MASTER

INTERNATIONAL ECONOMICS AND EUROPEAN STUDIES

MASTER´S FINAL WORK
DISSERTATION

EXPORT DIVERSIFICATION DETERMINANTS – WHERE DO BRAZIL, CHILE AND MEXICO DIVERGE?

HUGO SANTANA DE MELLO

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SUPERVISION:
MANUEL ENNES FERREIRA

SEPTEMBER 2019

To all who by merit and will
would be completing a
master's degree, but do not
have this opportunity.

BoP – Balance of Payments

ECLAC – Economic Commission for Latin America and the Caribbean

FTA – Free Trade Agreement

GDP – Gross Domestic Product

HHI – Hirschman-Herfindahl Index

JEL – Journal of Economic Literature

LA – Latin America

LAC – Latin American Country/Countries

MERCOSUR – Southern Common Market

NAFTA – North American Free Trade Agreement

OLS – Ordinary Least Squares

REER – Real Effective Exchange Rate

TOT – Terms of Trade

USA – United States of America

WTO – World Trade Organization

ABSTRACT, KEYWORDS AND JEL CODES

This dissertation aims to identify and compare the determinants of products exports from Brazil, Chile and Mexico, seeing that their intensive margin exports have evolved differently. Data analysis and time series ordinary least square (OLS) models from 1990 up to the present allow us to infer which variables explain the greater picture. The results suggest that the most relevant determinant to achieve a diversified export basket is the shift on the production from commodities and primary goods to manufacturing. The empirical analysis also indicates that variables such as exchange rate, institution quality, credit, and remoteness play relevant roles on diversification. Curiously, trade liberalization, while relevant to the three countries, favoured specialization in the Brazilian and Chilean cases, and diversification in the Mexican case, presumably due to its access to the North American market and the maquiladoras' cheap production process.

KEYWORDS: International trade; export diversification; structural economic transformation; Latin America.

JEL CODES: C13; F14; O54.

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EXPORT DIVERSIFICATION DETERMINANTS – WHERE DO BRAZIL, CHILE AND
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By Hugo Mello

The objective of this dissertation is to identify the main determinants of
intensive margin export diversification of Brazil, Chile and Mexico, making
use of OLS models, literature review and data analysis.

1. INTRODUCTION

Over time, the terms of trade (TOT) of primary goods deteriorate, and the exports of
the countries that depend on them become more vulnerable and volatile. Consequently,
the pursue of a diversified export agenda towards manufacture good has become a goal
for many of these countries. It is a way to develop production and therefore, to create
internal benefits, such as knowledge spill over, more dynamic domestic markets,
backward and forward linkages and job creation, among others.

Brazil, Chile and Mexico are, per se, three of the most influential Latin American
countries (LAC) and with global relevance when it comes to aspects such as geopolitics
and market size – the first two are in the G20 group, and emerging markets groups such
as BRICS and MINT[1] have become significantly more relevant since the 2008 crisis.
Historically, since the colonial times (1500-1822), they share similarities that stretch from
social characteristics and language to economic policy agendas. The factors in common
binding LAC are much stronger than those of Africa, Asia or Europe (Bulmer-Thomas,
2003). As the author points out, the region has been quite stable since independence and
its borders have changed much less than elsewhere in the past 150 years. And in spite of
Brazil being the sole Southern Common Market (Mercosur) member-state, the economic
integration encompasses all three countries in some way.

Throughout the 20th century they tried to diversify their production and exports – just
as many other countries have done worldwide – meeting successful outcomes along the
way, and also dealing with the costs of some failed projects. At the end of the last century
they pursued similar policies, such as markets' liberalization and the stabilization of
prices. Their exports, however, did not respond similarly. Chile specialized in ores and
minerals, with great share on copper; Mexico exported more manufactured and less

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[1] Acronyms for Brazil, Russia, India, China, and South Africa; and for Mexico, Indonesia, Nigeria and
Turkey respectively, two groups of the major emerging markets.

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primary goods; and in spite of the fact that Brazil did not show a turning point during this period, its exports indicate a tendency to re-commoditization since the mid-1990s, that increased rapidly and led the country to achieve one of the biggest foreign exchange reserves in the world in the 2000s.

At this stage, my objective is to examine the determinants of their diversification of exports since 1990, capturing a period of liberalization and price stabilization. What determinants are more relevant when it comes to their exports' products diversification?

The determinants of their export diversification will be acknowledged by using some ordinary least squares (OLS) models. The empirical investigations on the topic are usually done through panel models, in order to understand what variables have been central to a group of countries – such as the least developed countries, or countries from a specific region, for example. In this study, however, the objective is to determine not only the common variables between countries, but also the distinct variables, since they are similar but have shown distinct paths in the last 30 years. Is there any relevant variable that will us that?

Stylized facts about individual countries will enrich further investigations and help guide future studies about this, or related, topics. Filling the gap of research on export diversification of specific countries will contribute to the literature, which is mostly focused on panel data analysis, in view of the fact that there are actual conclusions about three relevant emerging countries with distinct exports evolution.

After this introduction, Chapter Two reviews the literature, broadly looking at the export diversification and more specifically at topics on the subject about each country. It will also address export diversification and include some data analysis that will enable an apprehension of each countries' reality. The quantitative analysis is made in Chapter Three, and the data and methodology are discussed before the result analysis. In Chapter Four, the final remarks and conclusions of this dissertation are made. There follows References and Appendices, the latter with some notes, charts and tables.

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2. LITERATURE REVIEW

An extremely specialized export basket is rarely found in a developed country, but that is not the case with most developing countries (Agosin et al, 2011). Indeed, the development of a country is associated with its Hirschman-Herfindahl Index (HHI)[2], and there are cases when this association is extremely negative.

After the failure of the export-led commodities-based growth model in Latin America (LA) – from shortly after independence, largely in the first quarter of the 19th century, and until the Great Depression, when their prices fell glaringly –, the region aimed at implementing the import substitution development model. After the Second World War, some recently industrialized countries in East Asia organized themselves pointing at an export-led growth based on labour-intensive manufacture products and diversifying their export portfolio towards products of higher added value. Over time, those Asian economies became internationally competitive and surpassed the LA standard of living, which was much higher than the former during the 19th century (Bulmer-Thomas, 2003).

Nevertheless, the Asian case is not uniform, and indeed we find opposite examples of development strategy in Asia and therefore, contrasting consequences. Studwell (2013) confronts the cases of Asian countries that promoted export-oriented production (such as Japan, South Korea, Taiwan and recent China) and those that have not done so (such as Malaysia, Indonesia, and The Philippines). Next, he contrasts how the first group has developed and grown, or develops and grows, much faster than the second. Their distinct approach to external trade made a great difference: while the first group generated conglomerates and became internationally competitive with the carrot and stick approach, the second chose the national champion approach and ended up with non-competitive firms dependent on foreign technology.

Although Ricardo suggested specialization of production according to comparative advantage[3], and the Heckscher-Ohlin model implied that endowments should determine a country's international trade[4], at least since the Singer-Prebisch hypothesis[5], LACs have often tried to diversify their export portfolio towards added value products. In sum, while

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[2] UNCTAD Stat (2019). Author's own calculations.
[3] See Ricardo, David (1817), on Principles of Political Economy and Taxation.
[4] See Ohlin, Bertil (1933), on Interregional and International Trade.
[5] It argues natural resource-based countries' TOT deteriorates in the long term due to a fall of relative prices of commodities to industrial products.

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according to Ricardo a country should specialize its production, and exports, and Heckscher-Ohlin did not worry about the diversification per se, and rather accumulation, Prebisch pointed out that diversification was very relevant to achieve development. And according to de Ferranti et al. (2002), the highly concentrated structure of export revenues is a recurrent concern of LACs, since it could deteriorate TOT, diminish economic growth, and lead to economic and income volatility, among other points. Even when suggesting a different path, Prebisch and the Economic Commission for Latin American and the Caribbean (ECLAC) always emphasized the importance of international trade, just as preceding theories have also done so. In his own words:

> The more active LA's foreign trade, the grater the possibility of increasing productivity by means of intensive capital formation. The solution does not lie in growth at the expense of foreign trade, but in knowing how to extract, from continually growing foreign trade, the elements that will promote economic development.

In: Prebisch (1950), p. 2.

It is relevant to decompose export diversification into intensive and extensive margins (export basket value distribution and greater number of partners respectively), as several authors have done so (e.g., Evernett & Venables, 2002; Brenton & Newfarmer, 2007; Cadot et al., 2011a; Baumann, 2013). The growing number of Free Trade Areas (FTAs) has caused a geographic spread of trade, a phenomenon that has brought the bilateral trade down to much lower numbers for many developing countries (Evernett & Venables, 2002), and consequently expanding the extensive margin of several countries in the same direction. In relation to the basket variety, Hausmann et al. (2007) concluded that if a country's export basket is more similar to that of a rich country, the better it will perform. Notwithstanding the fact that the development of extensive margin plays a decisive role in a developing country's sovereignty, my focus here is on the intensive margin, since it is the main component of export growth – some authors found a contribution as high as 80 per cent (Cadot et al. 2011b).

All in all, there are many positive outcomes from the intensive margin export diversification. The next paragraphs will briefly review three topics. Firstly, since this work is about three developing countries, I would like to point out the Dutch disease, a consequence of export concentration. If a resource-rich country does not diversify its production, the structure of its economy combines aspects such as real exchange rate

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appreciation and higher imports, compromising the Balance of Payments (BoP) (Venables, 2016), and therefore export variety reduces exposure to external shocks and macroeconomic volatility (De Ferranti et al., 2002; Agosin et al., 2011). Batista (2004) concluded in his analysis that exporter countries with low share of resource-based products tended to perform better than those with high shares. Sachs and Warner (1999) noticed from LACs that primary goods dependency did not accelerate future growth, rather the opposite, while Husmann et al. (2007)'s results show that exports of goods of higher productivity is linked to higher levels of economic growth. De Ferranti et al. (2002) link export concentration to institutional failure, the latter a result of large supplies of natural resources. Another interesting aspect to highlight is the result found by Lederman & Maloney (2003), that while natural resource abundance affects growth positively, export concentration hampers it.

Secondly, diversification of the export basket contributes to economic growth and development through several means, such as fewer volatile earnings (Agosin et al, 2011; Osakwe et al, 2018), reduced macroeconomic volatility (Agosin et al, 2011), manufactured goods quality improvement (Osakwe et al, 2018), structural transformation (Hesse, 2008), per capital income growth (Hesse, 2008), higher gross domestic product (GDP) (Osakwe et al, 2018), productivity (Agosin et al, 2011; Hausmann et al, 2007) and employment levels (Osakwe et al, 2018), among others. Besides that, Berg et al. (2012) argue that a sophisticated export basket contributes to future sustained growth, since it pushes innovation and makes the economy more flexible to shocks. Grancay et al. (2015), however, concluded that export of commodities might lead to higher future growth, but only if their prices are on the rise. They studied the period 2004-2013, encompassing the commodities' prices boom. In this specific case a country can achieve higher growth rates and enhance its TOT by exporting commodities, but when their prices are stable, the export of more sophisticated goods is also the best path, according to the authors.

Thirdly, causes and consequences of intensive margin exports diversification have been analyzed by many authors. As a country grows and develops, it tends to diversify its exports until it reaches a specific level of per capita income[6], when it specializes again (Imbs & Wacziarg, 2002; Cadot et al., 2011a). Empirically positive effects of human

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[6] Cadot et al. (2011a) estimated it at PPP$ 25 000.

capital and institutions development were found in the diversification of exports (Agosin et al., 2011; Osakwe et al., 2018), and Hesse (2008) noticed that it was related to better TOT and higher GDP per capita growth. The volatility of real exchange rate, in contrast, leads to concentration of exports (de Ferranti et al., 2002). Osakwe et al. (2018) found some cases of trade liberalization related to export diversification, while Agosin et al. (2011) consider it leading to export concentration and no relation of overvaluation and financial development, measured by credit to non-banking sector. Brazil was one of the poorest LAC in the 1920s but by the 1970s it had become one of the richest, due to its production and export transformation, delinking itself from the world economy (Bulmer-Thomas, 2003).

In sum, diversifying exports are essential to reduce a country's export dependency, and it is necessary to aim the production structure towards a larger share of greater added value goods in order to achieve it (Osakwe & Kilolo, 2018).

2.1. Looking at Brazil, Chile and Mexico

With respect to Brazil's exports, Baumann (2013)'s results show that it has not been able to conquer developed markets (as China and India have) and that only about one-tenth of its export growth is made of new products. However, comparing to other LACs, Brazil disposes of a well-diversified export basket and it is responsible for the region's concentration in resource-based high-tech manufactures (Santos-Paulino, 2010), although Bastista (2004) ranks the country in third, after Mexico and Chile, with regards to the share of high differentiated resource-based products. Brazilian exported primary goods are classified as homogenous, and so the composition effects[7] tend to be negative (Batista, 2004). This means Brazilian resource-based exports tend to be price takers and account for 84 percent of the total Brazilian exports, according to the author. Canuto et al. (2013) consider that Brazil can explore its export growth taken that it already overcame the huge initial fixed costs, and earned its recognition as a global trader with diversified industrial structures and natural resources. During the decade of 2000-10, the authors found an increase in the share of primary goods exports and a decline in the share of high

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[7] Composition effect is the effect caused by trade liberalization, generating re-allocation of resources towards products the country has comparative advantages.

technological products due not only to the commodities prices boom, but also to the poor performance of more sophisticated industries.

The extensive margin is very concentrated in the Brazilian case, which relies greatly on the regional market, even with long experience in export promotion ideas (Baumann, 2013). Vieira and Reis (2018) found Brazilian exports highly influenced by income and size of the trade partner's consumer market. Therefore, a broader extensive margin would secure Brazil from downturns in those respective partners. Brazil's low intensive margin might have serious implications concerning the region economic performance and also in terms of competition with other emerging countries – such as India and China (Santos-Paulino, 2008). The author points out that the fast and dynamic growth of specialized exports compared to other exports might lead to higher concentration.

State instruments promoting export diversification in Chile had positive impacts concerning both new markets and new products in the 1990s (Alvarez & Crespi, 2000). The authors identify firm technological innovation, organizational management innovation, technological improvement, among other state instruments, when it seemed that Chile was moving towards a change in its export agenda. In the 2000s, however, according to Coldeco's[8] chairman, the increasing demand for copper from emerging markets in order to sustain urbanization (China in particular) changed the country's economy, and the bust of its price in 2011 brought down the Chilean GDP growth with it (FT, 2017). The specialization of LA is complex given its heterogeneity, but Chile classifies as an outlier concerning this aspect since it is highly specialized in copper (Santos-Paulino, 2010). In general, countries that have gained market share by exporting more commodities, as Chile has done, have also suffered from it (Batista, 2004). Nevertheless, the author argues that the Chilean case is unconventional: most of its commodities exports are classified as differentiated or highly differentiated products, and therefore the composition effect tends to be positive. This means that Chilean resource-based exports volume might increase by cutting down the relative price (differentiated), or that the international competition of these resource-based exports is not mainly based on price differences (high-differentiated). Jointly, differentiated and high-differentiated account for 62 percent of the total.

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[8] The state-owned copper company.

Nevertheless, this does not mean that Chile gave up on diversifying its exports. Agosin and Bravo-Ortega (2009) investigated some promising new opportunities that have gained importance over the last years – such as wine, blueberry and pork. While Asian countries remolded their comparative advantage to manufactures, Chile aimed at the food and forestry sectors instead of the manufacturing sector. Agosin and Bravo-Ortega (2009) say that in 2005, however, they still represented less than 10 percent of the Chilean non-copper exports, as they did in 2018 according to the author's own calculations. Naturally, beating mineral based exports might be very hard, taking into account that a huge share of the world's copper and lithium known reserves are in the Atacama Desert – thirty and fifty percent respectively (FT, 2017). On the other hand, Castillo and Neto (2016) argue that Chile was as specialized in 2014 as in 1990, since primary and natural resources accounted for 89 percent of its total exports in both years. According to the authors, the Chilean deindustrialization begun during its own early stages. Unfortunately, none of the recent industrial attempts succeeded.

Mexico's exports experienced a significant increase in variety in all the industries, especially after the North American Free Trade Agreement (NAFTA) (Feenstra & Kee, 2007), and it accounts for most of the LA manufactured products, given the labor-intensive export-oriented production supplying the NAFTA market (Santos-Paulino, 2010). Batista (2004) highlights Mexico as the country with comparative advantage in high differentiated products, while LA excluding Mexico reveals some comparative advantage in price taker products. The author affirms that Mexico is the top first LAC, holding a very large share in high differentiated products. Pateka and Tamberi (2011) found empirically that a country's size, location and trade conditions are the most robust explanatory variables of a country's export diversification. All these three variables corroborate in favor of the Mexican export diversification, since it is a large country, close to a huge consumer market and a partner of liberal trade agreements – such as NAFTA and the World Trade Organization (WTO).

The work of Castillo and Neto (2016) treats Mexico as a special case among the main LA economies (along with Argentina, Brazil and Chile) – Mexico has not shown deindustrialization and has reduced primary goods' exports while medium and high-technology exports' share grew. They emphasize the great importance of the

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maquiladoras[9] in this process, as do Sánchez et al. (2017), who go deeper and point out the Mexican risk of becoming a "*maquila*-dominated economy".

2.2. *Understanding the countries*

Following the presentation of the broad idea, it is important to understand the countries' relative position in LA. Concerning GDP, these three countries together sum up circa 65% of all LA & Caribbean production, in which Brazil and Mexico alone account for around 61% of the region. Chile disposes of a much more moderate economy, although its GDP per capita ranks the highest among them. Considering over thirty countries, the three countries account for over half of population and land area. Brazil is the most populated of LA & Caribbean countries and Mexico the second, 33 and 20 percent of total respectively (210 and 125 million people). As regards land area, approximately 42 percent of the region is Brazilian, and 10 percent of it is Mexican. Chile represents about 3 percent of both population (18 million people) and land area[10].

FIGURE 1 – Export to GDP ratio
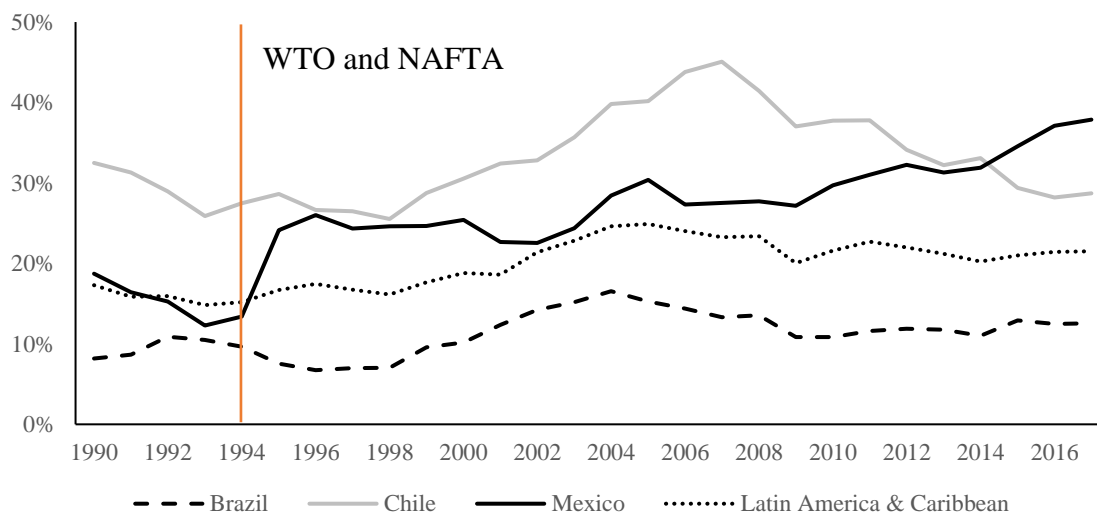
Source: UN Comtrade (2019). Author's own calculations.

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[9] A maquiladora is a factory which operates under favourable tariff programs. Inputs are bought duty-free, and outputs sold into the North American market under the NAFTA agreement.
[10] WB (2019b). Author's own calculations.

Export to GDP ratio is illustrated in Figure 1 – Mexico has grown its ratio, while Chile's ratio booms along with commodities prices, and Brazil has kept it low. I highlight the Mexican case after 1994, when the FTAs came into practice.

The exchange rate plays a key role when it comes to international trade, since it is the BoP adjustment variable. The World Bank's real effective exchange rate (REER) Index and the export to GDP ratio correlations do not behave in the same manner in each country. While the Chilean REER and Export to GDP ratio correlation index from 1990 to 2017 is -0,27, the Mexican is -0,47 and the Brazilian is as high as -0,78[11]. Hence, the Brazilian Real fluctuations are highly correlated with its export to GDP ratio, which conform with the idea of the currency's overvaluation after the Real Plan – indeed, Figure 1 indicates clearly how the devaluation after 1998 is related to a higher ratio.

The analyzes of merchandising exports (Figure 2) highlight the peculiarity of the Chilean and Mexican cases. More than half of Chile's merchandise exports has been of ores and metals. Brazil stays closer to LA & Caribbean's numbers, and Mexico's even less, around 3 percent. On the other hand, manufacture merchandise exports in Mexico account for about 76 percent of total merchandise exports, while Chile's draws near the 14 percent mark. Mexican manufactures exports grew significantly in the beginning of the 1990s. Brazilian manufactures exports suffered a noteworthy fall in 25 years, from 52 to 37 percent. LAC are usually known for their foods exports, a usually volatile sector, which Mexico has kept low in percentage of its total merchandise exports. In 1990, Brazil, Chile and LA & Caribbean exported about a quarter of their total merchandise exports in foods. In Brazil, this share grew and almost reached 40 percent of total merchandise exports, thanks to soya beans exports, as Jerkins (2015) analyses. Chile's foods export share went down after 2004 given the percentage increase of Ores and Metals. During the 2000s, the LA & Caribbean food exports percentage went down as well, but it grew again after 2014, when some commodities prices fell – in 2017 it represented 26 percent of the total, against 24 percent in 1990. It can be observed that for LA & Caribbean there was not an export structural change, as all three subsectors analyzed here maintained almost stable percentages.

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[11] WB (2019a). Author's own calculations.

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FIGURE 2 – Commodities, Foods and Manufactures Exports
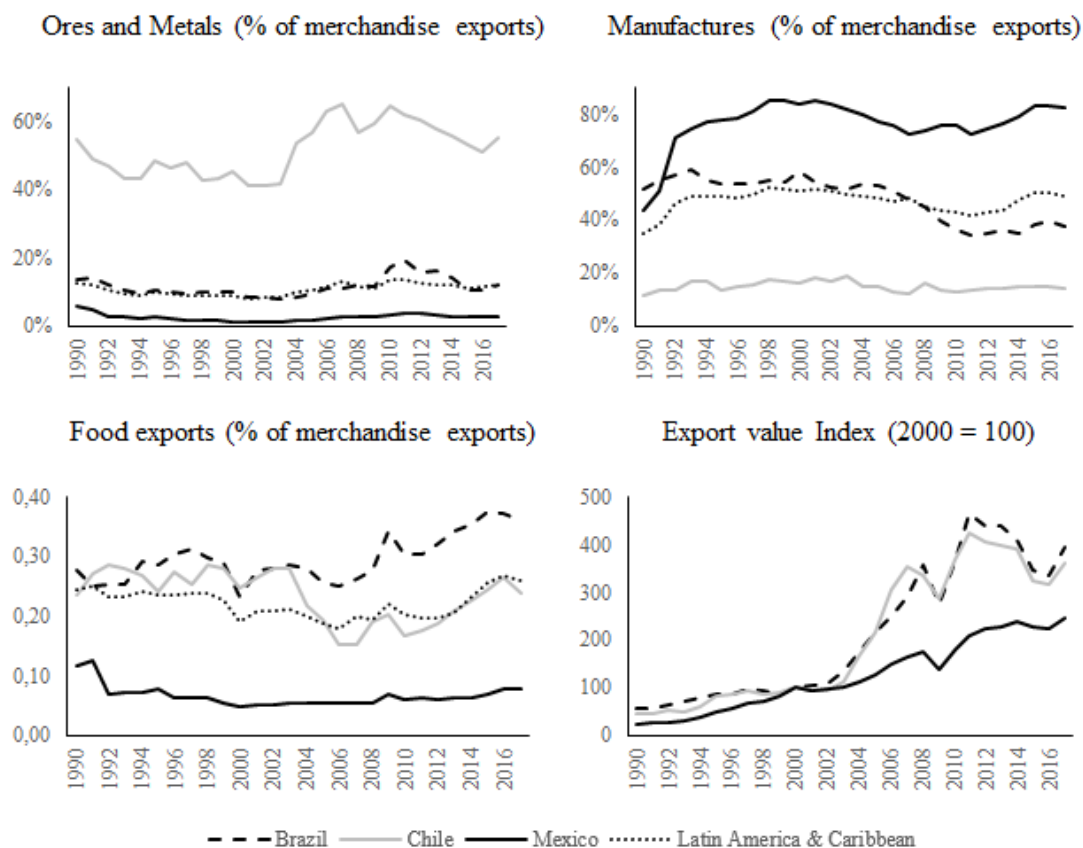
Source: UN Comtrade (2019). Author's own calculations.

Another interesting point on Figure 2 is the export value index, that shows that exports from Brazil and Chile grew much faster. It is not a coincidence that they were more volatile while Mexican exports maintained its growth more stable – Brazilian merchandise exports are mainly foods; Chile counts with ores and metals; and Mexico merchandise portfolio is mostly manufacture goods. In a matter of comparison, Brazilian and Chilean coefficient of variation is considerably higher than the Mexican (0,67; 0,68 and 0,59 respectively[12]).

Their main partners' configurations are summed up in Appendices Figure 11, which reflect their exports in an interesting way. Until the 2000s, the United States of America (USA) was Brazil's largest partner, accounting for about a fifth of all its exports, but since 2009 China has increased its share, which accounted for 26 percent of the total in 2018. Thus, not surprisingly, the products that China demands took some of the Brazilian

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[12] Author's own calculations. Data retrieved from UN Comtrade (2019).

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manufactures export share. The Argentinian trade partnership was consolidated right after Mercosur came into practice (1991), and it consists mostly of high added value Brazilian exports, being the largest shares transportation and machines along the years (OEC, 2019). Chile's range also switched from USA and Japan (countries that used to represent around 30 percent of the total of export value) to China, which accounted for as much as 34 percent in 2018. Brazilian imports were quite stable, comprising around 5 percent of the total Chilean exports. All those four countries buy mostly metal and mineral products from Chile (OEC, 2019).

If China's share of a quarter and a third of Brazilian and Chilean exports respectively is already too much, the USA's share of Mexican exports achieved an astonishing share of 89 percent in 2004, averaging 82 percent throughout the whole period. During all the NAFTA existence, Canada has been the second largest Mexican importer. Going deeper in analyzing the Mexican-USA trade, we can see that the Mexican export diversification is nothing more than a reflection of the Mexican export diversification to the USA, showcasing a Mexican export dependence. As Figure 3 below shows, manufacture exports to the USA have grown from 46 to 88 percent of the total, gaining space over the foods and ores and minerals sectors – the same trends seen in Figure 2. Hence, the remoteness index for Mexico is much lower than for Brazil and Chile, averaging 17, 70 and 78 respectively[13].

FIGURE 3 – Mexican Exports to USA
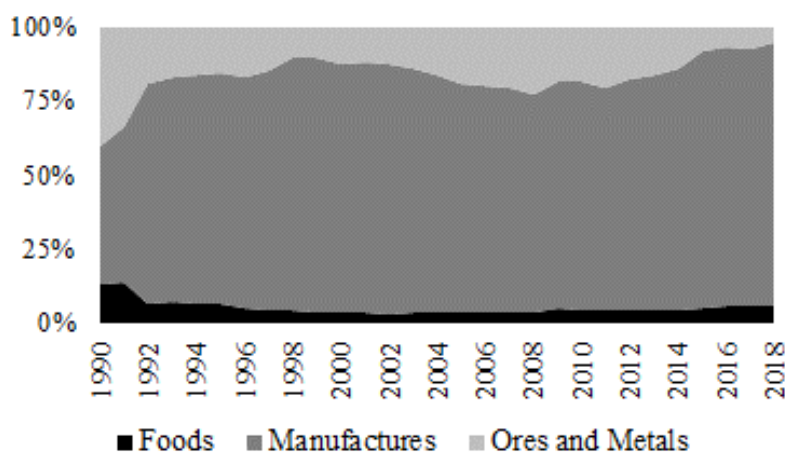
Source: UN Comtrade. Author's own calculations

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[13] Author's own calculations. The applied methodology is suggested by UN (2015) using trade and distance between countries. If a country is physically close to its major export destinations, then the index tends to be lower. Details can be found in the Appendices.

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After comparing the countries among themselves, it is interesting to compare them worldwide. The diversification indexes in Figure 4 measure how diverse the export pattern of a country is from the world pattern going from 0 to 1. From 1995

FIGURE 4 – World Pattern Diversification

	1995	2005	2015
Brazil	0,52	0,48	0,55
Chile	0,78	0,76	0,74
Mexico	0,39	0,39	0,41

Source: UNCTAD (2019)

to 2005, Brazil came closer to the world pattern, as its index decreased, but then it increased again to even higher levels following the country's recent crisis and some commodities prices fell once more. Chile was by far the furthest from the world pattern, although its index has decreased over the period and it is the only country showing consistence. The Mexican index did not change much, and it is the closest to world pattern. Unfortunately, there are no data available from before 1995, when Mexico would have probably shown its improvement.

The internal market plays a fundamental role in determining the export agenda. After conquering national market, enterprises are more likely to become internationally competitive and to export, just as the Asian cases presented by Amsden (2004). Countries such as Brazil and Mexico, with huge internal market, are able to exploit it in this sense. It is necessary, however, to give incentives and limits – like the carrot and stick approach applied to Japanese keiretsu and South Korean chaebol.

Thus, it is relevant to observe each country's production by sector. Figure 5, bellow, illustrates the production as percentage of GDP of agriculture and industry sectors14. The latter is divided in three categories: mining, manufacturing, and construction. In both three countries, the service sector has become more relevant to overall production, especially in Brazil (the only country where it represents over 70 percent). As Araújo et al. (2012) state, Brazilian economy has been going through a deindustrialization since the 1990s structural change, and a deepening of the financialization process along with strong exchange rate appreciation process, declining the share of industrial added value production – the process seen in Figure 5, as a huge change in 1994[15]. In Chile's production we can easily note the mining sector gaining relevance over the manufacture

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[14] The remaining GDP production is from the service sector.

[15] In 1994 the Real Plan was introduced and the new currency very appreciated, assuming a value close to the US dollar (BCB, 2019). Along with liberalization policies, the national industries could not sustain themselves.

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sector during all the period and a persistent declining of agriculture. During the 2000s copper price inflation, the mining sector surpassed 20 percent of production. In Mexico, however, the national production did not change abruptly (as it did in Brazil in 1994 or in Chile in the 2000s), but the mining sector fell considerably – from 12 to 7 percent – and the manufacture sector maintained almost a fifth of the country's production.

FIGURE 5 – Production by Sector (percentage of GDP)
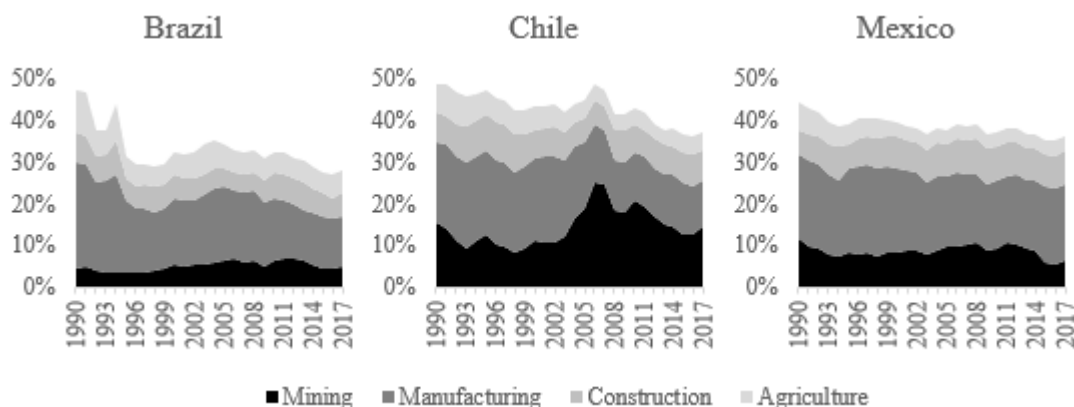
Source: UNCTAD Stat (2019). Author's own calculations.

Another relevant data is the evolution of dispersion indexes – here I show the HHI, as well as the Theil and Gini indexes[16]. Their increase indicates a more specilizaed intensive margin export portfolio. The indexes suggest that Brazilian and Chilean exports became more specialized, while Mexican diversified during the period. Although there is indeed concentration of the Chilean export value on fewer goods (and therefore more specialized export basket), it does not mean that there is a change in the structure of production or that the country is exporting less manufactured goods. In fact, it was the opposite. In the Appendices Figure 10 it becomes clear that even though the share of Chilean manufactured goods decreased during the prices boom, its total value increased.

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[16] The indexes and their methodology are explained in the Appendices.

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FIGURE 6 – Concentration Indexes
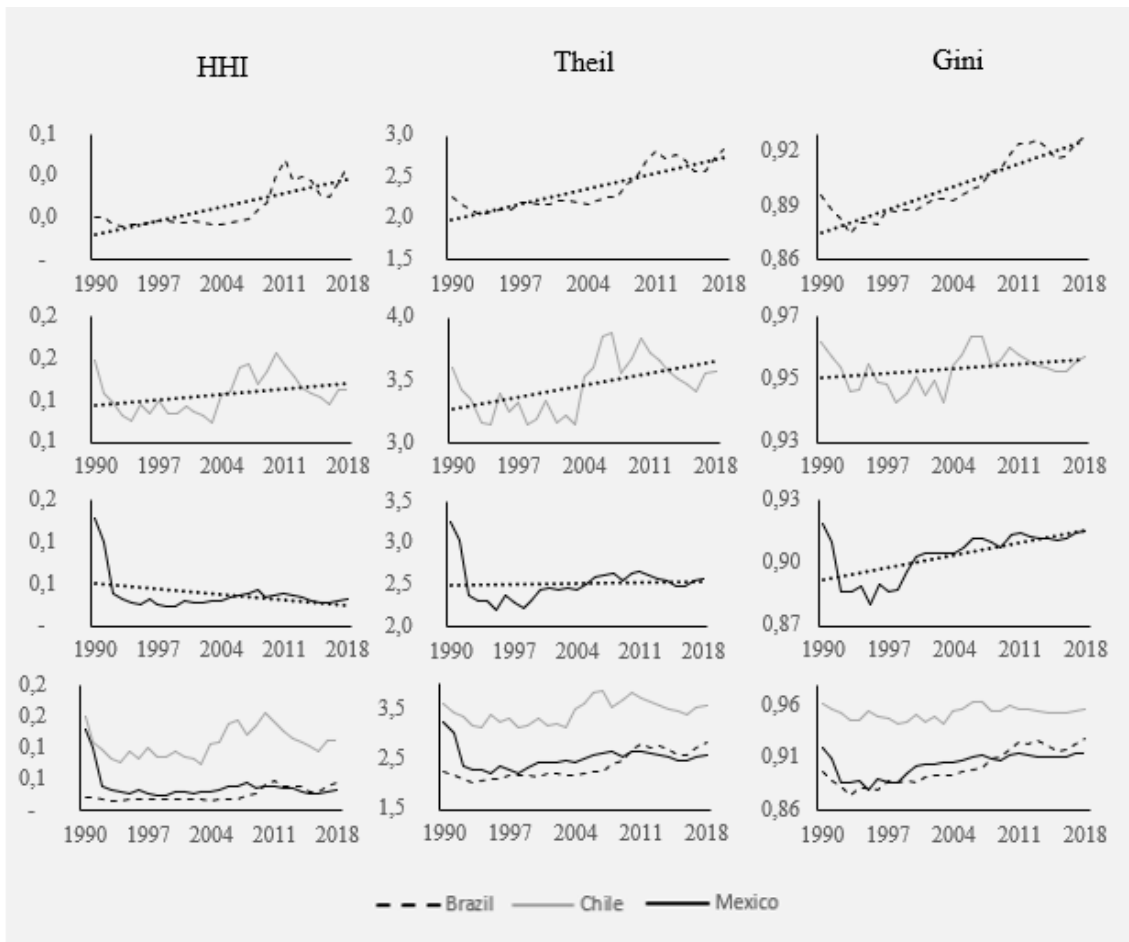
Source: UN Comtrade (2019). Author's own calculations.

The Brazilian concentration index seems to be the most stable and the country saw its intensive margin exports concentrate, evolving relatively slowly comparing to the other two countries. Great shocks, such as the currency reforms of 1994 and 1998, the Asian financial crisis and the 2000s commodities boom could have represented a more significant turning point, but they have not. The biggest LAC did suffer structural changes after those shocks, but its huge production was not as proportionally affected as other economies. Apace with this, the recent Brazilian downturn in manufactures is also due to a switch in this sector's trade balance, which fell from surplus in 2005 to a large deficit in 2012, a period when China's growth impacted Brazil directly and indirectly – buying more Brazilian commodities[17], but less of its manufactures and harshly competing

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[17] The major Brazilian exports are soya bens and iron ore, products China purchases more than half and around quarter of total worldwide output respectively (Jerkins, 2015).

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internationally (Jerkins, 2015). The soya beans price more than doubled between 2006 and 2008, and in 2016 it was almost half of it was in 2012[18]. During the period between 1990 and 2011, Brazilian sectors such as agriculture, primary commodities and natural resources saw higher labor productivity and investment levels, factors which corroborate the idea of premature deindustrialization (Kirsch, 2018), that is when a mid-income country structural transformation lacks an inter-sectorial reallocation gain. Therefore, if the goal is to achieve more intensive margin export diversification, the sectors of higher added value production should be the ones with more resources and productivity gains, and not as it has been done. Brazil's Theil Index varied between 2,04 and 2,85 during this period with an average of 2,36, and from 2004 to 2011 it grew year after year, showing it was not immune to the commodities' prices boom.

Chile's Theil Index went up and down during the same period, seeming more volatile. There were efforts to diversify the country's exports in 2000 through industrial policy focusing on efficiency gains and innovation, which generated mixed results, but only until 2004 (Varas, 2012). From the copper inflation – seen as valorization in the eyes of an exporter – derived a huge fiscal revenue growth (Varas, 2012), in a manner that it became difficult to maintain the focus on diversification – in 2008 the price of copper was five times higher than in 1999[18]. The funds allocated to science, technology and innovation, however, did increase during that time as the author shows, even though it does not yet impact the export diversification, and in fact does not even come close to that. The impact of the copper price boom is visually clear in the charts (Figure 6). For a change to take place, a deeper reconfiguration is necessary, as Ffrench-Davis (2017) proposes – economic policies (such as fiscal, monetary, credit and exchange rate policies) should be countercyclical if the goal is to diminish the volatility that comes with both copper exports and financial markets; and support to small and medium enterprises through capital market reform to facilitate access to financing. The index fluctuated between 3,15 and 3,88 with an average of 3,46, the highest range among the three countries. All indexes have been on the rise during the period, as have the Chilean FTA agreements (Figure 12 in Appendices).

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[18] FRED (2019). Author's own calculations.

The Mexican case is also peculiar. Before 1995 its exports were much more specialized than they later became. It is interesting to compare the manufacture chart in Figure 2 with its indexes (Figure 6) – the larger the share of manufacture exports in total merchandise exports, the lower are the concentration indexes. Although Mexico is now in many FTAs (Figure 12 in Appendices), NAFTA certainly had a huge positive impact towards its export diversification, since it turned possible that a cheaper production conquered the USA market. The maquiladoras surely affect the export diversification indexes as they represent around half of Mexico's manufactured exports from the beginning of NAFTA up to 2006[19] (Blecker, 2014), but it does not mean that the country is benefiting from the promises that NAFTA brought with it, and it is not only because maquiladoras have a limited positive effect within the country itself. As the author points out, it has not generated as many Mexican qualified jobs as expected; the country did not converge to the USA per capita income; as their trade grew, it became more USA dependent[20]; and all its manufacture production still relies on very expensive intermediate goods, which account for about as high as three-quarters of the export value when it comes to the maquiladoras. In 2012, the average Mexican manufacturing hourly wage was 16 percent of the USA's, an even larger gap than from 1993. The USA dependence is likely to be one of the main reasons Mexico has been in a pursuit of FTAs since NAFTA's origin (Villarreal, 2017). In that sense, Mexico's Theil ranged between 2,21 and 3,25 (in 1990), averaging 2,52. Since 2010 it is the most diversified export portfolio among the countries, surpassing Brazil's index. After a very fast diversification in the beginning of 1990s, there was a specialization from late 1990s until the end of the period. This second movement is softer through the HHI index and much more significant by the Gini index, in a way that their trend lines have opposite slopes, even though manufactures are still the largest share of Mexican merchandise exports.

All in all, the three indexes show that Chilean exports are much more specialized than the others, and that Mexico became the most diversified country, since Brazilian exports have slowly – but considerably – specialized over time.

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[19] The last year with available data for maquiladoras alone.
[20] Besides the extensive margin export high specialization (Figure 11), around 47 per cent of Mexican imports are from USA alone. (Villarreal, 2014)

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3. EMPIRICAL METHODOLOGY AND ANALYSIS

The generally chosen method to analyze the export diversification determinants is the Generalized Method Moments (GMM) (e.g., Agosin et al., 2011; Balavac, 2012; Osakwe & Kilolo, 2018; among others). It is preferred over the OLS due to its suitability to dynamic panel models (Hoday, 2013). Here, however, the goal is not to estimate a panel model but to find similarities and differences between the three countries. Hence, the OLS models were calculated through IBM SPSS Statistics 24 and the results contrasted. This method was also applied by Osakwe et al. (2018) and Cadot et al. (2011b).

3.1. Data Description

Both Osakwe et al. (2018) and Cadot et al. (2011b) chose the Theil Index as the dependent variable for export diversification. There are not as many investigations analyzing the HHI variance, but some authors such as Elhairaika & Mbate (2014) chose this index. The Theil Index achieved more robust results than the HHI and, as a result of its performance, it was selected to be the dependent variable. Besides that, it has advantages such as not to be bounded between 0 and 1 and to be less skewed (Mau, 2014).

There were some independent variables common to both Osakwe et al. (2018) and Cadot et al. (2011b), such as GDP per capita, human capital, remoteness, infrastructure, institutions and trade. Besides that, tariffs, FDI, size of economy, preferential market access, and policy score were also considered. Apart from these, Agosin et al (2011), Osakwe & Kilolo (2018), Elhairaika & Mbate (2014) and Paterka & Tamberi (2011) also added financial development, investment, exchange rate volatility and overvaluation, and dummies for regional trade agreements and different levels of income per capita (since they calculated panel estimations).

The chosen independent variables are summed up in Appendices Figure 13, and since it is not a panel model, the variables were chosen in accordance to the countries' contexts and data availability. They were selected following the literature review and kept as they showed significance and matched the statistical criteria. In sum, two variables were considered for manufacture, commodities, and trade liberalization, given their relevance and statistic suitability. The increase of manufacture production and manufacture exports are expected to have a negative sign, due to its propensity to diversify exports, while the

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mineral rents and natural resources rents as percentage of GDP tend to be positive and increase the concentration index. The literature has shown trade liberalization with both negative (e.g. Osakwe et al. (2018) and Perteka e Timberi (2011)) and positive signs (e.g. Agosin et al (2011)). Moreover, credit; education; institution quality; investment; exchange rate; and remoteness were also included in the models. Among these, exchange rate and remoteness are expected to have a positive sign – exports tend to specialize as the currency becomes more expensive and distance of major partners increases. All the remaining variables' coefficient sign tend to be negative – more credit and investment are usually linked to more opportunity of rentability and production and, therefore, diversification; and education and institution quality are generally associated with better governance and opportunity, generating results in favor of diversification as well.

3.2. Estimations and Analysis

Before analyzing the results, we must check if they are trustworthy. All the models are significant, since the F test type I error probability is always less than 1 percent. There cannot be any correlation between two random errors, to ensure that the Durbin Watson (DW) test was taken for each model, where we expect a value close to 2. In all of them the null hypothesis of no autocorrelation among regression residuals was not rejected, and those in zone of indecision are satisfactory considering the scatterplots in Appendices (Figure 14), where we cannot find any clear correlation. The residuals are normally distributed, as Figure 15 in Appendices show. To guarantee that there is no heteroskedasticity in the models, a different OLS was calculated for each model, where the residual square was the dependent variable, and a probability of type I error higher than 10 percent in the F test, that is, a large chance that any of the independent variables can explain the residuals' variance simultaneously, would confirm homoscedasticity[21]. Finally, it was not found collinearity either, since the VIF tests were always smaller than 10. It is important to point out that the independent variables for each model were chosen considering the collinearity – when it was found collinearity among two or more explanatory variables, they were separated into distinct models.

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[21] Since the Brazilian Model B in Figure 8 presented a value of 0,06 – the only lower than 0,1 –, the error's constant variances were checked through the Breusch-Pagan test and the null hypothesis of homoscedasticity was not rejected.

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Considering that the models are from time series analysis for each individual country, the results tend not to be as precise and robust as panel data analysis. Nevertheless, identifying stylized facts for each country specifically enriches the understanding of each one of them, that have had similar – but not identical – paths. That being said, we can confirm that the results that follow below[22] are robust in all the assumptions underlying the method of OLS[23] and finally ask: how much of each country's Theil Index is explained by those independent variables? Is there any difference among them after all?

In Figure 7 there are three models for each country (Models 1, 2 and 3) where the target is the comparison between them. In the following figure each country has its own best results, also in three regressions (respectively Models A, B and C).

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[22] The models were run through backward method. Significant export variables' coefficients are from the last software's automatic output, while the not significant variable's values from the first one.

[23] All assumptions exposed by Gujarati & Porter (2008).

FIGURE 7 – Joint OLS Estimations

Independent Variables	Model 1			Model 2			Model 3		
	Brazil	Chile	Mexico	Brazil	Chile	Mexico	Brazil	Chile	Mexico
Constant	2,16 ***	6,31 ***	8,07 ***	1,19 ***	3,51 ***	3,64 ***	1,18 ***	3,02 ***	3,24 ***
	8,76	15,38	8,89	5,52	12,43	21,43	5,76	77,38	19,50
Trade / GDP	0,08	0,89 **	1,54 ***						
	0,08	2,04	3,55						
Tariff Weighted (AHS)				-0,95	-3,05 ***	0,12			
				-0,96	-4,52	0,26			
Manufacture Production	-2,37 ***	-6,96 ***	-20,0 ***	-3,95 ***	-9,45 ***	-6,60 ***	-4,02 **	-5,42	-4,20 ***
	-3,45	-4,25	-5,68	-8,26	-4,93	-7,70	2,68	-2,11	-4,58
Mineral Rents							0,05 *	4,04 ***	0,19 ***
							1,82	12,27	3,95
Credit	0,36 **	-0,23	-1,22 **	0,21 **	-1,00 **	-0,92 **	0,22 **	-0,67	-1,31 ***
	2,17	-0,33	-2,36	2,07	-3,90	-4,07	2,68	-2,36	-6,34
Education	0,13 ***	-0,16 ***	-1,83 ***						
	3,09	-3,23	-6,44						
Institutions	-0,12 **	-0,10	-0,66	0,01	0,05	-0,04			
	-2,46	-1,04	-0,94	0,21	0,71	-1,38			
Investment / GDP							1,77 *	-0,40	1,11
							2,02	-0,56	0,92
REER				0,23 *	-0,41	-0,02	0,13	-0,44	0,12
				1,73	-0,73	-0,16	1,02	-1,39	0,07
Remoteness				1,99 ***	0,03	1,42 ***	1,73 ***	0,00	1,44 ***
				8,88	0,09	11,05	8,40	-0,11	16,57
Adjusted R-squared	0,66	0,74	0,64	0,83	0,77	0,87	0,89	0,84	0,94
F-test	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Durbin-Watson	1,32	2,12	1,97	1,28	1,95	1,69	1,48	1,75	1,95
Homoscedasticity [1]	0,36	0,60	0,51	0,61	0,57	0,91	0,46	0,24	0,82

Dependent variable: Theil Index

t values are below the coefficients

Significance test: *** $p < 0,01$; ** $p < 0,05$; * $p < 0,1$.

[1] F test p-value of OLS with Residual² as the dependent variable instead of Theil

FIGURE 8 – Individual OLS Estimations

Independent Variables	Brazil			Chile			Mexico		
	A	B	C	A	B	C	A	B	C
Constant	1,12 * 1,79	1,10 *** 6,00	2,18 *** 9,20	2,59 *** 9,35	6,06 *** 14,81	3,95 *** 20,58	3,55 *** 14,24	3,17 *** 14,98	0,76 ** 2,81
Trade / GDP	3,58 ** 2,60	0,92 0,54			0,90 ** 2,05	0,54 ** 2,23	-0,11 -0,16		
Tariff Weighted (AHS)			0,73 0,38	-2,38 ** -2,18				0,14 0,39	0,53 * 1,91
Manufacture Production	-2,20 *** -2,90	-3,62 *** -8,82	-2,29 *** -3,46	0,57 0,16	-6,96 *** -4,26			-3,79 *** -3,62	
Manufacture Exports						-6,58 *** -10,07	-3,42 -1,15		-1,93 ** -2,86
Mineral Rents	0,05 0,69		0,07 * 1,74			1,78 *** 4,19	0,62 *** 4,96		
Natural Resources Rents		3,99 *** 3,09		2,96 *** 4,64				2,84 *** 3,16	1,51 1,89
Credit / GDP	0,54 *** 3,56	0,23 ** 2,69	0,37 ** 2,33	-0,02 -0,21	-0,02 -0,03		-1,89 ** -2,87	-0,84 *** -4,32	-0,84 *** -4,17
Education			0,09 * 1,88	-0,04 -0,24	-0,16 *** -3,23	0,00 0,10	-0,58 *** -3,82		0,65 *** 10,18
Institutions	-0,14 ** -2,12	0,05 1,03	-0,09 * -1,87	-0,11 -1,09	-0,08 -0,74	-0,05 -1,35	0,01 0,05	-0,06 *** -2,93	-0,02 -0,93
Investment / GDP	-1,31 -0,72		-1,09 -0,53	-1,62 -1,16		-1,05 *** -3,40		1,76 1,48	2,96 *** 3,16
REER	0,90 ** 2,79	0,29 ** 2,50		0,67 * 1,94		0,21 * 1,82	0,36 0,85	0,05 0,45	0,31 *** 3,32
Remoteness		1,79 *** 9,15		0,10 0,34	-0,30 -0,87	0,11 1,12		1,37 *** 12,61	1,69 *** 16,71
Adjusted R-squared	0,66	0,89	0,69	0,88	0,74	0,98	0,53	0,92	0,95
F-test	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Durbin-Watson	1,40	1,57	1,34	2,27	2,12	1,73	0,98	2,03	2,45
Homoscedasticity [1]	0,13	0,06	0,11	0,14	0,71	0,93	0,66	0,72	0,44

Dependent variable: Theil Index

t values are below the coefficients

Significance test: *** $p < 0,01$; ** $p < 0,05$; * $p < 0,1$.

[1] F test p-value of OLS with Residual² as the dependent variable instead of Theil

It is clear that in all three countries the higher the participation of manufactures in production as percentage of GDP, or the higher its share in total merchandise exports, the more diversified the export basket is. Accordingly, also in all three, the larger rents from mineral or all-natural resources as percentage of GDP, the more specialized the intensive margin exports. So, if they want to be less vulnerable to external shocks; to stabilize their international trade; to not have exchange rate or BoP pressure in times of disturbances; or any of the consequences of an imbalanced export portfolio, structure reforms which sectorial reallocation are towards more added value output will surely help them. All three countries had at least one proxy of manufacture data and one of commodity data significant at 1 percent. Model 3 indicates the impact of mineral rents are much stronger to Chile. Model 1 suggests Mexico's Theil as taking the strongest impact of the manufacture production variable, while Model 2 implies Chile's Theil.

A higher REER means less external competitiveness and this proxy is positively significant for all of them. For Brazil, this explanatory variable was significant in all the used models, in accordance with the literature review and data analysis.

As for institutional quality and remoteness, both Brazil and Mexico show significant coefficients with expected signs, but Chilean coefficients are not significant. In the Brazilian and Mexican regressions where remoteness is an explanatory variable, its p-value is lower than 1 percent, showing robust evidence of significance. The closer the goods' destination, the more diversified the exports, a reality that goes along with the Mexico-USA and Brazil-Mercosur (specially Argentina) trade relations. Thus, institutional quality and physical distance from importer has been relevant at least to the two large countries' export diversification.

Concerning education, Chile's negative sign in more than one model corroborates with theory and literature review. Unfortunately, although in two models its sign is also negative in the Mexican case, there is one positive sign. Brazilian cases indicate a positive effect in Theil as well. Whilst there is a great variety of educational data at UNESCO (2019), it is not a simple task to find simultaneously complete dataset for these three countries during the period 1990-2018. As the results of the chosen proxy were significant in some cases, they were kept given the relevance and significance of education on the

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topic, even with data missing, what may have affected the final results in some regressions.

For investment and credit, negative signs were expected since they usually collaborate to a Theil's fall in economic rationale. Chilean signs and significances are, again, as expected, and the increase of both independent variables help to diversify the exports, as does Mexican credit – one of the most robust variables, being significant at 1 or 5 percent levels in all models. Chile and Mexico's credit coefficients are quite similar between them in Model 2. Brazilian credit, however, shows the opposite sign, and it is interesting to go a bit deeper on the topic. Unfortunately, data identifying Brazilian credit by sector is unavailable before 2012. On Figure 9 we can see the share of total credit received by aggregate economic activity[24], where the monthly series are quite stable during all the period. Well, the so called lower added value industry is by far the one which receives most credit, counting for more than half of total – the highest shares within it go to foods and to oil, alcohol and gas. Thus, it can be inferred that credit moved to previously established subsectors and has helped their consolidation, while Chilean and Mexican credit help diversification in some scale since their coefficients are positive, even if it goes to the sectors of higher export shares. In that sense, Brazilian credit – a powerful mechanism that could be used to exploit diversification – has helped to specialize, and not diversify, its export portfolio. This may also contribute to explain why Brazilian

investment coefficient was positive in Model 3, although it has a negative sign in Brazilian Models A and C. However, the Mexican positive sign in its Model C cannot be

FIGURE 9 – Brazilian Credit

	January 2012	July 2019
Higher added value	22%	23%
Lower added value	55%	55%
Construction	18%	16%
Infrastructure	5%	5%

Source: BCB (2019). Author's own calculations

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[24] Lower added value industry: packing; nondurable goods; sugar; textile, clothing, leather and footwear; paper and cellulose; metallurgy and steel and iron industry; foods; oil, alcohol and gas; and mining.

Higher added value industry: chemical and pharmaceutical; capital good; durable goods; and automobile.

Construction and Infrastructure only compute themselves and for these calculations SIUP (Industrial Services of Public Utility) was not considered, given it is not discriminated among sectors. However, even if all SIUP amount goes to higher added value industries, lower added value industries continue as the largest share.

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explained by theory or literature review and the lack of detailed data makes it difficult to investigate deeper. INEGI (2019) data about private investment in capital formation allow us to see not only the amount that is going to machinery, but also the economic activity it is related to. In the year 2012, for example, 43 percent of it went to manufacture and 23 percent to mining (numbers that go along with a negative sign of the coefficient). Public investment data, however, are not as specific and do not differentiate manufacture from mining. Chile's sign was negative, as expected.

Brazilian and Chilean market openness is associated with specialization of exports as the models suggest. Indeed, it was seen premature deindustrialization and weakening, lack, and failure of industrial policies during the observed period, and their major exports' shares went to commodities and primary goods after aggressive liberalization and trust in the market efficiency. Mexican results, however, are not so consensual. The first proxy for liberalized markets – international trade as percentage of GDP – shows a positive and weak correlation with Theil of 0,08, while the second proxy – effectively applied tariff weighted – has a negative and stronger one, of -0,32[25]. An interesting point: if the proxy 1 correlation considers not 1990-2018, but 1992-2018 values, it goes to a much stronger level and reaches 0,65. In that sense, their coefficient signs were opposite, making it statistically coherent, but a difficult economic interpretation. After the dramatic fast Theil drop on 1990-1992, the Mexican exports kept specializing (Figure 6) as its international trade and FTA agreements grew (Figures 2 and 12). Therefore, as Brazilian and Chilean exports, proxy 1 captures this movements and says Mexico specializes as its trade liberalizes. Proxy 2 suggests the less tariff Mexico imposes, the more diversified it becomes, that is, the more liberalized its trade, the more diversified the export basket will be – the opposite of proxy 1 interpretation. Nevertheless, it is also understandable – the exports to USA weight altogether with NAFTA agreement probably shape this sign, as the USA has bought more diversified goods along this period. Indeed, it is undeniable that Mexican exports have become more diversified while the manufacture exports share grew.

In sum, the majority of the results found in this chapter are in line with the literature, despite that fact that the former are from country specific models and the latter from panel

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[25] All correlation values in this paragraph are from author's own calculations.

data. Manufacture and commodities proxies were very robust, contributing to more and less diversification respectively, as in Osakwe & Kilolo (2018). Remoteness, also with robust and positive evidence, is similar to other investigations, such as Agosin et al (2011), Parteka & Tamberi (2011) and Cadot et al. (2011b). The negative sign of institution quality was the same for Osakwe et al. (2018) and Cadot et al. (2011b). With regard to education, the literature has shown a negative sign, in works by as Agosin et al. (2011), Cadot et al. (2011b), and Osakwe et al. (2018), but this study found that this negative sign was robust only in the Chilean case. Contrary to Elhiraika & Mbate (2014), investment signs for Brazil and Mexico were found unexpectedly, while for Chile it was negative as literature suggests. For Agosin et al. (2011) credit and exchange rate did not affect diversification, and on this issue investigation has found robust evidence of REER and credit influence on Brazilian, Chilean and Mexican cases – they have showed the expected sign, but the Brazilian credit. Trade liberalization does not have a consensus on literature – Osakwe et al. (2018), Osakwe & Kilolo (2018) and Parteka & Tamberi (2011) consider it positive to diversification, while Agosin et al (2011) results suggest it leads to specialization and Cadot et al. (2011b) did not find any significance. For these South American countries trade liberalization had robust evidence in specializing the export basket, but for Mexico it is not so clear and there is a negative relation of effective weighted tariffs with Theil probably because of NAFTA.

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4. FINAL REMARKS

The purpose of this dissertation is to compare the realities of three major LAC, Brazil, Chile and Mexico, taking into account that they have shown distinct paths in exports by sector, but also many similarities between them. The LA relative backwardness, a term postulated by Gerschenkron, is also noticed by the lack of its export stability and TOT deterioration, as Prebisch and Singer pointed out. Therefore, the established goal here was to identify some of the most relevant determinants for their export diversification, or lack of. The factors to test were chosen based on literature review from the countries' specificities and export diversification broader literature.

Even after the liberal and financial policies that promoted the premature deindustrialization in the 1990s, the largest LAC had the opportunity to change its production structure in the 2000s, but it did not. Over time, its export basket became more specialized, and when commodities prices fell in mid-2010s the hope for a fast change fell as well. China is now Brazilian largest importer and continues to demand commodities that Brazil can, and wants, to sell. To change this scope, Brazil can direct credit to industries other than mining and agriculture – and the Brazilian Development Bank certainly has the capacity to be a decisive instrument. Brazil's main determinants for diversification were manufacture and institution quality, while for specialization, credit, REER, commodities, remoteness, and trade liberalization played an important role.

It was in Chile that re-commoditization of exports occurred severally, and where industrial policies did not receive the attention that the country deserves and did not work out as expected. The copper price inflation, due to China's 2000s growth, pushed aside the industrial projects and the Asian giant became the major Chilean exports destination. Since the 1990s, the country has joined many FTAs and its export basket specialized towards commodities. Trade liberalization had robust results of increasing the Theil, since both proxies captured this movement. All the significant variables' signs are consistent with the literature review, which is a great additional value for this country's literature. In sum, trade liberalization, commodities rents and REER were determinants of specialization, while manufacturing, education, investment and credit determined diversification. Although all its concentration indexes increased, the manufacture output did not stop growing during this time.

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A diversified export basket secures a country of external vulnerabilities and is also related to some international influence. Asian growth in the second half of the last century is a perfect example: some countries were able to diversify their production and exports towards added value production and therefore, their influence and lack of external vulnerability were consequences. Mexico has indeed diversified its production and exports, but through NAFTA and maquiladoras. In that sense, Mexico has become a cheap place to produce and a path to many companies to be price-competitive in the North American market. It is like an adaptation of the center-periphery model and a reaffirmation of its dependence on the USA, and the review of the literature mentions those authors who agree with this. But it is worth stressing that Mexico, by other means, can try to diversify its extensive margin exports considering that there are companies and manufacture production; initial fixed costs of industrialization have already been made; there is know-how at some considerable level; and that Mexico disposes of the main characteristics an emerging economy needs in order to make its path, such as the internal market. Its trade liberalization's results were different in the two proxies, but as discussed, it has helped Mexico diversify through NAFTA agreement. Institutions, credit and manufacturing helps to diversify the Mexican exports, and REER, remoteness, commodities seem to specify it.

In regard to the most relevant explanatory variable in terms of the coefficients' absolute value, Brazil, Chile and Mexico are in the same page: manufacturing and commodities. Seen in these terms, and not forgetting the extensive margin, it is crucial that these three countries acknowledge the necessity to shift most of their production of primary goods to higher added value manufactured products in order to achieve a lower Theil and succeed in consolidating a stable international trade.

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FIGURE 10 – Chile Manufactured Exports – value vs share
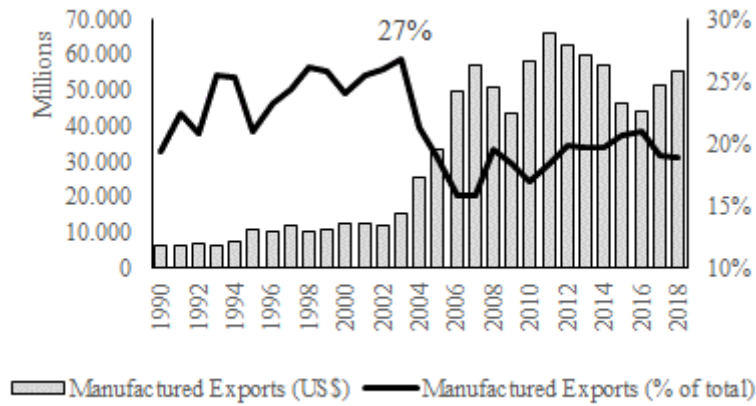
Source: UN Comtrade (2019). Author's own calculations[1].

FIGURE 11 – Main Export Destinations

Brazil

1990		2000		2010		2018	
Partner	Share	Partner	Share	Partner	Share	Partner	Share
USA	25%	USA	24%	CHN	15%	CHN	27%
NLD	8%	ARG	11%	USA	10%	USA	12%
JPN	7%	NLD	5%	ARG	9%	ARG	6%
DEU	6%	DEU	5%	NLD	5%	NLD	5%
ITA	5%	JPN	4%	DEU	4%	CHL	3%
Total	51%	Total	50%	Total	43%	Total	53%

Chile

1990		2000		2010		2018	
Partner	Share	Partner	Share	Partner	Share	Partner	Share
USA	17%	USA	17%	CHN	24%	CHN	34%
JPN	16%	JPN	14%	JPN	11%	USA	14%
DEU	11%	GBR	6%	USA	10%	JPN	9%
GBR	7%	BRA	5%	BRA	6%	KOR	6%
BRA	6%	CHN	5%	KOR	6%	BRA	4%
Total	56%	Total	47%	Total	57%	Total	67%

Mexico

1990		2000		2010		2018	
Partner	Share	Partner	Share	Partner	Share	Partner	Share
USA	70%	USA	88%	USA	80%	USA	76%
JPN	5%	CAN	2%	CAN	4%	CAN	3%
ESP	5%	ESP	1%	CHN	1%	CHN	2%
FRA	2%	DEU	1%	ESP	1%	DEU	2%
NLD	1%	JPN	1%	BRA	1%	BRA	1%
Total	84%	Total	93%	Total	88%	Total	84%

Source: UN Comtrade. Author's own calculations.

Remoteness Index

The applied methodology is suggested by UN (2015), and the data retrieved from UN Comtrade (2019) and CEPII (2019) – trade and distance between countries respectively. If a country is physically close to its major export destinations, then the index tends to be lower. A higher index is associated with higher transportation costs, what makes more difficult to effectively respond to external shocks and, therefore, being an obstacle to the economy's diversification. In short, remoteness is a structural obstacle to trade, potentially impeding exports.

$$R = 100 \times \frac{\ln(d_i) - \ln(d_{\min})}{\ln(d_{max}) - \ln(d_{\min})}, \text{ where } d_i = \frac{\sum_j^n (d_j \times share_j)}{\text{market share threshold}}$$

The cumulative share cannot exceed the market share threshold and consists of the sum of *n* partners' distance times their share. UN (2015) suggests a market share threshold of 50 per cent that was applied to Brazil and Chile. Since Mexican exports are too concentrated, it had to be expanded to 90 per cent. Therefore, the calculated difference between the Mexican index and the other two countries tends to be conservative.

If a country is landlocked or a small island, there is still another adjustment to be made, but since that is not the case it was not applied.

Indexes of specialization

All indexes were calculated by the author. Although HHI and Theil indexes can be found at UNCTAD and IMF respectively, the time series do not match the period studied on this dissertation.

Data comes from UN Comtrade (2019) at the 4-digit level of Harmonized System classification (HS4) level of disaggregation. Osakwe & Kilolo (2018) chose HS6 (disaggregation of richer information) and also some of their references, but the more disaggregated the data, the more it tends to appear diversified, since small variations of a certain product might be taken as a sign of diversification, as Agosin et al (2011) also account for.

Therefore, the indexes' absolute values used here should not be directly compared to indexes from another source, as different levels of disaggregation will end up in unequal absolute values. All of them go in the same direction – the higher the value, the more specialized the export basket.

Hirschmann-Herfindahl Index

It is a commonly accepted market concentration index ranging between 0 and 1 and calculated as the formula below.

$$HHI = \frac{\sum_{k=1}^{N}(x_k)^2 - \frac{1}{N}}{1 - \frac{1}{N}}$$

The broader the dataset, the lower the HHI, since a larger number of products generates lower individual shares. Therefore, HHI calculations from HS4 level of disaggregation is likely to be biased towards zero. Since the main objective is to compare the three countries, and the same methodology was applied to all three of them, the nominal value is not a concern per se.

Theil Index

The Theil Index considers the absolute values x_k and the share that each product would have in case of a perfect diversification $\mu = \frac{X}{N}$. Hence, the deviations from the mean are weighted by this same deviation log. It is not restricted between zero and one, and it smooths extremely skewed distributions.

$$Theil = \frac{1}{N}\sum_{k=1}^{N}\frac{x_k}{\mu}\ln\left(\frac{x_k}{\mu}\right)$$

Gini Index

The Gini Index is usually calculated to identify income disparities, but its application to exports differences is not unusual and it consolidates the evidences brought by HHI and Theil (the usual export diversification indexes). It was calculated as the formula below, where μ is the arithmetic average of x.

$$Gini = \sum_{k=1}^{N-1} \frac{k\,(N-k)(x_{k+1}+x_k)}{N^2\,\mu}$$

FIGURE 12 – Free Trade Agreements

Brazil

Agreements	Date of Signature	Date of Entry into Force
MERCOSUR - Colombia	21 Jul 2017	20 Dec 2017
MERCOSUR - Egypt	02 Aug 2010	01 Sep 2017
MERCOSUR - Israel	18 Dec 2007	03 Apr 2010
MERCOSUR - Peru	30 Nov 2005	2 Jan 2006
MERCOSUR - Bolivia	17 Dec 1996	28 Feb 1997
MERCOSUR - Chile	25 Jun 1996	01 Oct 1996

Chile

Agreements	Date Signed	Date Entered into Force
Argentina	2 Nov 2017	02 May 2019
Pacific Alliance	10 Feb 2014	01 May 2016
Thailand	04 Oct 2013	5 Nov 2015
Hong Kong, China	07 Sep 2012	29 Nov 2014
Vietnam	12 Nov 2011	04 Feb 2014
Malaysia	13 Nov 2010	18 Apr 2012
Turkey	14 Jul 2009	1 Mar 2011
Australia	30 Jul 2008	6 Mar 2009
Japan	27 Mar 2007	03 Sep 2007
Colombia	27 Nov 2006	08 May 2009
Peru	22 Aug 2006	1 Mar 2009
Panama	27 Jun 2006	7 Mar 2008
China	18 Nov 2005	01 Oct 2006
New Zealand, Singapore and Brunei Darussalam	18 Jul 2005	08 Nov 2006
EFTA[1]	26 Jun 2003	01 Dec 2004
United States of America	6 Jun 2003	1 Jan 2004
Republic of Korea	15 Feb 2003	01 Apr 2004
European Union[2]	18 Nov 2002	01 Feb 2003
Central America[3]	18 Oct 1999	19 Oct 2012 (last)
Mexico	17 Apr 1998	01 Aug 1999
Canada	05 Dec 1996	5 Jul 1997
MERCOSUR	25 Jun 1996	01 Oct 1996

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Mexico

Agreements	Date Signed	Date Entered into Force
NAFTA[4]	17 Dec 1992	1 Jan 1994
Chile	17 Apr 1998	1 Aug 1999
European Union[2]	8 Dec 1997	1 Oct 2000
EFTA[1]	27 Nov 2000	1 Jul 2001
Uruguay	15 Nov 2003	15 Jul 2004
Japan	17 Nov 2004	1 Apr 2005
Colombia	13 Jun 1994	1 Jan 2011
Peru	6 Apr 2011	1 Feb 2012
Central America[3]	22 Nov 2011	1 Sep 2013
Panama	3 Apr 2014	1 Jul 2015

[1] European Free Trade Association: Iceland, Liechtenstein, Norway, and Switzerland

[2] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom

[3] Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua

[4] North American Free Trade Association: Mexico, Canada, and USA

Source: OAS (2019). Author's own development.

FIGURE 13 – Independent Variables

Variable	Proxy	Source
Commodities	Mineral Rents as percentage of GDP	WB (2019b)
	Natural Resources Rents as percentage of GDP	WB (2019b)
Credit	Credit as percentage of GDP	WB (2019b)
Education	Govrenment Expenditure as percentage of GDP	1) UNESCO (2019) 2) Brazilian missing data was taken from Junior (2007)
Exchange Rate	Real Effective Exchange Rate	WB (2019b)
Institutions	International Country Risk Guide - Law and Order	PRS Group (2017)
Investment	Investment as percentage of GDP	IMF (2019)
Manufactures	Manufacture Exports as percentage of total merchandise exports	WB (2019b)
	Manufacture value added as percentage of GDP	WB (2019b)
Remoteness	Remoteness Index	Author's own calculations
Trade Liberalization	International Trade as percentage of GDP	WB (2019b)
	Effectively Applied Weighted Tariff (AHS)	WB (2019c)

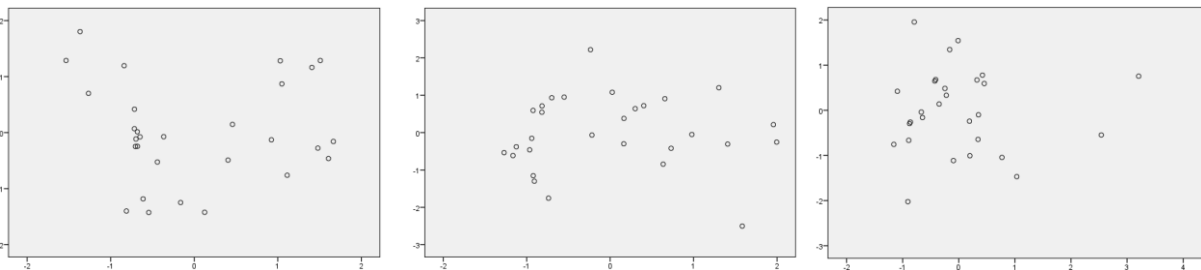FIGURE 14 - Scatterplots – Regression Standardized Predicted Value vs Residual

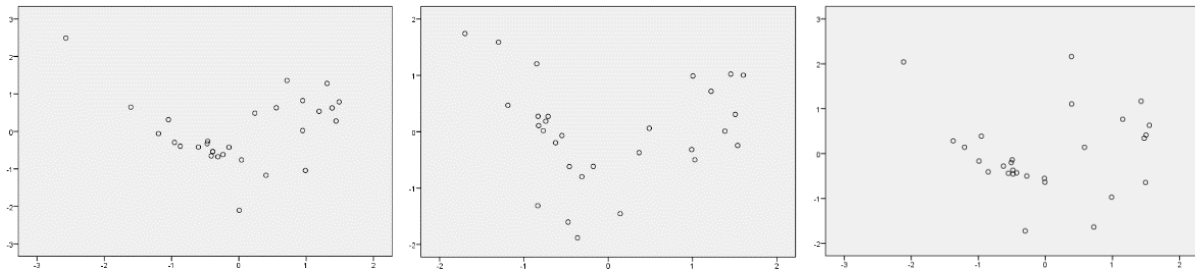Model 1 – Brazil, Chile and Mexico respectively
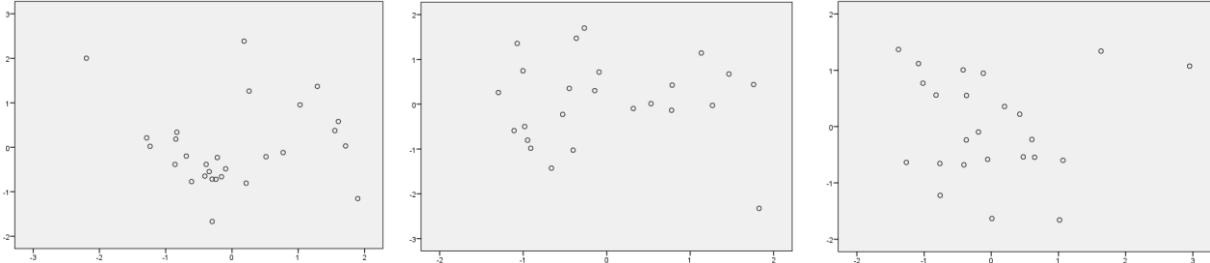
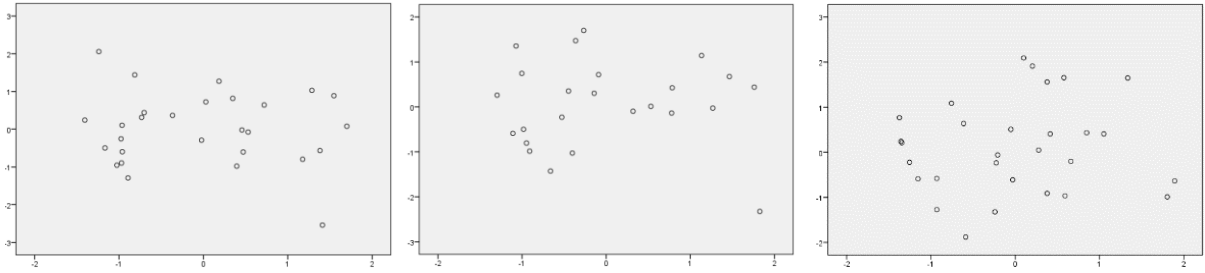Model 2 – Brazil, Chile and Mexico respectively
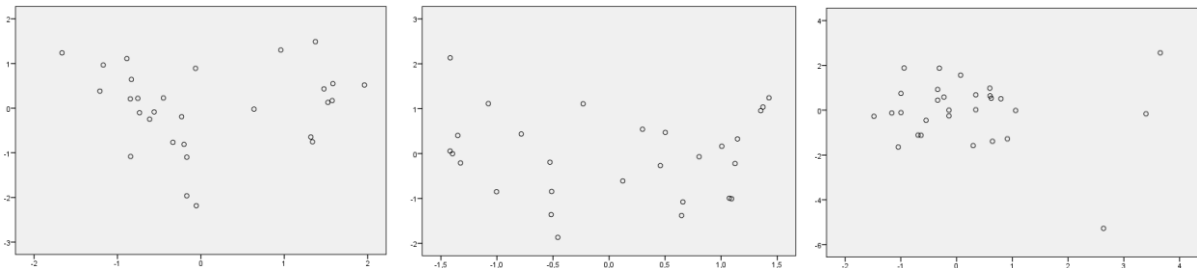
Model 3 – Brazil, Chile and Mexico respectively
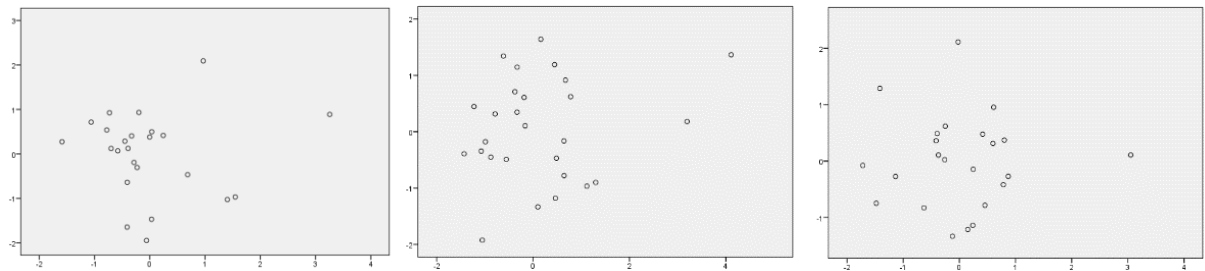

Brazil – Models A, B and C respectively
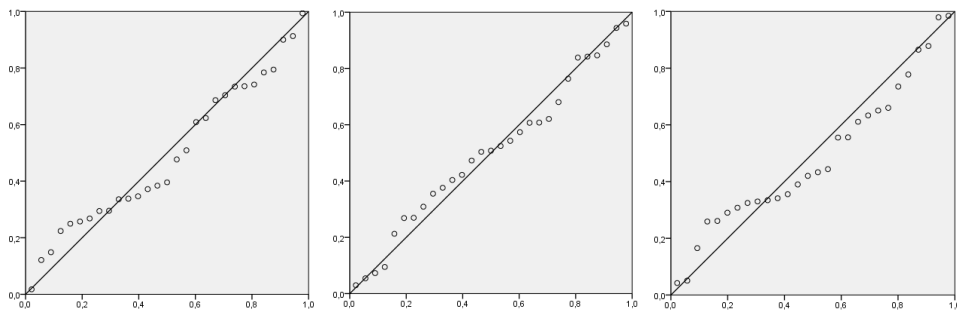
Chile – Models A, B and C respectively
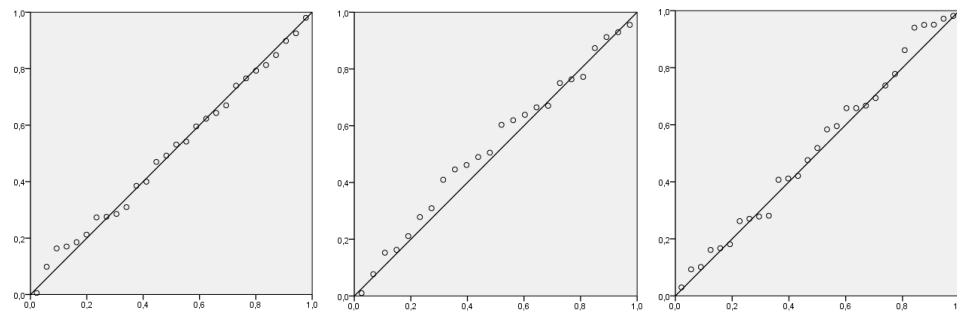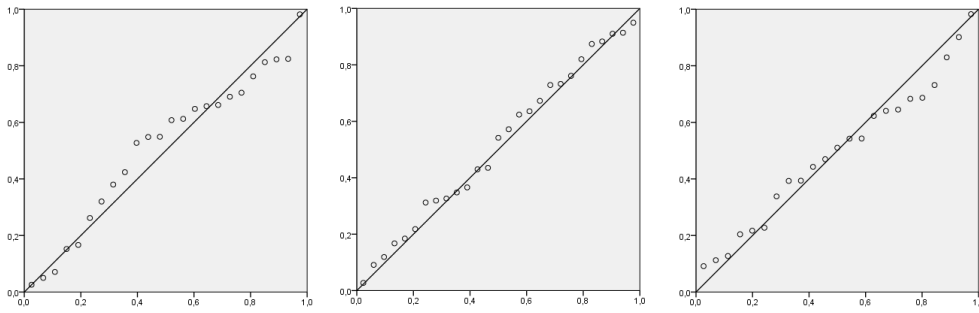

Mexico – Models A, B and C respectively

Source: Author's own calculations. SPSS 24 output.

FIGURE 15 - Normal P-P Plot of Regression Standardized Residual

Brazil – Models A, B and C respectively
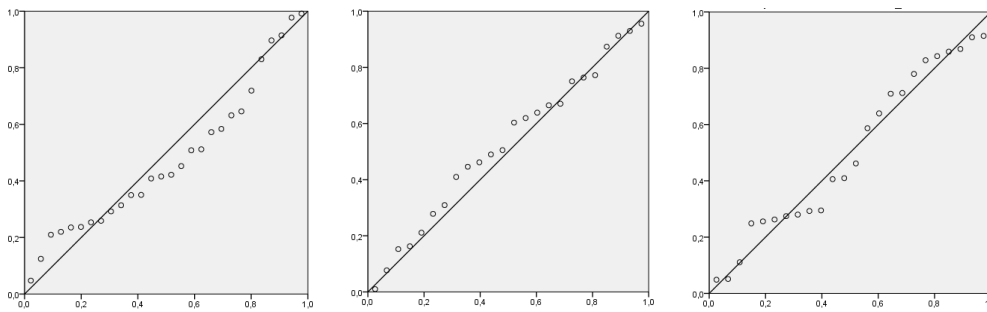

Chile – Models A, B and C respectively

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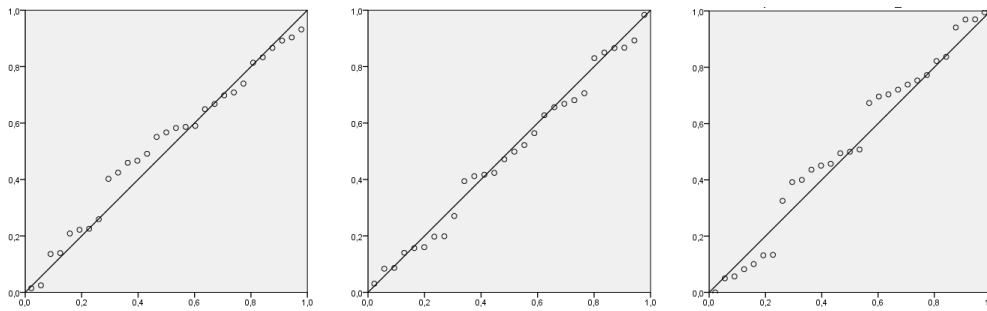WHERE DO BRAZIL, CHILE AND MEXICO DIVERGE?

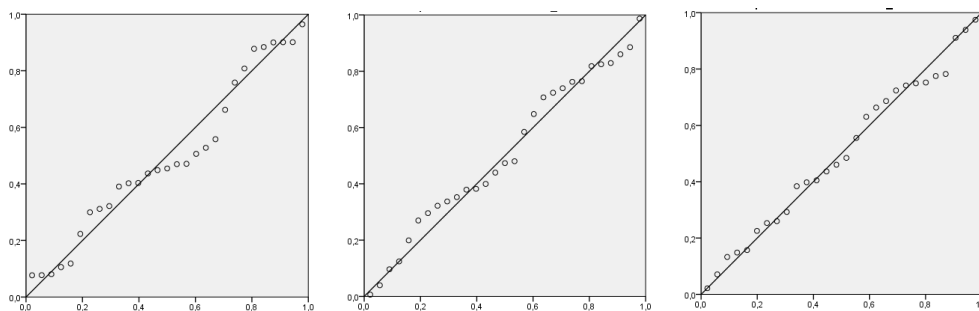Mexico – Models A, B and C respectively

Model 1 – Brazil, Chile and Mexico respectively

Model 2 – Brazil, Chile and Mexico respectively

Model 3 – Brazil, Chile and Mexico respectively

Source: Author's own calculations. SPSS 24 output.