictions could help reduce cabotage freight rates, make more tonnage available, and allow shipping companies to achieve better economies of scale. Additionally, cabotage is frequently cited as an environmentally friendlier than road freight transport and given the pressure on Brazilian road infrastructure, greater use of cabotage could help ease the stress on Brazil's roadways by shifting cargo away from roads.

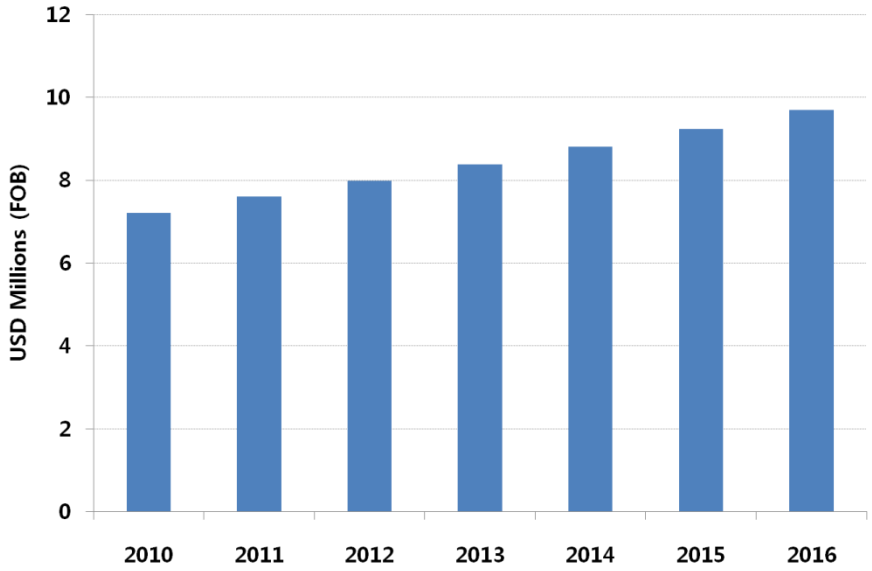
As the effect of cabotage can be compared with the effect of a NTB, the average ad-valorem equivalent of core NTBs across all tariff lines is used to assess the impact of cabotage liberalization. According to UNCTAD statistics, transport services accounted for approximately 5% of the value of Brazilian imports in 2009. Brazil's average ad-valorem equivalent for core NTBs is approximately 18%. Therefore, removal of cabotage restrictions could reduce Brazil's average ad-valorem equivalent for core NTBs down to approximately 17%; a 1% decrease in trade barriers. In this scenario it is assumed that Brazil's trading partners do not reduce their own NTBs. One thing to keep in mind about this scenario is that given the lack of data on domestic Brazilian freight costs this thesis is unable to properly model the full effect of cabotage reduction. Since cabotage services are often offered as part of a door-to-door service, especially for container shipping, lowering or removal of cabotage restrictions could have additional effect on the overall cost of door-to-door transport. Moreover, in order to fully assess the impact of cabotage, information

[8] Additional Freight Rate for the Renovation of the Merchant Marine

would be needed on how the possibility to acquire or use foreign ships would lower capital costs for domestic Brazilian companies and how this would impact the freight rates they offer. Furthermore, foreign shipping lines would perhaps be able to achieve better economies of scale allowing for further freight rate reduction but without freight rate data it's difficult to assess exactly what would be the full impact of removing cabotage restrictions. Finally, removal of cabotage restrictions would most likely have the greatest impact on domestic costs. This thesis, on the other hand focuses on international trade flows so it's only providing a rough estimate of the impact of removing cabotage restrictions on exports and imports rather than on purely domestic trade flows between different regions of Brazil.

Removing cabotage restrictions in Brazil would have a positive impact on both exports and imports with the impact on imports being significantly greater than the impact on exports. According to the simulation removing cabotage restrictions would result in anywhere from USD 7 to USD 10 million worth of additional exports per year; the impact on exports is therefore very modest (Fig. 45).

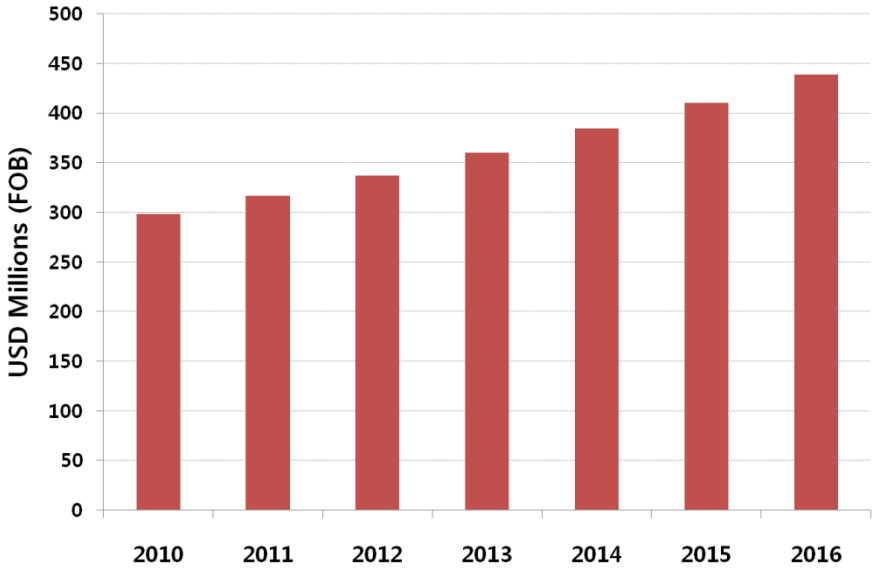
Fig. 45: Additional Exports Resulting from Cabotage Reform (USD m.)



Sources: Author

Imports on the other hand would benefit from removing cabotage restrictions as it would lead to several hundred million dollars worth of additional imports per year (Fig. 46). The impact on imports from cabotage liberalization is similar to the impact of imports from multilateral liberalization (Scenario 2).

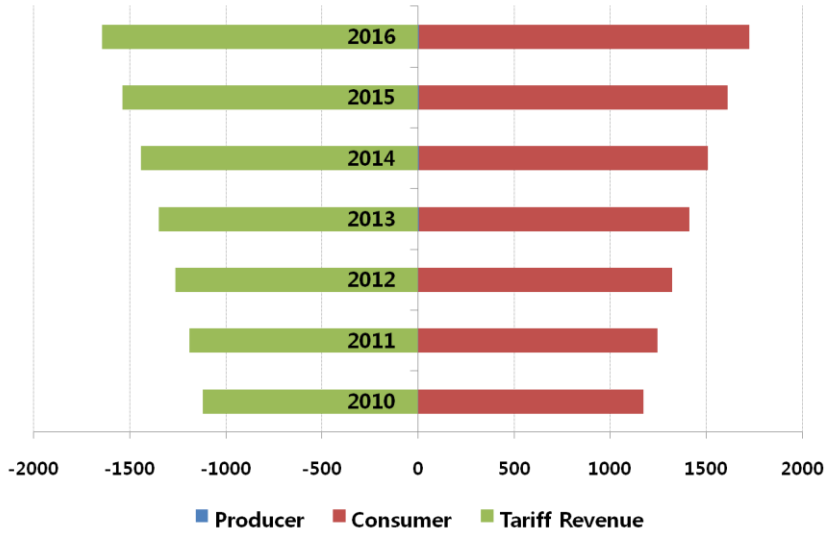
Fig. 46: Additional Imports Resulting from Cabotage Removal



Sources: Author

Given that the impact of cabotage liberalization would be greater on imports than exports, the welfare benefits of this policy option would accrue to Brazilian consumers as shown in Figure 47 below. Furthermore, the welfare results show that the government would lose tariff revenue which is reasonable as the government does charge special taxes on domestic shipping companies that purchase a vessel abroad. Part of the tariff loss however, would also accrue to Brazilian shipyards and other domestic marine equipment manufacturers.

Fig. 47: Additional Imports Resulting from Cabotage Removal

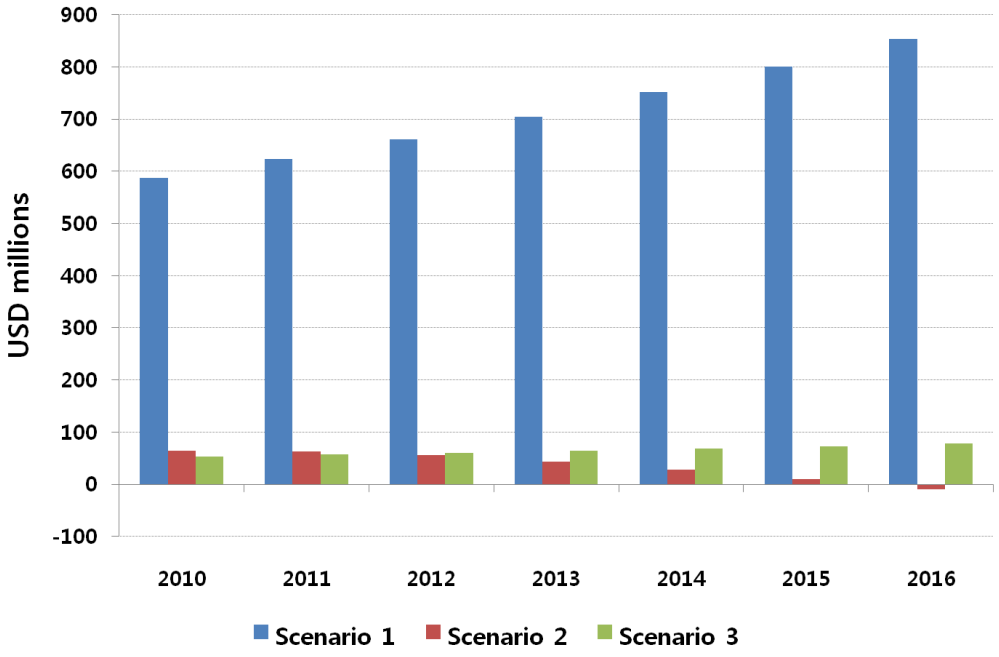


Sources: Author

5.6 Policy Comparison & Assessment

How do the three policy scenarios measure up against each other? Which policy option(s) offer the best option for Brazil? What are the implications of these policies? To address these questions the net welfare effect of each of the three policy options is taken into consideration (Fig. 48). The net welfare refers to the sum of the consumer and producer surpluses plus government tariff revenues. What the comparison reveals is that unilateral liberalization whereby Brazil would lower its tariffs and NTBs to the level of the EU offers the best net welfare effect amounting to several hundred million dollars per year. Multilateral liberalization whereby Brazil's trading partners reduce their trade barriers but Brazil doesn't would eventually result in a negative net welfare effect whereas cabotage liberalization offers a very modest net welfare effect accruing mostly to consumers.

Fig. 48: Net Welfare Effect - Scenario Comparison



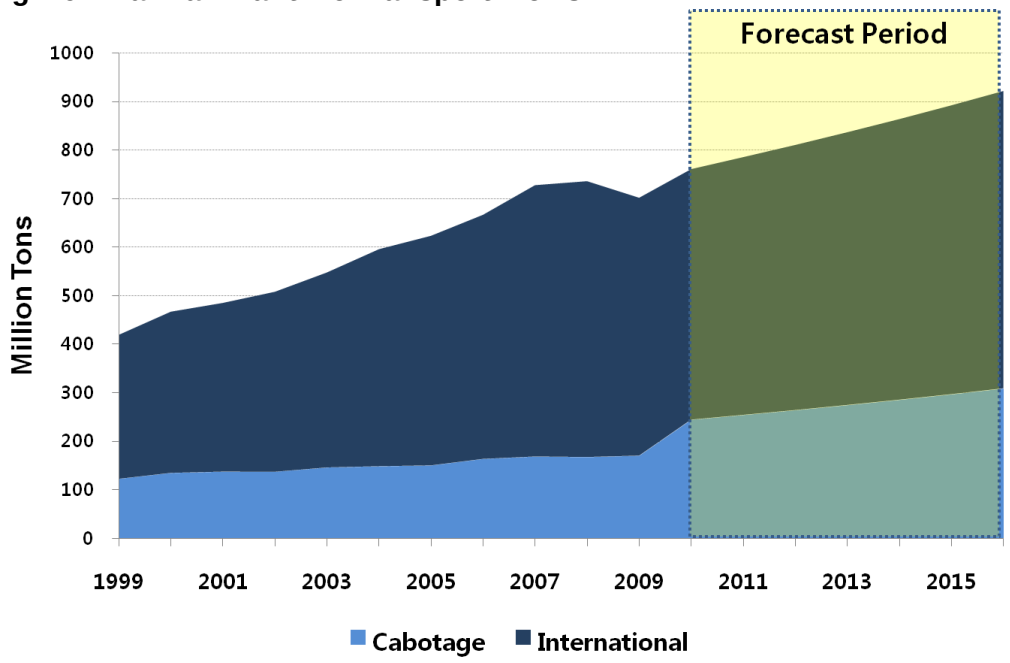
Sources: Author

What the comparison of the trade policies seems to suggest is that Brazil should follow a balanced approach seeking market access concessions from its trading partners while at the same time offering to reduce its own trade barriers. What the recent historical trade patterns and trade forecasts suggest is that Brazilian trade flows are being increasingly driven by trade with emerging economic powers such as China and by diversifying its export/import base. This trend is set to continue and the implications of the analyses herein seem to be that in order for Brazil to benefit from these trends it needs to harness the opportunities which Brazil's new trading partners offer while at the same time making the country more attractive to foreign investment.

5.7 Brazilian Maritime Trade Prospects

What are the implications of the analyses conducted herein for Brazil's maritime sector? How can we expect Brazilian maritime cargo flows to evolve over the next couple of years? How much cargo can Brazilian ports expect over the next few years? Using the equations 3.1 and 3.4 and the trade flow forecasts in this chapter maritime trade flow estimates were drafted as shown in Figure 49. What the estimates show is that total maritime transport flows could rise by about another 200 million tons over the next few years from 702 million tons of maritime cargo (international and cabotage) in 2009 to approximately 900 million tons of cargo by 2016. This estimate does not take into consideration Brazil's total international trade flows as it is only based on trade flows with 48 of Brazil's main trading partners. According to this estimate international maritime transport flows continue to lead the rise in maritime transport flows but cabotage also continue to rise reaching a possible amount of approximately 300 million tons in 2016.

Fig. 49: Brazilian Maritime Transport Flows



Sources: Author

6 Conclusion

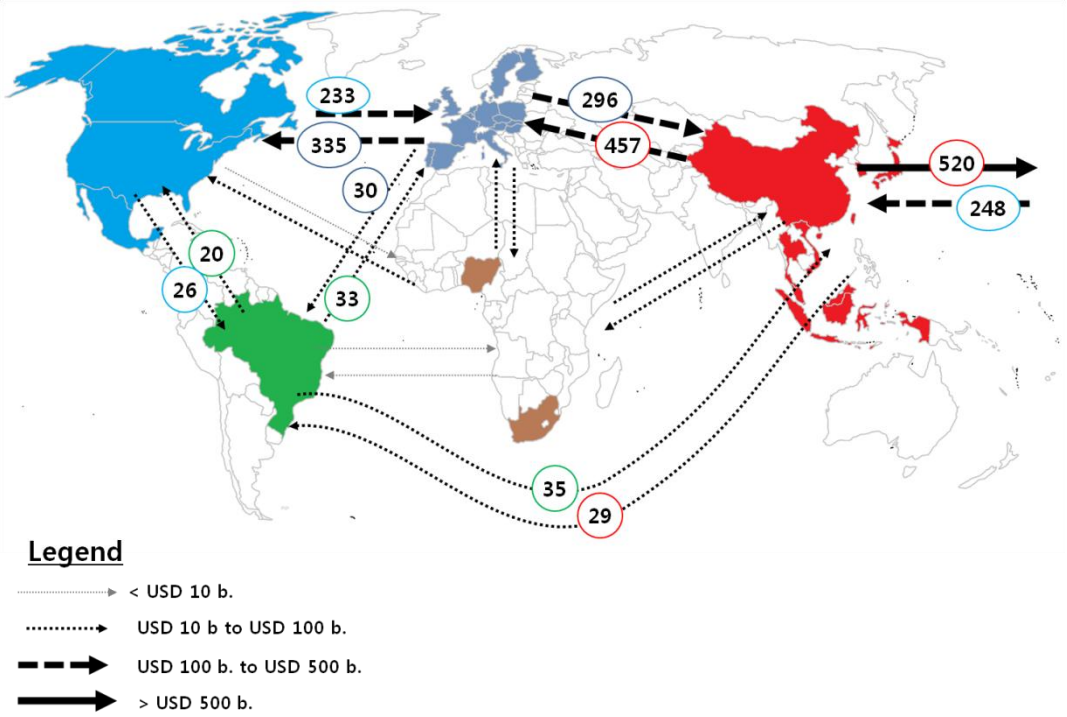
6.1 Key Findings

How has Brazilian economic growth affected trade and maritime transport flows? Over the past 60 years trade patterns have generally followed GDP patterns with the exception of the “Acceleration” period of the late 1950s when international trade did not play a significant role in the Brazilian economy. Economic growth during the “Miracle Years” of the late 1960s and early 1970s as well as the economic growth experienced during this past decade, resulted in steep growth in both trade and maritime transport flows. During the “Miracle Years” international trade flows (exports and imports) rose from USD 3.7 billion in 1968 to USD 20.6 billion in 1974 while during the past decade, total trade flows grew from USD 97 billion in 1999 to USD 280 billion in 2009. Over the decades, international trade has become more important for Brazil. This trade growth also led to sharp increases in maritime transport flows. During the “Miracle Years” maritime transport flows increased from 67 million tons to 176 million tons while during the past decade maritime trade increased from 435 million tons to 732 million tons. There are, however, some differences between these two periods. During the “Miracle Years” manufactured goods led export growth while commodities became a smaller share (in value) of Brazilian exports. During the past decade, however, the trend began to reverse as global demand for Brazilian commodities led Brazilian export growth. Another difference has been that during the past decade Brazilian trade growth has been driven by increasing trade with countries that were formerly minor trading partners for Brazil such as China, South Korea, Indonesia, and India. Both Brazilian economic and trade growth have been linked with solid economic growth in Asia and has led to a diversification of Brazil’s pool of trading partners. Whereas North America and Europe accounted for more than half of Brazil’s total trade 10 years ago, today they account for less than half. Trade with China, in particular, has been significant; China went from being a very minor trading partner in 1999 to rivaling the US as Brazil’s major trading partner. Over the past decade Brazilian trade has been driven by GDP; re-enforcing the idea that global economic growth has strengthened demand for Brazilian commodities and that the economic reforms of the past 20 years enabled Brazil to take advantage of favorable global macro-economic conditions and expand its trade. For Brazil, GDP appears to be the most reliable variable in predicting trade flows.

How is Brazilian economic growth expected to impact trade flows over the next few years? Are current trends likely to continue or will there be a break with the trends observed over the past decade? How will Brazilian trade flows compare with global other global trade flows? Is the South Atlantic likely to become another major trading route like the Pacific or the North Atlantic? Figures 50 through 52 below are trade flow projections along maritime routes. These projections are based on the data sets used for gravity Models 1 and 2. They therefore don’t represent total world trade. The only difference between these projections and the trade flow projections in

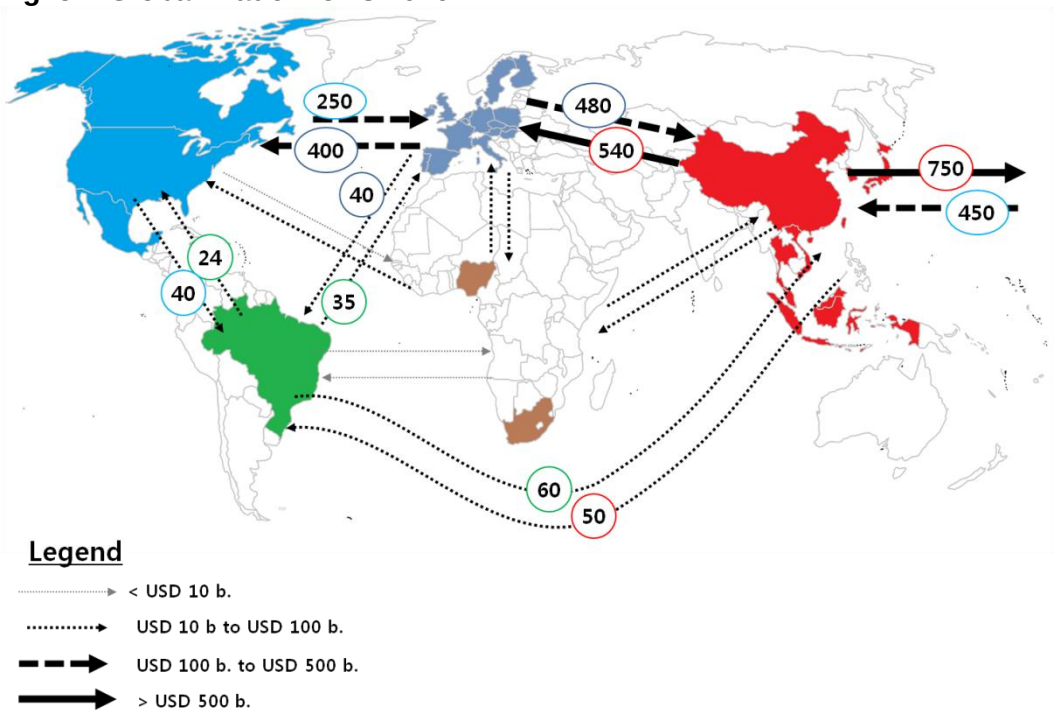
Chapter 5 is that the countries in these trade flows have been re-arranged according to geographical location.

Fig. 50: Global Trade Flows 2009



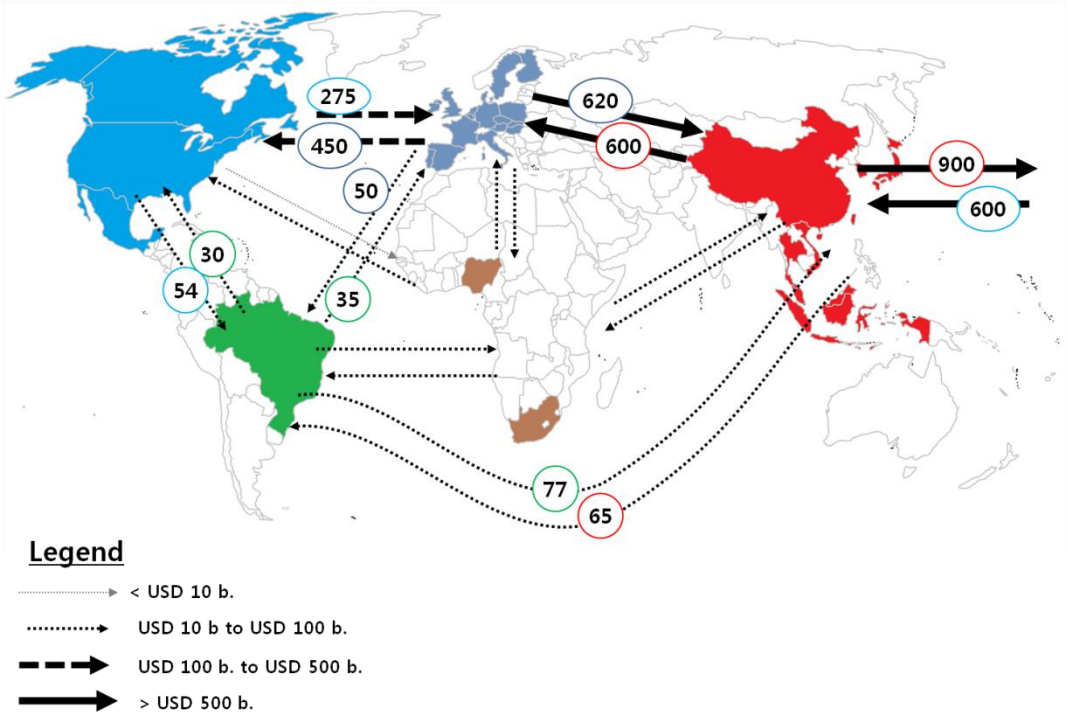
In 2009, Europe, East Asia, and North America dominated global trade and maritime transport flows. The trade flows among these three regions alone accounted for half of global trade flows in the data set with the East Asia/NAFTA trade flow alone accounting for just under 20% of the trade flows in the data set; the single largest trade flow in the data set. Total Brazilian trade flows with all the countries in the data set only amounted to about 6% of the total trade flows among all the countries in the data set. In 2009 Brazil's trade flows were roughly evenly split among East Asia, the EU, NAFTA, and ROW.

Fig. 51: Global Trade Flows 2016



By 2016 Europe, East Asia, and North America continue to dominate global trade and maritime transport flows accounting for half of trade flows in the data set. Transatlantic trade, however, has become relatively less important but remains one of the largest trade routes accounting for 11% (down from 14% in 2009) of the trade flows in the data set. The Eurasian and Transpacific trade flows have become even more important with the latter accounting for just over 20% of global trade flows. Brazil's status doesn't change much; it only accounts for about 6.5% of total trade flows but what is noticeable is that trade with East Asia has almost doubled from approximately USD 64 billion in 2009 to roughly USD 110 billion in 2016; accounting for 30% of Brazil's total trade.

Fig. 52: Global Trade Flows 2020



Assuming that current GDP trends continue, by 2020 Europe, East Asia and North America continue to dominate global trade but together they only account for slightly under half of global trade flows as trade with and among other regions of the world becomes increasingly important. By 2020 Brazil's total trade flows have nearly doubled from USD 244 billion in 2009 to roughly USD 465 billion but they still only account for less than 7% of the trade flows in the data set. Trade with East Asia amounts to roughly USD 142 billion; more than double the amount of trade with East Asia in 2009. Trade with the EU and NAFTA continues to grow but less steeply than trade with Asia. Basically, Brazil's trade partner diversification continues throughout the decade as trade with East Asia and ROW could account for roughly 60% of Brazil's total trade; up from roughly half in 2009. Despite Brazil's continued trade growth, its total trade flows will only amount to roughly 30% of the transpacific or Eurasian trade flows in 2020. Due to the diversified nature of Brazil's trade flows, maritime transport flows to and from Brazil will still be relatively small. The East-West trade flows among Europe, East Asia, and North America and in particular transpacific trade flows can be expected to continue dominating world trade. Therefore, even if Brazil continues growing, it is unlikely to have the same impact on world trade that the economic rise of East Asia has had over the last couple decades.

6.2 Implications

What are the implications of these projections and trends for Brazil and its policy makers? To have the kind of impact that East Asia has had on the geography of

trade; Brazil would need to make itself a more competitive exporter and manufacturing base. It would therefore have to improve its infrastructure, improve the competitiveness of its labor force, and make itself a more attractive manufacturing export base.

As mentioned earlier, despite being a rising economic power, Brazil's infrastructure ranks among the worst in the world. Brazil's infrastructure hinders the country's export potential by increasing the overall costs of its products. For example, despite having lower production costs and being as productive as its main rival, the United States, Brazilian soybeans end up being more expensive than their American rivals due to higher transport costs (World Bank 2008; Wheatley, 2009). Brazil's poor infrastructure also makes it harder to better integrate Brazil's regions and link its poorer regions to global markets. Improving infrastructure would not only benefit Brazil's competitive agribusiness sector but would also perhaps make it more attractive as a manufacturing base. Tackling infrastructure, however, could be difficult. The Brazilian government has worked hard over the past two decades to reduce government spending and put its finances in order. Memories of PND II, high government debt, and inflation are still fresh making the government reluctant to increase public spending.

Labor is also another issue in Brazil. Brazilian labor costs are higher than those of Asia and the country faces a shortage of engineers. Furthermore, labor rights built into the constitution make it difficult to negotiate with labor and also help make Brazilian labor more expensive. This is a major issue for the Brazilian manufacturing sector as its struggles against the might of the Asian industrial giants even on its own home turf. Brazil has worked hard to diversify its economy and develop an industrial sector but which manufacturing sectors should Brazil focus on? Can Brazilian labor compete with Asian labor and if so in which sectors would it have an advantage over its Asian rivals? These are questions which are beyond the scope of this thesis but which are important for Brazil to address so as to properly train the kind of workforce it needs. Moreover, should Brazil even be focusing on heavy industry? Given export performance over the past decade the country appears to have a competitive edge in agribusiness and energy sectors. Should it instead focus on these sectors? The planet's resources will continue to face pressure as the global population continues to increase. As suggested by Brainard and Martinez-Diaz, the country appears to have a competitive edge in addressing some of the resource problems that the planet is facing.

Unlike China, Korea, or Vietnam, Brazil has never really been an export base for foreign manufacturers. Foreign manufacturers entering the Brazilian market typically tended to enter Brazil simply to meet local demand. Moreover, Brazilian policies for most of the past 60 years have tended to encourage foreign investment for the purpose of acquiring foreign know-how to develop local industries and meet local demand (i.e. import substitution and industrialization). Aside from improving infrastructure and making its labor force more competitive, Brazil should also

continue liberalizing its policies in order transform itself into a more competitive dynamic economy. Removing local content regulations would help Brazilian companies, including manufacturers, acquire the technology and goods they need at lower prices. Removing local content regulations would also enable Brazilian manufacturers to better develop global logistics networks. Furthermore, the policy scenarios in Chapter 5 suggest that a mixture of both unilateral and multilateral liberalization could help Brazil increase its exports while also improving consumer welfare. So far Brazil has not been very active in promoting free trade agreements. It only has free trade agreements with MERSOCUR nations and as the gravity models showed, MERSOCUR has not been a significant factor in Brazilian trade. Through participation in free trade agreements, Brazil could perhaps transform itself into a more attractive manufacturing base. Through greater involvement in free trade agreements Brazil could perhaps facilitate the development of greater industrial ties with its trading partners thereby enabling technology transfers and the development of logistics networks. Such ties could enable Brazil to develop manufacturing niches that enhance the competitiveness of its industrial sectors. Moreover, over the past decade Brazil has diversified its pool of trading partners with Asia becoming particularly important. In doing this, Brazil has “diversified” its economic risk by making itself less dependent on the economic fortunes of one or two trading partners. Unlike Mexico, which trades mostly with its North American neighbors, Brazil is less susceptible to the economic fortunes of any one of its trading partners. At the same time, however, Brazil needs to develop trade strategies with each of its major trading partners so to enhance the benefits of trade with these regions. For example, Brazil could compete with Asia by fostering stronger industrial ties with NAFTA so as to provide an alternative base for consumer goods and decrease NAFTA’s dependence on Asian imports. With Asia, Brazil could negotiate free trade agreements that enable it to better integrate itself into the Asian manufacturing logistics networks. For example, instead of simply exporting iron ore it could export steel or steel parts for Asian manufacturers through joint ventures with Asian companies.

What seems to be clear from looking at Brazil is that simply reducing trade barriers is not enough. Although reducing trade barriers could perhaps make Brazil a more attractive market and enhance market access of Brazilian goods, Brazil still faces some difficult issues that it needs to tackle such as infrastructure and labor. Brazil therefore needs a mix of “soft” measures (i.e. free trade agreements, trade liberalization etc.) and “hard” measures (i.e. infrastructure investment, education, etc.) before it can achieve the kind of growth and influence of the Asian industrial giants.

6.3 Limitations

One of the major hurdles in assessing the impact of trade barriers and in particular

NTBs on trade was the lack of data on the ad-valorem cost of NTBs. The bits of data available on this topic do not have time series making it difficult to assess the impact of trade reform over the years. Likewise, there was a shortage of data for properly assessing the impact of cabotage regulations on Brazilian shipping. Although there is a lot of statistical data available regarding cabotage shipping such as number of ships deployed, tons of cabotage cargo loaded and unloaded in Brazilian ports going back to the 19th century, and data on the type of cabotage cargo (i.e. containers, bulk, etc.) there is no data on freight rates and on the flows along major cabotage routes. Moreover, given that the effect of cabotage reform would perhaps be greater for Brazil's domestic market, data on domestic transport costs would also help to provide a fuller assessment of the benefits of liberalizing cabotage legislation. As such the analysis of cabotage conducted herein is only a rough sketch of the possible effects of liberalizing cabotage regulations. As mentioned earlier other factors would need to be taken into consideration.

6.4 Suggestions for Further Research

Brazil is currently going through some interesting changes and there is no shortage of interesting topics for research. For example cabotage alone is an interesting subject. Brazil is a very big country with most of its population living along the coast and therefore with potential for cabotage to play an even bigger role than it does now. This could not only help to reduce wear and tear on Brazil's overburdened road infrastructure but it could also help reduce transport costs and leads to the development of a more active short sea shipping market like the one here in Europe. To the author's knowledge there have been no studies done on the impact of completely liberalizing Brazil's cabotage market – this thesis may be one of the first attempts to quantify the impact of liberalizing the cabotage market. To fully assess this, however, would require a study of the domestic trade flows within Brazil and whether the ability to purchase or use foreign built and/or crewed vessels could help make cabotage more competitive. Cabotage, however, does not only rely on a sufficient supply of available tonnage; it is also highly dependent on good port/hinterland interfaces which for Brazil is a problem especially since railroads are not widely used. An interesting area of research could be the impact of infrastructure and in particular port infrastructure investment on Brazilian international and cabotage trade flows. Would better ports and better port/hinterland interfaces help shift more cargo away from roads? To what extent would better infrastructure make Brazil a more competitive exporter? The topic of infrastructure and transport is also relevant for Brazil on a domestic level due to the fact that the country has many regions some of which are distant from major economic centers and which struggle to develop; how would infrastructure improvements or changes in transport policy help to better tie the country together and open up domestic markets?

The Brazilian manufacturing sector also offers another interesting area for research as it faces rising competition from Asian manufacturers on the home front and a stronger Real which makes Brazilian products more expensive overseas. How

should the Brazilian manufacturing sector tackle these two challenges? How can Brazilian manufacturers compete in global markets in light of these two challenges? Which policies would best enhance Brazilian manufactured exports? How can Brazilian manufacturers better integrate themselves into global manufacturing logistics networks?

Another potential area for research is the impact of distance versus liner connectivity. Does geographical distance still matter? In the quantitative analyses conducted herein the effect of distance was somewhat inconclusive as shown by the results of Models 2 and 2a in Chapter 5. It seems that when only major trading partners are taken into account distance does indeed have a detrimental impact for Brazil but when more minor trading partners are taken into account the effect of distance does not seem to be significant. To address this issue it would be interesting to distinguish between trade flows in manufactured goods and trade in raw materials. Does distance have a different effect on trade in manufactured goods than on trade in commodities? It would also be interesting to compare the effect of liner connectivity with distance to see which one is more detrimental for Brazil.

In closing, Brazil is going through some interesting and exciting times and it will be interesting to see how the country handles the risks and opportunities ahead.

Bibliography

Altimani de Oliveira, H., (2006), “China-Brasil: perspectivas de cooperación Sur-Sur” Nueva Sociedad Vol: 203 ISSN: 0251-3552 Start Page: 138

Anderson, J.E. (1979), “A Theoretical Foundation for the Gravity Equation.” American Economic Review, 69: 106-116.

Anderson, J & E van Wincoop, (2003), ‘Gravity with Gravitas: A Solution to the Border
Puzzle’, American Economic Review, 93 (1), 170-192.

Agência Nacional de Transportes Aquaviários (ANTAQ): http://www.antaq.gov.br/Portal/Estatisticas_Anuarios.asp# accessed June, 2011

Baer, Werner, (2008) *The Brazilian Economy: Growth & Development – Sixth Edition,* Lynne Rienner Publishers

Baier, S.L. and J.H. Bergstrand (2001), “The Growth of World Trade: Tariffs, Transport Costs, and Income Similarity,” Journal of International Economics, 53: 1-27.

Baier, S., & Bergstrand, J. (2009). “Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation” Journal of International Economics, 77(1), 77-85. Elsevier B.V.

Baltar, C. T. (2008), “Comércio exterior inter e intra-industrial: Brasil 2003-2005.” Economia e Sociedade, 17(1), 107-134.

Baumann, R., (2009), “Some Recent Features of Brazil-China Economic Relations,” Economic Commission for Latin America & The Caribbean (ECLAC).

Bergstrand, J. H. (1981), “The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence,” Financial Statistics

Bergstrand, J. (1985), ‘The Gravity Equation in International Trade: Some microeconomic Foundations and Empirical Evidence’, The Review of Economics and Statistics, 67 (3), 474-481

Brainard, L, Martinez-Diaz, L., (2009) *Brazil as an Economic Superpower? Understanding Brazil’s Changing Role in the Global Economy*, Brookings Institution Press, Washington DC

Button, Kenneth (2010), *Transport Economics, 3rd Edition*, Edward Elgar Publishing Inc.

Clark X., et al (2004), “Port Efficiency, Maritime Transport costs and Bilateral Trade,” Working Paper 10353, National Bureau of Economic Research

Ferreira, F., Leite, P., & Wai-Poi, M. (2007), “Trade Liberalization, Employment Flows and Wage Inequality in Brazil,” World Bank Policy Research Working Paper 4108

Francois, J.; Hall, K., (2003), “Global Simulation Analysis of Industry-Level Trade Policy,” Tinbergen Institute and US Department of Commerce

Goebel, D. (2002). “A Competitividade Externa e a Logística Doméstica,” in *O Desafio das Exportações,* BNDES (pp. 285-365).

Goldman Sachs (2007), *BRICs & Beyond*, Goldman Sachs Global Economics Group

Instituto Brasileiro de Geografia e Estatística (“IBGE”): http://www.ibge.gov.br/home/ accessed June/July 2011

Instituto de Pesquisa Econômica Aplicada (“IPEA”): http://www.ipeadata.gov.br/ accessed June/July 2011

Kee, Hiau Looi, Alessandro Nicita and Marcelo Olarreaga. "Estimating trade restrictiveness indices", Economic Journal, 2009, vol. 119, p. 172--199.

Keller, G., (2008), *Managerial Statistics – Eighth Edition,* Cenage Learning

Kruse, C. J., Villa, J. C., Bierling, D. H., Solari, M., & Hutson, N. (2007). “Short-sea Shipping Initiatives and the Impacts on the Texas Transportation System: Technical Report 7. Security, 7(2).

Lacerda, S. M. (2004), “Navegação de cabotagem: regulação ou política industrial?” BNDES Setorial, Rio de Janeiro, n. 19, p.46-66, March 2004

Lacerda, S. M. (2004), “Navegação e Portos no Transporte de Contêineres,” Revista do BNDES, 11(22), 215-243

Levinson, M, (2006), *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, Princeton University Press

Limão N., Venables A., (2001) “Infrastructure, Geographical Disadvantage,

Transport Cost, and Trade," The World Bank Economic Review, Vol. 15, No. 3, 451-479

Mankiw, N. Gregory, (2008) *Principles of Economics – 5th Edition,* Cenage Learning

Martinez-Zarzoso I., Wilmsmeier G., (2009), "Determinants of Maritime Transport Costs – a Panel Data Analysis for Latin American Trade," Transportation Planning and Technology 33:1, 105-121

Medianu, D., Whalley, J., (2010), "The Deepening China-Brazil Economic Relationship," CESifo Working Paper No. 3289, Category 8 – Trade Policy

Meloni Nassar, A. (2009), "Brazil as an Agricultural and Agroenergy Superpower" in Lael Brainard and Leonardo Martinez-Diaz (eds.), *Brazil as an Economic Superpower? Understanding Brazil's Changing Role in the Global Economy,* Brookings Institution Press, Washington DC

Mendonça de Barros, C. (2008), "Um novo futuro" Novos Estudos, pgs. 11-20.

Mold, A., (2005) "Non-Tariff Barriers – Their Prevalence and Relevance for African Countries," Work in Progress No. 25, UN Economic Commission for Africa

Ministério do Desenvolvimento, Indústria e Comércio Exterior ("MDIC") http://www.desenvolvimento.gov.br/sitio/interna/interna.php?area=5&menu=608&refr=608 accessed summer 2011

Mutambatsere, E., (2006), "Trade Policy Reforms in the Cereals Sector of the SADC Region:
Implications on Food Security," Paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia

Neill, J. O., Wilson, D., & Stupnytska, A. (2005), "Global Economics Paper No: 134 How Solid are the BRICs?" Goldman Sachs

Pedreira, A. (2006), "Os Recentes Avanços da Multimodalidade no Brasil", Dissertation, Pontifica Universidade Catolica do Rio de Janeiro

Radelet, S et al., (1997), "Economic Growth in Asia", Harvard Institute for International Development

Radelet, S; Sachs, J., (1999), "Shipping Costs, Manufactured Exports, and Economic Growth," Harvard Institute for International Development

Salama, P. (2010). "Brasil, Balanço Econômico, Sucessos e Limites," *Estudos Avançados*, *24*(70), 167-183.

Sánchez, R. J., & Wilmsmeier, G. (2005), “Short-sea Shipping Potentials in Central America to Bridge Infrastructural Gaps,” Maritime Policy & Management, 32(3), 227-244.

Schwab, K (2010), “The Global Competitiveness Report,” World Economic Forum

Stopford, M. (1997), *Maritime Economics, 2nd Edition,* Routledge, London & New York

Stopford, M. (2009), *Maritime Economics, 3rd Edition,* Routledge, London & New York

Veiga, Pedro da Motta, (2009), “Brazil’s Trade Policy: Moving Away from Old Paradigms”, in Lael Brainard and Leonardo Martinez-Diaz (eds.), *Brazil as an Economic Superpower? Understanding Brazil’s Changing Role in the Global Economy,* Brookings Institution Press, Washington DC

Villarim de Siqueira, T. (2006), “Comércio Internacional: Oportunidades para o Desenvolvimento Regional,” Revista do BNDES, 13(25), 115-154.

Wilson, D., Purushothaman, R., (2003) “Paper No: 99 Dreaming With BRICs: The Path to 2050,” (October 2003), 1-24.

Wheatley, J., (2009) “Poor Infrastructure Hampers Brazil’s Booming Farms,” Financial Times

World Bank (2008), “Brazil: Evaluating the Macroeconomic and Distributional Impacts of Lowering Transportation Costs, Report No. 40020-BR”, World Bank – Brazil Country Management Unit

World Bank World Economic Outlook Database April 2011 Edition: http://www.imf.org/external/pubs/ft/weo/2011/01/weodata/index.aspx accessed summer 2011

World Bank, World Integrated Trade Solution (“WITS”) Database: http://wits.worldbank.org/wits/ accessed July/August 2011

Zepeda, C., (2011). *What is the effect of Brazil’s Multimodal Transport System on Brazil’s Economy ?*

Zendron, P., & Catermol, F. (2006), “O Boom Exportador Brasileiro e sua Base de Exportadores,” *Revista do BNDES*, *13*(25), 87-114.

Appendix 1

Refer to page 23:

Correlation

L(International) and Exports (USD m.) FOB	
Pearson Coefficient of Correlatior	0.9938
t Stat	68.2757
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Correlation

L(International) and Imports (USD m.) FOB	
Pearson Coefficient of Correlatior	0.9878
t Stat	48.2514
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Correlation

L(Total) and Exports (USD m.) FOB	
Pearson Coefficient of Correlatior	0.9939
t Stat	68.6825
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Correlation

L(Total Shipping) and L(Total Trade)	
Pearson Coefficient of Correlatior	0.9927
t Stat	62.6596
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Correlation

Cabotage and L(Total Trade)	
Pearson Coefficient of Correlatior	0.9563
t Stat	24.8992
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Correlation

Cabotage and International	
Pearson Coefficient of Correlation	0.9556
t Stat	24.7101
df	58
P(T<=t) one tail	0
t Critical one tail	1.6716
P(T<=t) two tail	0
t Critical two tail	2.0017

Appendix 2

Refer to page 23

TOTAL TRADE & INTERNATIONAL SHIPPING

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.994511826
R Square	0.989053772
Adjusted R Square	0.988865044
Standard Error	0.091881026
Observations	60

ANOVA

	df	SS	MS	F	Significance F
Regression	1	44.24203407	44.24203407	5240.628927	1.44323E-58
Residual	58	0.489643135	0.008442123		
Total	59	44.7316772			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	-0.365370375	0.073676609	-4.959109564	6.51361E-06	-0.51285013	-0.21789	-0.51285	-0.21789
Total Trade (USD m.) FC	0.530579697	0.00732924	72.3921883	1.44323E-58	0.51590863	0.545251	0.515909	0.545251

International Shipping & Exports

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.993836372
R Square	0.987710733
Adjusted R Square	0.987498849
Standard Error	0.097354623
Observations	60

ANOVA

	df	SS	MS	F	Significance F
Regression	1	44.1819577	44.1819577	4661.565603	4.14193E-57
Residual	58	0.549719507	0.009477923		
Total	59	44.7316772			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	0.038816865	0.07228087	0.537028194	0.593302411	-0.105869015	0.183503	-0.10587	0.183503
Exports (USD m.) FOB	0.522665599	0.007655226	68.27565893	4.14193E-57	0.507341999	0.537989	0.507342	0.537989

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.987771991
R Square	0.975693506
Adjusted R Square	0.975274429
Standard Error	0.136916174
Observations	60

ANOVA

	df	SS	MS	F	Significance F
Regression	1	43.64440696	43.64440696	2328.193586	1.61981E-48
Residual	58	1.087270242	0.018746039		
Total	59	44.7316772			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0	Upper 95.0%
Intercept	0.023925447	0.102562587	0.233276557	0.816368004	-0.181375875	0.22922677	-0.1814	0.22922677
Imports (USD m.) FC	0.533711118	0.011061059	48.25135839	1.61981E-48	0.511570004	0.55585223	0.5116	0.55585223

Cabotage and Total Trade

SUMMARY OUTPUT

Regression Statistics		
Multiple R	0.956268924	
R Square	0.914450255	
Adjusted R Square	0.912975259	
Standard Error	0.363753745	3.66
Observations	60	

ANOVA

	df	SS	MS	F	Significance F
Regression	1	82.03219	82.03218976	619.968122	1.17881E-32
Residual	58	7.674374	0.132316787		
Total	59	89.70656			

	Coefficients	tandard Err	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	Jpper 95.0%
Intercept	-3.512598466	0.291683	-12.04251635	2.03802E-17	-4.096465616	-2.92873	-4.09647	-2.92873
Total Trade (USD m	0.722479015	0.029016	24.89915906	1.17881E-32	0.664396777	0.780561	0.664397	0.780561

Appendix 3

GLOBAL GRAVITY MODEL RESULTS

Source	SS	df MS	Number of obs	= 15466	
		F(48, 15417)	= 956.14		
Model	52101.1181	48 1085.43996	Prob > F	= 0.0000	
Residual	17501.917	15417 1.13523494	R-squared	= 0.7485	
		Adj R-squared	= 0.7478		
Total	69603.0351	15465 4.50068122	Root MSE	= 1.0655	

l_exports	Coef.	Std. Err. t	P>t	[95% Conf.	Interval]
l_origingdp	.6954777	.014129 49.22	0.000	.6677832	.7231722
l_destgdp	.6203471	.014068 44.10	0.000	.5927722	.6479221
l_dist	-.5197512	.0153725 -33.81	0.000	-.549883	-.4896193
l_tfi	.4922645	.0548597 8.97	0.000	.3847331	.5997959
lang	.2645541	.0387981 6.82	0.000	.1885054	.3406029
colony	.3133772	.06227 5.03	0.000	.1913207	.4354337
landl	-.8398397	.0897602 -9.36	0.000	-1.01578	-.6638992
smctry	.6600029	.0659488 10.01	0.000	.5307354	.7892704
contig	.534252	.0479576 11.14	0.000	.4402495	.6282546
fta	1.061076	.0346151 30.65	0.000	.993226	1.128925
are	-1.403586	.0684645 -20.50	0.000	-1.537785	-1.269388
aus	-.3323796	.0688319 -4.83	0.000	-.4672982	-.1974611
aut	-.5398448	.1051191 -5.14	0.000	-.7458907	-.3337989
bel	-.2266917	.0748838 -3.03	0.002	-.3734727	-.0799107
bra	-.5887025	.0692338 -8.50	0.000	-.7244089	-.4529961
can	-.7654616	.0689398 -11.10	0.000	-.9005918	-.6303314
che	.0097132	.1031429 0.09	0.925	-.1924591	.2118854
chn	.2725802	.0727526 3.75	0.000	.1299766	.4151838
cze	-.4625298	.1062182 -4.35	0.000	-.67073	-.2543296
deu	-.0355318	.070813 -0.50	0.616	-.1743337	.1032701
dnk	-1.115781	.065913 -16.93	0.000	-1.244979	-.9865839
esp	-.8412786	.0670534 -12.55	0.000	-.9727112	-.709846
fin	-.9395982	.0665748 -14.11	0.000	-1.070093	-.8091037
fra	-.6736361	.0693516 -9.71	0.000	-.8095734	-.5376988
gbr	-.5475977	.0712927 -7.68	0.000	-.6873399	-.4078556

hkg	-.6830581	.068637 -9.95	0.000	-.8175948	-.5485215
hun	-.4028521	.1064028 -3.79	0.000	-.6114142	-.19429
idn	-.4976827	.0668906 -7.44	0.000	-.6287962	-.3665693
ind	-.4650618	.0733902 -6.34	0.000	-.6089152	-.3212084
irl	-.845427	.0665912 -12.70	0.000	-.9759536	-.7149004
ita	-.5538979	.0684959 -8.09	0.000	-.688158	-.4196378
jpn	-.056124	.0751063 -0.75	0.455	-.2033413	.0910933
kor	.284069	.0678617 4.19	0.000	.151052	.4170859
mex	-1.870112	.0692972 -26.99	0.000	-2.005943	-1.734281
mys	.2964934	.0680409 4.36	0.000	.1631253	.4298614
nld	-.0210465	.0659901 -0.32	0.750	-.1503949	.1083019
nor	-1.514237	.0659215 -22.97	0.000	-1.643451	-1.385023
pol	-1.455344	.0659374 -22.07	0.000	-1.584589	-1.326099
rus	-.4469853	.0687591 -6.50	0.000	-.5817613	-.3122093
sgp	.711709	.0687788 10.35	0.000	.5768945	.8465234
svk	-1.153077	.1087813 -10.60	0.000	-1.366301	-.9398525
swe	-.7609907	.0656023 -11.60	0.000	-.889579	-.6324025
tha	.1349724	.0670716 2.01	0.044	.0035042	.2664407
tur	-1.381487	.0657121 -21.02	0.000	-1.51029	-1.252683
twn	.2577016	.0674684 3.82	0.000	.1254555	.3899477
usa	.0833264	.0816957 1.02	0.308	-.0768067	.2434596
vnm	-.6393366	.0711372 -8.99	0.000	-.778774	-.4998993
zaf	-.7423365	.0685988 -10.82	0.000	-.8767984	-.6078747
_cons	-7.198074	.3858964 -18.65	0.000	-7.954477	-6.441672

Appendix 4

Source	SS	df MS	Number of obs =	1056
	F(55, 1000)	= 63.14		
Model	2356.01315	55 42.8366027	Prob > F	= 0.0000
Residual	678.485484	1000 .678485484	R-squared	= 0.7764
	Adj R-squared	= 0.7641		
Total	3034.49863	1055 2.87630202	Root MSE	= .8237
l_exports	Coef.	Std. Err. t	P>t [95% Conf.	Interval]
l_origingdp	.7808129	.0768646 10.16	0.000 .6299784	.9316474
l_destgdp	.6315175	.0745656 8.47	0.000 .4851945	.7778405
l_dist	-6.430499	1.798066 -3.58	0.000 -9.958915	-2.902083
l_tfi	.7334297	.1891696 3.88	0.000 .3622148	1.104645
lang	3.26142	3.58751 0.91	0.364 -3.77849	10.30133
landl	-6.70309	2.470943 -2.71	0.007 -11.55192	-1.854262
contig	2.13022	1.009619 2.11	0.035 .1490046	4.111436
mrdist	.042867	.2124621 0.20	0.840 -.3740557	.4597896
mrlang	541.7269	744.023 0.73	0.467 -918.2986	2001.752
mrcontig	-66.04131	71.793 -0.92	0.358 -206.9235	74.84089
mrll1	-16.6467	117.7644 -0.14	0.888 -247.7403	214.4469
are	5.74209	2.811067 2.04	0.041 .2258236	11.25836
arg	-3.579538	1.744088 -2.05	0.040 -7.002031	-.1570451
aus	7.792222	2.96657 2.63	0.009 1.970806	13.61364
aut	12.7154	4.958588 2.56	0.010 2.98497	22.44583
bel	7.523393	2.383038 3.16	0.002 2.847063	12.19972
bol	4.527228	1.355553 3.34	0.001 1.867174	7.187283
can	5.179854	2.093794 2.47	0.014 1.07112	9.288589
che	13.4683	4.880296 2.76	0.006 3.8915	23.04509
chn	11.13501	3.470878 3.21	0.001 4.323973	17.94605
cze	12.2299	4.91937 2.49	0.013 2.576429	21.88337
deu	7.326389	2.430547 3.01	0.003 2.556832	12.09595
dnk	6.03478	2.518074 2.40	0.017 1.093466	10.97609
dza	6.664875	2.151552 3.10	0.002 2.4428	10.88695
esp	5.812755	2.136284 2.72	0.007 1.620642	10.00487
fin	7.292152	2.66304 2.74	0.006 2.066364	12.51794
fra	6.5094	2.346343 2.77	0.006 1.90508	11.11372

gbr	6.288408	2.364066 2.66	0.008 1.64931	10.92751
hkg	9.295446	3.500129 2.66	0.008 2.427006	16.16389
hun	12.52075	4.936574 2.54	0.011 2.833518	22.20798
idn	9.386013	3.244966 2.89	0.004 3.018288	15.75374
ind	8.987027	3.112573 2.89	0.004 2.879104	15.09495
irl	5.703118	2.330674 2.45	0.015 1.129545	10.27669
ita	6.779866	2.358481 2.87	0.004 2.151727	11.40801
jpn	10.47856	3.569507 2.94	0.003 3.473974	17.48314
kor	11.21084	3.536225 3.17	0.002 4.27157	18.15011
mex	5.243369	1.921429 2.73	0.006 1.472873	9.013865
mys	9.868523	3.276878 3.01	0.003 3.438178	16.29887
nga	4.861723	1.642577 2.96	0.003 1.63843	8.085016
nld	7.463915	2.412095 3.09	0.002 2.730567	12.19726
nor	6.653977	2.5538 2.61	0.009 1.642555	11.6654
per	-1.156559	.5115941 -2.26	0.024 -2.16048	-.1526383
pol	5.994952	2.559014 2.34	0.019 .9733	11.0166
rus	7.936346	2.747764 2.89	0.004 2.544301	13.32839
sgp	10.39557	3.282651 3.17	0.002 3.953895	16.83724
svk	11.33001	4.919016 2.30	0.021 1.677237	20.98279
swe	7.14764	2.603786 2.75	0.006 2.038129	12.25715
tha	10.1047	3.329496 3.03	0.002 3.571104	16.6383
tur	5.867322	2.547203 2.30	0.021 .8688462	10.8658
twn	10.97933	3.576534 3.07	0.002 3.960962	17.99771
ury	-5.153847	1.888967 -2.73	0.006 -8.860641	-1.447052
usa	5.883466	2.035089 2.89	0.004 1.88993	9.877001
ven	-.1810674	.3080923 -0.59	0.557 -.7856489	.4235142
vnm	8.943971	3.413093 2.62	0.009 2.246326	15.64162
zaf	4.022547	1.634461 2.46	0.014 .8151797	7.229914
_cons	37.55316	14.20835 2.64	0.008 9.67157	65.43476

Appendix 5

note: bol omitted because of collinearity			
note: guy omitted because of collinearity			
note: pan omitted because of collinearity			
note: phl omitted because of collinearity			
note: prt omitted because of collinearity			
note: pry omitted because of collinearity			
Source SS df MS	Number of obs	= 1562	
	F(80, 1481)	= 74.72	
Model 9227.16429 80 115.339554	Prob > F	= 0.0000	
Residual 2285.99189 1481 1.54354618	R-squared	= 0.8014	
	Adj R-squared	= 0.7907	
Total 11513.1562 1561 7.37550043	Root MSE	= 1.2424	
l_export Coef. Std. Err. t	P>t	[95% Conf.	Interval]
l_origingdp 1.25758 .0942608 13.34	0.000	1.072682	1.442479
l_destgdp .5632382 .0937665 6.01	0.000	.379309	.7471674
l_dist -1.504647 2.690954 -0.56	0.576	-6.783133	3.773838
l_tfi -.1826681 .2198135 -0.83	0.406	-.613847	.2485108
landl 4.168176 .7277057 5.73	0.000	2.740732	5.595619
contig -.744267 1.353135 -0.55	0.582	-3.398532	1.909998
lang -3.417795 3.383054 -1.01	0.313	-10.05388	3.218294
continent -2.542413 3.721616 -0.68	0.495	-9.842612	4.757786
mercosur -.9132675 2.030271 -0.45	0.653	-4.895779	3.069244
mrdist -.0148987 .3090312 -0.05	0.962	-.6210841	.5912866
mrland -204.4617 287.0137 -0.71	0.476	-767.4583	358.5349
mrcontig -91.63095 425.6681 -0.22	0.830	-926.6074	743.3455
mrlang 803.8276 611.2513 1.32	0.189	-395.1828	2002.838
mrcontinent -120.8728 338.1001 -0.36	0.721	-784.0789	542.3333
mrmercosur 153.18 275.2596 0.56	0.578	-386.7601	693.1201
ago 1.549009 2.303216 0.67	0.501	-2.968903	6.066922
are -1.974573 1.207075 -1.64	0.102	-4.342332	.3931856
arg 4.544407 1.076428 4.22	0.000	2.432921	6.655892

aus -.6769906 1.009097 -0.67	0.502	-2.656403	1.302422
aut -3.887101 2.144992 -1.81	0.070	-8.094647	.3204451
bel .7984853 1.836393 0.43	0.664	-2.803723	4.400693
bgd -1.209906 .6242525 -1.94	0.053	-2.434419	.0146071
bol (omitted)			
can -.9490991 2.280338 -0.42	0.677	-5.422135	3.523936
che -2.52767 2.651527 -0.95	0.341	-7.728817	2.673478
chl 2.807021 1.824105 1.54	0.124	-.7710834	6.385126
chn .8656001 .5356375 1.62	0.106	-.1850889	1.916289
col 3.128535 1.412706 2.21	0.027	.3574184	5.899652
cpv 1.21884 3.08156 0.40	0.693	-4.825847	7.263527
cri -.6515334 3.326187 -0.20	0.845	-7.176072	5.873005
cze -4.915399 1.389284 -3.54	0.000	-7.640573	-2.190225
deu .075244 1.811938 0.04	0.967	-3.478994	3.629482
dnk -.9865704 1.634625 -0.60	0.546	-4.192997	2.219856
dom -2.254543 3.428735 -0.66	0.511	-8.980236	4.47115
dza .695591 2.173662 0.32	0.749	-3.568194	4.959376
ecu 1.68249 .5813678 2.89	0.004	.5420985	2.822882
egy -.6909914 1.684276 -0.41	0.682	-3.994812	2.612829
esp -.4338895 2.216906 -0.20	0.845	-4.782499	3.91472
fin -.078722 1.421696 -0.06	0.956	-2.867474	2.71003
fra -.4598357 1.92475 -0.24	0.811	-4.235361	3.31569
gbr -.7287336 1.899443 -0.38	0.701	-4.454618	2.997151
gha -2.110853 3.115672 -0.68	0.498	-8.222452	4.000745
guy (omitted)			
hkg -.3261259 .3947083 -0.83	0.409	-1.100373	.4481209
hun -4.726543 1.309113 -3.61	0.000	-7.294455	-2.15863
idn .2824464 .6307097 0.45	0.654	-.9547329	1.519626
ind -.3386078 .8397198 -0.40	0.687	-1.985774	1.308559
irl -.7354738 1.907879 -0.39	0.700	-4.477907	3.006959
irn -1.85195 1.225778 -1.51	0.131	-4.256397	.5524963
isr -.0094201 1.584398 -0.01	0.995	-3.117324	3.098483
ita -.1850629 1.901166 -0.10	0.922	-3.914328	3.544202
jpn -.0405356 .5927692 -0.07	0.945	-1.203292	1.122221
kor 1.091516 .4254784 2.57	0.010	.2569118	1.926121

kwt -2.781336 1.476006 -1.88	0.060	-5.676621	.1139493
lbn -.9302191 1.555449 -0.60	0.550	-3.981336	2.120898
lca -.9437621 4.33614 -0.22	0.828	-9.449392	7.561868
mar .0800327 2.447868 0.03	0.974	-4.721625	4.88169
mex -.4004441 2.533428 -0.16	0.874	-5.369932	4.569044
moz .4965699 2.428138 0.20	0.838	-4.266385	5.259525
mys .8266178 .5848153 1.41	0.158	-.3205366	1.973772
nga .2206252 2.935244 0.08	0.940	-5.537053	5.978304
nld .5555098 1.800762 0.31	0.758	-2.976806	4.087825
nor -.4748748 1.583212 -0.30	0.764	-3.58045	2.630701
omn -3.496535 1.273941 -2.74	0.006	-5.995456	-.9976145
pan (omitted)			
per 3.075226 .7884524 3.90	0.000	1.528624	4.621828
phl (omitted)			
pol -1.188967 1.576617 -0.75	0.451	-4.281606	1.903673
prt (omitted)			
pry (omitted)			
qat -1.907682 1.418453 -1.34	0.179	-4.690074	.8747092
rus -.0605548 1.319064 -0.05	0.963	-2.647988	2.526878
sau -1.512413 1.403231 -1.08	0.281	-4.264945	1.240118
sgp 1.428407 .5771562 2.47	0.013	.2962766	2.560538
sur 1.17809 .4442545 2.65	0.008	.306655	2.049525
svk -5.924158 1.241622 -4.77	0.000	-8.359684	-3.488632
swe -.1823751 1.513288 -0.12	0.904	-3.15079	2.78604
tha .8568357 .5290495 1.62	0.106	-.1809304	1.894602
tto -.4989122 4.52828 -0.11	0.912	-9.381437	8.383613
tur -1.353659 1.597812 -0.85	0.397	-4.487874	1.780556
twn .9617832 .3914439 2.46	0.014	.1939397	1.729627
ury 3.937848 .6543479 6.02	0.000	2.654301	5.221395
usa -.5246709 2.517403 -0.21	0.835	-5.462725	4.413384
ven 3.435085 1.291919 2.66	0.008	.9008991	5.969271
vnm -.4070992 .4523071 -0.90	0.368	-1.29433	.4801316
zaf -.6010516 2.947298 -0.20	0.838	-6.382375	5.180271
_cons -1.945901 26.5574 -0.07	0.942	-54.04003	50.14822