Three Essays on the Effects of Mexico's Trade Liberalisation Policies, 1962-2011

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Abstract

In the 1980s, Mexico utilised trade liberalisation policies as part of an overarching globalisation policy initiative, which has extended to their policies through the 1990s and 2000s. Nevertheless, there lacks a comprehensive and long term discussion of the effect these policies have had on the Mexican economy over the last thirty years, especially in relation to their performance pre- liberalisation and the intersection of multiple economic crises. Therefore, this thesis studies the impact of the trade liberalisation policies on different aspects of the Mexican economy, in order to provide a robust discussion and understanding of how these policies can impact a developing country. Given the previous policies, what was the impact of these policies on not only economic trade, but also income inequality and the agriculture sector?

Chapter 1 provides an introduction with a discussion on the introduction and motivation of the thesis. Chapter 2 utilises an augmented gravity model of trade to evaluate the changes in trade determinants in Mexico over 50 years. The importance of Chapter 2 is to understand how trade agreements and trade policy changed their trade flows, before and after the trade liberalisation period. The chapter builds an augmented gravity model to apply cultural, geographic, and historical factors to study the impact of changing determinants of trade while utilising a Heckman Sample Selection method in addition to OLS via robust standard errors. This chapter's main contribution to the literature and research question is that while cultural variables and NAFTA were important to Mexico's exports in the 1990s, this impact has waned in recent years.

Chapter 3 evaluates the effect that these trade changes have had on their income determinants, for both GDP per capita and manufacturing wages in Mexico. Chapter 3 is also a necessary discussion, given the link between trade policy and income changes, as discussed in the literature (Rodriquez and Rodrik, 2000; Redding and Venables, 2004; Head and Mayer, 2007; Hanson, 2005) The chapter applies a market access measure from Redding and Venables (2004) in addition to recommended variables from the literature representing health, education, skills, social infrastructure, and physical geography. The main results from this chapter are that while foreign market access is important for multiple other countries, for Mexico it is only a significant indicator after trade liberalisation and there exhibits a significant distributional difference in the effect of these policies on income in Mexico.

Chapter 4 utilises propensity score matching to analyse the effect of *PROCAMPO*, an agricultural subsidy enacted to compensate farmers for the negative effects of NAFTA, over three waves (2002, 2005, and 2009). *PROCAMPO* was enacted in 1994, to partially compensate farmers adversely affected by NAFTA, which liberalised agricultural trade after decades of state protection. The main result from this chapter is that there is an even greater distributional difference in the effect of the subsidy, with the majority of the positive treatment effects being experienced by larger farms, while small farms did not experience a substantial treatment effect in consumption, investment, or income. Chapter 5 concludes with policy recommendations and proposed further research.

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Declaration

I hereby confirm that this thesis and the work presented are of my own. In addition, I have generated the work as a result of my own original research. All the chapters are sole-authored. The work in this thesis has not been submitted for any other degree at the University of York or any other institution. Chapter 4 utilises the Mexican Family Life Survey, and all errors in my work are my own. All other sources are acknowledged as references.

Chapter 1: Introduction

This thesis examines Mexico's experience with trade liberalisation policies and its effects on multiple aspects of their economy. Globalisation policies, including financial privatisation, deregulation, and other economic liberalisation, increased in the 1980s and 1990s, contributing to an explosion of international trade. Overall, in the period from 1948-1994, the World Trade Organisation ratified 124 regional trade agreements (WTO). However, from 1995 to 2011, over 400 regional and free trade agreements have been ratified. Mexico provides an excellent case study of these types of policies, once considered the model country of enacting these policies (Robertson, 2006). By investigating Mexico's experience, this can aid other developing countries, and provide policy implications, which may be used while forming their own trade and development policy. For Mexico, the increase in trade agreements and other globalisation policies have followed decades of state-led industrialisation, and in some cases, increased state debt, crises, and volatility. Due to these previous policies, Mexico experienced significant growth and poverty reduction in the 1960s and 1970s; at a time, they allowed oil led growth, and import substitution industrialisation policies to drive their debt to crisis level (Robertson, 2006; Teichmann, 1986).

This culminated in a large debt crisis in 1982, prompting the government to receive a significant bailout from international organisations and governments, including the IMF. John Williamson, an economist at the World Bank, referring to the effort by those in Washington to push for more liberalised policies, including financial liberalisation, privatising state entities, and trade liberalisation, then coined these policies "Washington Consensus" (Williamson, 1990). The literature characterises the 1980s period as a "silent revolution" in developing countries, which adopted these policies, willingly or unwillingly[1]. Mexico was one of the countries to adopt these policies under financial stress. The IMF was insistent on the economic plan for developing countries that included financial, trade, and economic liberalisation. Therefore, in the 1982 bailout, the Mexican government agreed to reduce tariffs, privatise their national companies, and other financial liberalisation policies. Over the late 1980s and 1990s, the focus for the government was trade liberalisation. Mexico began to sign large trade agreements, such as LAIA (1980), NAFTA (1994), and EUTA (2001). The key understanding of these policies was that it would bring significant growth opportunities, poverty reduction, and a fiscal stability in Mexico (Ros 1999; Stiglitz, 1998; Williamson, 1990).

Several studies including Ros (1993) and Teichmann (1986) were sceptical of the economic benefits of these policies, even before the implementation of NAFTA. However, the literature provides evidence of the benefits of these policies, including work by Hanson (2005), Hanson and Harrison (1999), and Fairris (2003), as well as other indicators of the positive benefits of these policies, such as a tripling of GDP between 1984 and 1992 and a reduction in overall poverty in the 1990s (Robertson, 2006). Other analysis including Kehoe and Meza (2012) discuss

[1] Work including Stiglitz (2004), Williamson (1990)

the relative stagnation in growth in Mexico after these policies were enacted[2]. This shows a difference in opinion by other researchers in the effect of these policies on Mexico. Work including Weisbrot et al (2014) questions whether these policies have helped Mexico due to their low growth and increasing inequality, while Zepeda et al (2009) provide evidence that these policies have largely been a disappointment for the country. Given the mixture of evidence provided in the literature, as well as the 20-year anniversary of NAFTA, it is important to revisit the Mexican experience of trade liberalisation. This thesis goes further than previous studies, by providing an extensive discussion of the impact of these policies in multiple aspects of the economy, including trade volume, income inequality, and agriculture. Agriculture is included in this analysis, as its role within the Mexican economy is vital, and the majority of literature reviews the changes in manufacturing (Hanson, 2005; Hanson and Harrison, 1999; Kehoe, 2002). For this reason, agriculture is considered, to evaluate the total effect of these trade policies on all aspects of the economy. Specifically, this thesis explores the impact of the trade liberalisation policies on different aspects of the Mexican economy, in order to provide a robust analysis and understanding of how these policies can impact a developing country.

Chapter 2 provides the evidence of the trade explosion in Mexico, utilising an augmented gravity model to study the long-term changes in total trade flows over 50 years. The gravity model is built by relating the amount of trade between two countries to their economic size, as measured by their national incomes, and the cost of transport between them. In the original model, the distance between their economic centres, or capital cities measured the cost of transport. More theoretical developments arise from new trade theory, whereby the critical factor in determining international patterns of trade are the substantial economies of scale and network effects. The economies of scale can outweigh the more traditional theory of comparative advantage, but if one country specialises in a particular industry then it may gain economies of scale and other network benefits from its specialisation (Krugman 2008). The amount of trade between the two countries increase in their economic size and decrease as the cost of transport increases between them.

Furthermore, the chapter includes analysis of their crisis years (1982 and 1994, among others), to fully understand the effect of these years on their total trade flows. Previous work by Martinez-Zarzoso (2003) utilises a gravity model on Mexico's trade flows, however without any discussion of their crisis years. In addition, the analysis does not include trade flow analysis pre-1980s. This chapter is novel in its scope, as it provides decade-by-decade analysis of the trade flows from the 1960s to 2010s. The chapter also reviews the effects of NAFTA (1994), the Latin American Integration Association (LAIA, 1980), and European Union Trade Agreement (EUTA, 2001). This chapter also uses a new database, compiled by the researcher, using over 21,000 observations and 30 variables. By employing an augmented gravity model, the chapter provides an important discussion of exactly how their trade flows changed, and provides evidence to how these

[2] Timothy Kehoe has written extensively on this subject, including work with Raphael Bergoeing, Patrick Kehoe, and Raimundo Soto (2001), and Kim Ruhl (2011). It is highly recommended to review his many papers on this subject.

trade agreements changed Mexico's trade flows, an essential analysis for discussing the implications of these changing trade flows over time.

Building on these results, Chapter 3 analyses the changes in Mexico's income before and after their trade liberalisation and globalisation period (1962-2011). To analyse the change in Mexico's income before and after trade liberalisation, this chapter employs an economic geography and trade model augmented with other variables suggested in the literature. The subsequent growth in economic trade in Mexico leads the researcher to question the relationship between this globalisation period and income changes for Mexico related to other countries. As a significant amount of the research discusses the relationship between trade policies and income including Goldberg and Pavcnik (2003), Attanasio et al (2004), and Feenstra and Hanson (1997), this is an important discussion in light of the trade changes. Furthermore, there are a few theories to understand the variation in income between countries, such as Gallup et al (1999), Nissanke and Thorbecke (2010), Dollar and Kraay (2002), and Redding and Venables (2004). These theories include the impact of geography, trade shocks, market access, development status, skill level, and social infrastructure. This chapter combines all of these aspects to fully understand the implications of trade policies and globalisation on income inequality between countries. The theoretical framework follows a trade and geography model, as outlined in Fujita et al (1999) in Chapter 14.

The theoretical framework is based on standard new trade theory, but is extended to have transport frictions in trade and intermediate goods in production. The world consists of i = 1,….,R countries, composed of firms that operate under increasing returns to scale and produce differentiated products. The full general equilibrium model involves specifying factor endowments and factor market clearing conditions to determine income and expenditure. Output levels of manufacturing are specified, as well as the payments balance. Expenditure and output levels are treated of exogenous[3]. For demand, each firm's product is differentiated from products of other firms and used in consumption and as an intermediate good. There is constant elasticity of substitution. The model defines a gravity-like relationship for bilateral trade flows between countries. This is an original contribution to the literature, as this type of analysis does not exist in the literature for Mexico, and the distinction between GDP per capita and manufacturing wages provides a necessary understanding of the distributional effect of these policies on income within Mexico. The results provide a different effect of trade policies on income between those within the manufacturing sector, and those in the wider economy. Other implications for those with a lower-skilled level and economic geographic indicators are also found to be important in this analysis.

Chapter 4 follows on from Chapter 2 and 3, but provides a necessary discussion of the distributional changes in agriculture after the implementation of these policies. Missing from the literature is the understanding that NAFTA and the other trade policies were meant not only to transform their economy, but also improve all incomes and transform the living standard in

[3] For further information on Fujita (1999)'s general equilibrium, see Chapter 14 Fujita (1999), Redding and Venables (2004), and Head and Mayer (2008).

developing countries. Also, the majority of the focus in the literature is on the impact of these policies in manufacturing. Therefore, the analysis of the implications of the trade policies on Mexico would be incomplete without an analysis of the agriculture sector. Given the possible negative effect of trade liberalisation on the agricultural sector, Mexico enacted an agricultural subsidy, *PROCAMPO*, to compensate these farmers or producers in agriculture, and also to help reduce the high poverty within the agriculture sector. Previous work by Sadoulet et al (2001) analysed the effect of the subsidy on the multiplier effect of consumption. The majority of work completed on *PROCAMPO* utilise the 1994 and 1997 ENCASH panel survey. As well, the majority of the academic work utilising microeconomic survey data focuses on the changes in migration (Gonzalez- Konig and Wodon, 2005; Cortina, 2014; Davis, 2003; Cuecuecha and Scott, 2009). Using data from the Mexican Family Life Survey (2002, 2005, 2009), Chapter 4 implements propensity score matching to examine the effects of this subsidy on production, consumption, income, and assets of farmers throughout Mexico. The Roy-Rubin model (1951,1974) is utilised here to determine the impact of a treatment on the outcome of an individual. To do this, inference about this involves speculation about how this individual would have performed had he not received the treatment. In evaluation analysis, this problem is addressed in the Roy-Rubin model, whereby the main pillars of the model are individuals, treatment, and potential outcomes. Another contribution to the literature, by scrutinising the effects of this subsidy on total farmers, and then dividing the farmers into groups by farm size (small, medium, and large), this thesis provides further evidence of the distributional impact of the subsidy within the agriculture sector. The main findings include evidence that small farms did not experience the same benefits of *PROCAMPO* as the large farms, especially related to income and production. This chapter highlights the importance for a multi-faceted approach to implementing such wide-ranging policies to benefit all within the economy.

Chapter 5 concludes by discussing the overall themes, contributions, and limitations of the thesis. Chapter 5 also includes a discussion of further research given the work provided here.

Chapter 2: Trade Liberalisation, Crises, and Historical Links. A Gravity Analysis of Mexico's Exports

2.1 Introduction

This chapter utilises a gravity model to study the long-term changes in trade flows in Mexico from 1962 to 2011. The time period, 1962 to 2011, was chosen for this analysis for one main reason. First, this time period represents a significant change in economic policies for the 50 years. The 1960s represented import substitution policies, while the 1970s was mostly oil led export growth. The 1980s were marred with economic and fiscal crises stemming from their borrowing mistakes in the 1970s. The 1990s were mostly related to NAFTA and other trade agreements. Finally, the 2000s included the European Union Trade Agreement, the rise of China and Asia as a competitor for export markets, and the global recession. The chapter analyses the effect of the EUTA (European Union Trade Agreement), NAFTA (North American Free Trade Agreement), and LAIA (Latin America Integration Association), which have been signed over the last 30 years. Are the trade effects of these agreements still profound or are other factors now determining trade for the emerging market country? As well, multiple historical events, such as crises will be explored to understand how they may have affected Mexico's trade over time. For both the total panel and Mexico, this analysis will estimate exports, imports and total trade for the country pairs.

After building the model, the results show that Mexico's trade patterns have changed dramatically over 50 years, with a declining influence of NAFTA as competition from Asia began to decrease exports to NAFTA. Furthermore, cultural, historical, and political factors mattered to Mexico in the 1990s, yet this effect has declined. The motivation for studying Mexico is due to their history of import substitution before liberalising trade in the 1980s and then signing more trade agreements than any country. Mexico provides a good case study on analysing the long-term effect of enacting multiple trade agreements and trade liberalisation policies due to their economic history through their various economic crises. This would fit into the overall discussion of understand the effects of trade liberalisation on an economy. It's important to understand how the policy changes affected their trade determinants and how the trade agreements fit into this picture. Another novelty of this chapter is to confirm the necessity of multilateral resistance terms in estimating the gravity model as well as analyse the effect of heterogeneity and heteroscedasticity in the data. This chapter builds the necessary model for estimating a robust gravity equation for estimation on Mexico and its trade partners while also exploring the above questions.

One of the major novelties of this chapter is in its originality. In the literature, the only paper to utilise a gravity equation to Mexico's exports is in Martinez-Zarzoso (2003). On the other hand, Martinez-Zarzoso (2003) did not apply the gravity model to multiple trade agreements. As well, Martinez-Zarzoso (2003) did not use as many years as this analysis. If so, this could provide a robust discussion of the long-term effects of these policies, by analysing the effects of the regional trade agreements in addition to the time effects of this crisis and change. Therefore, considering this panel includes multiple Asian countries, such as China, Indonesia, Malaysia, and South Korea, it provides a robust discussion of the changing patterns and the changing impact of distance on trade patterns. The literature has attempted to understand the effects of trade agreements over the last twenty years as more countries use them to forge new trade partners and reduce trade costs. Martinez-Zarzoso (1999), Martinez-Zarzoso and Marquez-Ramos (2005), and Lee and Park (2007) have tried to understand whether these trade agreements actually reinforce historical, cultural, political, and linguistic ties or are discriminatory trade policies by region, which could divert trade to the rest of the world. If these are reinforcing historical, cultural, political, and linguistic ties, then in the analysis you should see an increase in trade between these countries are due to the above variables, such as sharing a language, colonised by the same power, ever colonised, and sharing a common religion. Mexico is a prime example of this discussion because it shares a language with Chile, Costa Rica and Spain, and shares the same religion as Brazil, Canada, the USA, and most of Europe. However, other Asian countries are in this analysis, which represent a higher distance than those countries near Mexico, and could thus reflect a diminishing effect of distance on trade. This is an important addition to the discussion of the determinants of trade flows because it analyses the effects of three large trade agreements on one country by comparing these effects to their pre-trade liberalisation era. It also discusses how trade determinants and patterns change over time for an emerging market country. It is important to understand if the changes to Mexico's trade patterns are due to the different stages of trade liberalisation in Mexico.

The rest of the chapter is organised as follows. Section 2.2 provides an overview while Section 2.3 describes the data utilised in this database. Section 2.4 discusses the theoretical framework of the gravity model and relevant literature to this analysis while also providing the precise estimations will be detailed, including cultural, historical, political, and geographic variables/factors. Section 2.5 conducts multiple estimations, utilising methods and variables discussed in the literature. This provides a robust analysis of the free trade agreements, including trade creation. The last analysis reviews the multiple crises that affected Mexico over the last 50 years. The methods are completed, as recommended in the literature, to support the analysis and improve the robustness. Section 2.6 concludes with policy advice for future trade flows and research follows.

2.2 Trade Liberalisation and Free Trade Agreements

Mexico enacted trade liberalisation after decades of import substitution industrialisation. The trade reforms were a product of the crippling 1982 debt crisis, whereby Mexico was forced to fully open their economy to receive a bailout from the international community. Before trade liberalisation, tariffs were as high as 100 per cent and licenses were required for importing any good. As well, foreigners were restricted to no more than 49 per cent ownership in Mexican enterprises. Mexico enacted trade liberalisation over three steps, lasting 25 years. By 1994, these tariffs were cut substantially. The maximum tariff was cut to 20 per cent, import licenses had been cut for 89 per cent of imports, and restrictions were lifted on most foreign investment. Import licenses were required for 100 per cent of imports in 1983. This was cut to 65 per cent in 1984, 10 per cent by 1985, and 2 per cent in 1992. Import licenses were still required for crude petroleum products, the automotive industry, and some agricultural commodities. The simple average tariff line went from 23.2 per cent in 1983 to 13.1 per cent in 1992 (Kehoe 1995).

In addition to reductions in tariffs, Mexico simplified the tariff structure. The number of tariff rates fell from 13 in 1983 to 5 in 1987. By 1992, 36.5 per cent of Mexico's imports were subject to a 10 per cent tariff rate (Kehoe 1995). The impact of the reduction in trade barriers was an increase in exports beginning in 1987. In 1982-83, import licences were Mexico's significant trade barrier. In late 1983, these licences were replaced with tariffs. By the end of 1984, the portion of tariff items subject to licence requirements fell from 100 percent to 65 percent. By 1992, the percentage of tariff items subject to licence requirements fell to 2 percent. However, some licence requirements remain for some agricultural and agro-industrial commodities, crude petroleum, and for the automotive industry. In addition, Mexico changed their tariff schedule. In 1982, the number of tariff rates was 16, with the maximum rate of 100 percent. By 1986, this number fell to 11 percent, and 5 percent in 1987.

Mexico is a member of the Latin American Integration Association (1980), providing preferential treatment to imports of all member countries. The LAIA initially included Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela but by 2011 included Cuba and Panama. The LAIA was a step for regionalisation throughout Latin America. The integrated area promotes an establishment of an area of economic preferences throughout the region, to create a Latin American common market. The LAIA used a regional tariff preference, regional scope agreements, and partial scope agreements. The regional tariff preference applied to goods from the member countries compared to tariffs for third countries. The regional scope agreements were allowed for all member countries participate and the partial scope agreements applied to two or more countries in the area. This LAIA has led to multiple trade agreements amongst the region, including Mexico and Costa Rica, Mexico and Chile, and Mexico and Peru.

In 1986 Mexico acceded to GATT, they adopted the Harmonised Commodity Description and Coding System in 1987, and in 1992 Mexico reformed agriculture. The composition of trade in the 1990s changed greatly. Petroleum became less important and trade with the United States grew from 56 per cent of Mexico's trade in 1982 to 70 per cent in 1992. Maquiladoras, in-bond assembly factories originally established in 1965 by agreement with the United States, expanded rapidly in part due to the reduction in foreign investment barriers. Most of the maquiladoras were built on the U.S.-Mexico border. The maquiladora programme paved the way for the North American Free Trade Agreement (NAFTA).

NAFTA was a culmination of over 5 years of negotiations. Specifically, NAFTA was signed to "eliminate barriers to trade" and facilitate freer trade for all the parties in the agreement

(NAFTA 1994). The most important additions of NAFTA were to strengthen anti-dumping measures and increase FDI to industries in Mexico. NAFTA also eliminated import and export restrictions over 15 years and imposed export duty tax on foodstuffs, to protect domestic consumers. Sensitive products received longer phase-out schedules of 15 years, including sugar, corn, frozen concentrated orange juice, winter vegetables, and peanuts (Villarreal 2012). However, NAFTA also required partner countries to eliminate all non-tariff barriers to agricultural trade, replacing import license requirements with tariff rate quotas and gradually phasing these out over the 15-year implementation period. NAFTA included provisions where a partner country could apply the tariff rate if imports of a product reached a "trigger" level set out in the agreement (Villarreal 2012).

Following NAFTA, a number of free trade agreements were signed. In 2001, Mexico signed a FTA with the European Community (EUTA). The EUTA was initially signed with the EU-15 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom). The EUTA reduced import barriers in the EU for imports of agriculture from Mexico to no greater than 50%, some agricultural items had 0% ad valorem customs duty. This agreement completely eliminated import customs duties on vehicles to Mexico. Mexico agreed to eliminate tariffs on 47% of imports from the EU immediately and to phase out remaining tariffs by January 2007. Import/export licenses and quotas were removed upon implementation of the agreement. The EU eliminated tariffs on 82% of imports by value coming from Mexico, agreeing to phase out the remaining tariffs by January 1, 2003. Given the above events in their economic history, reviewing how this changed their trade determinants would be very important for understanding the full impact of these policies on trade flows as well as income and agriculture.

2.3 Data

North America:	**Europe:**	**Latin America:**	**Asia:**
Canada Mexico United States of America	France Germany Italy Netherlands Spain Sweden Switzerland United Kingdom	Brazil Chile Costa Rica	China India Indonesia Japan Malaysia South Korea Thailand

Table 2.1: Countries by Region

The analysis uses a panel of 21 countries including Mexico, other NAFTA countries, China, Japan, Brazil, and most European Union countries. A list of the countries utilised in the analysis, by region, is available in Chart (1). These represent Mexico's top 20 trade partners in

2011. The analysis is completed over 50 years, from 1962-2011. Thus, there are 21,000 observations and 420 country pairs. The exports and imports come from the UN Comtrade database, and are used under SITC Revision 4. The geographic, political, and cultural variables come from CEPII database. GDP and population statistics originate from the World Bank, in their World Development Indicators database. GDP is in PPP These countries represent Mexico's top 20 trading partners in 2011. The trade flow data originate from the UN Comtrade database, and are in US Dollars. GDP and Population statistics come from the World Development Indicator Database. Variables in natural log form are detailed in the methodology. This panel represents 93.2% of Mexican exports and 91.7% of Mexican imports. It also represents 72% of world trade.

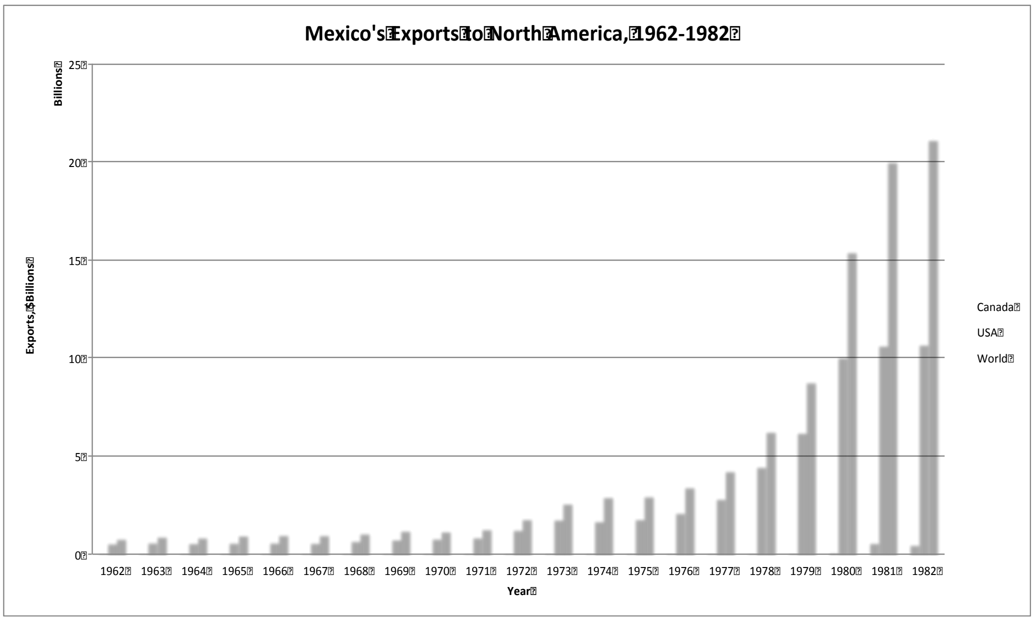

Figure 2.1: Mexico's exports to North America, 1962-1982

Source: UN Comtrade, $billions

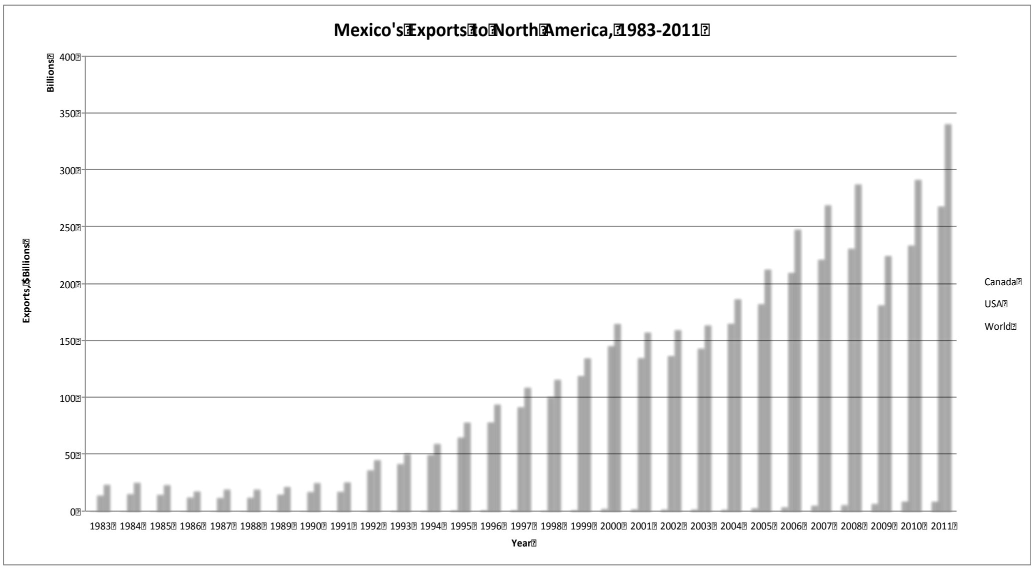

Figure 2.2: Mexico's Exports to North America, 1983-2011

Source: UN Comtrade, $billions

Figure 2.1 and 2.2 contain the volume of exports from Mexico to Canada and the USA before and after trade liberalisation. The volume of exports to these countries is also reported with overall exports to the world. It's clear the overall volume of trade to the world has increased rapidly from about $20 billion in 1981, to about $50 billion in 1993. By 2011, their value of exports was just under $150 billion. The majority of those exports are to the USA (76% in 2011). However, in 2004, 88.6% of Mexico's exports were going to the USA. It would be interesting to understand the recent decline in exports to the USA, and to see if this was mostly related to the economic crises in 2007-2009, or if this was a consequence of increased competition from Asia.

The panel is quite original because it contains aggregate trade for all countries over 50 years. In addition, all of the country pairs exist for each year, and thus is a strongly balanced panel. An unbalanced panel would not have the country pairs for each year. Although not all variables are analysed in this chapter, the database used to analyse the above questions includes over 39 separate indicators, such as wages, disaggregated trade data (manufacturing, agriculture, and fuel), prices, and exchange rates. The database was constructed over consecutive months, with indicators originating from multiple separate sources (individual countries, World Bank, IMF, CEPII, etc) and the database is large enough to conduct other trade welfare analysis. It is also large enough to control for unobserved heterogeneity and endogeneity in the countries. As it is not a cross-section, it provides enough observations for longitudinal analysis.

The database does include some zero-trade flows over time for certain countries. The zero trade flows exhibited in the dataset match a pattern. For example, India did not report total trade, exports and imports, pre-1975. Germany did not report their data pre-1970 and Malaysia did not report their data pre-1965 for all trade data. These three countries represent a significant volume of historical trade flows, and to miss out on these in the model would be significant and lead to significant bias. It is of course possible that even if the countries had reported the data, they still did not trade with all countries in the panel. This may also be a result of rounding errors. This is a form of measurement error, which will depend on the covariates leading to inconsistency and more likely to occur for smaller countries. This may also occur due to poor political infrastructure and data collection tools. However, the zero trade flows account for less than 10% of the observations, and thus a robust panel study can be conducted as other tools are utilised to control for the zero trade flows. Historically, panel studies including trade data have missing trade flows, and it is a widely discussed problem with using trade flows. However, this thesis analyses the trade flows while utilising methods completed in the literature, to ensure the missing data does not result in information bias.

2.4 Theoretical Framework and Econometric Specification of the Gravity Equation Model

2.4.1 Theoretical Framework

Historically, the gravity equation has been highly effective in describing trade flows in empirical studies. However, the theoretical foundation arose well after the empirical development of the model. Tinbergen (1962) and Poyhonen (1963) developed the gravity model of international trade independently. According to this model, the amount of trade between two countries increases in their size, as measured by their national incomes, and decreasing in the cost of transport between them. In the original model, the distance between their economic centres, or capital cities measured the cost of transport. Linnemann (1966) followed with including population as an additional measure of country size. In addition, it is also common to use per capita income as a measure for country size. Aitken (1973) was one of the first to apply this approach to analyse regional trade agreements (RTAs). However, Anderson (1979) made the first formal attempt to derive a gravity equation based on the Armington assumption of specialisation in producing only one good for each country. Bergstrand (1985) completed the theoretical foundation by including a more detailed explanation of the supply side of the economies and included prices in the equation.

Later, more theoretical developments in the gravity model came with the emergence of new trade theory. More theoretical developments arise from new trade theory, whereby the critical factor in determining international patterns of trade are the substantial economies of scale and network effects. The economies of scale can outweigh the more traditional theory of comparative advantage, but if one country specialises in a particular industry then it may gain economies of scale and other network benefits from its specialisation (Krugman 2008). The major addition is the replacement of the assumption based on product differentiation by country of origin but product differentiation by producing firms. Bergstrand (1990) generalised the model by introducing prices and incorporating the Linder hypothesis[4]. He also provided a foundation based on Dixit and Stiglitz's monopolistic competition assumption. Helpman (1987) derived a foundation based on the assumption of increasing returns to scale and monopolistic competition. Deardoff (1998) proved that the gravity equation could be derived from multiple standard theories; merging both the old and new trade theories. Eaton and Kortum (2003) provided a microeconomic foundation for the gravity model by developing a Ricardian trade model with realistic geographic features into a general equilibrium. This model resembles a gravity equation as it relates trade flows to distance and to the product of the trade partners' GDPs. This model is highly significant in the literature on

[4] The Linder hypothesis is in contrast with supply-side orientation of the Heckscher-Ohlin-Samuelson model, and is primarily demand-side oriented. Countries generally produce goods for the domestic market, and then export the surplus, deriving their pattern of trade from "overlapping demand." Therefore, countries that have an interest in acquiring this surplus would have demand patterns similar to those of the exporting country. For more details on the Linder hypothesis, and Heckscher-Ohlin-Samuelson model, Linder (1961) is suggested, as well as Heckscher (1950).

the gravity model in that it combines a general equilibrium and a gravity analysis. With the framework given in Eaton and Kortum (2003), it is possible to not only analyse trade pattern changes but also conduct policy experiments and conduct gains from trade analysis for all trade partners. Finally, this analysis utilises Anderson and van Wincoop (2003), considered the most comprehensive derivation of the gravity model available.

The Anderson and van Wincoop (2003) model is one of the most well used gravity models in the literature. In this model, Anderson and van Wincoop (2003) outline the reasons and necessity of utilising multi-resistance terms to improve the fit of the model. Their main contribution is the inclusion of multilateral resistance terms for the importer and the exporter that proxy for the existence of unobserved trade barriers. Goods are differentiated by place of origin where each country is specialised in the production of only one good and preferences are identical, homothetic, and approximated by a constant elasticity of substitution (CES) function [5]. Countries are representative agents that export and import goods. In this model, Anderson and van Wincoop (2003) use multilateral resistance terms to further capture unobserved heterogeneity and thus should be used to avoid a biased estimation of the model parameters. Anderson and van Wincoop (2003) noted that the methodology for these multilateral resistance terms can be difficult to estimate, and thus suggested using time-varying multilateral trade resistance terms in the form of source and destination effects. However, they reject the idea of using a remoteness variable, as it incorporates distance in the equation, as a proxy for multi-lateral resistance term. Baier and Bergstrand (2007) followed this methodology and extended the methodology to incorporate time varying fixed effects as well as country-pair fixed effects to obtain unbiased estimates and to capture the individual country heterogeneity that can change over time. Baier and Bergstrand (2007) found that conventional time-invariant fixed effects are insufficient to capture the unobservable factors of the gravity equation. The most important theoretical developments to the framework of the gravity model is from empirical and econometric work on the gravity model. The Anderson and van Wincoop (2003) model is the starting point for augmenting the gravity model for our estimation. In the Anderson and van Wincoop (2003, AvW) model, they begin with the Anderson (1979) theoretical foundation and utilise the extensions described by Bergstrand (1989,1990) and Deardoff (1998) to derive an operational gravity model. A brief discussion of this model is below[6].

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[5] Anderson and van Wincoop (2003) derived their gravity equation to measure further trade barriers, P_i and P_j:

$$x_{ij}=\frac{y_i\, y_j}{y^w}\left(\frac{t_{ij}}{P_i\;P_j}\right)^{1-\sigma}$$

x_{ij} refers to exports from country I to country j, P_i and P_j measure the trade barriers of country I and country j in exports and imports. Thus this represents the outward and inward multilateral trade resistance.

[6] Anderson and van Wincoop (2003) provide an exacting discussion of the derivation of the general equilibrium utilised to prove the gravity model. As the main purpose of this chapter is to

As discussed above, all goods are differentiated by place of origin, and each region is specialised in the production of only one good. The supply of each good is fixed. There are identical, homothetic preferences, estimated using a CES utility function. C_{ij} is consumption by region j, who are consumers of goods from region i. Trade costs are borne by the exporter and for each good shipped from i to j the exporter incurs an export costs T_{ij} -1. Price indices are multilateral resistance variables, as they depend on bilateral resistances, which may include those not involved in i. The gravity model implies that bilateral trade is homogeneous of degree zero in trade costs. Trade between regions is determined by relative trade barriers, such as relative trade costs and unobservable multilateral resistance terms. The trade cost factor T_{ij} is a log linear function of observables, bilateral distance d_{ij} and whether there is an international border between i and j. By the end of the general equilibrium utilised in AvW (2003), the theory implies that:

$$\ln x_{ij} = k + \ln y_i + \ln y_j + (1-\sigma)\rho \ln d_{ij} + (1-\sigma)\ln b_{ij} - (1-\sigma)\ln P_i - (1-\sigma)\ln P_j \qquad (1)$$

In this model, k is a constant and $(1-\sigma)\rho$ and $(1-\sigma)\ln b_{ij}$ are multilateral resistance terms that may impact trade costs. The AvW (2003) model is the starting point for the econometric analysis.

apply the model, this chapter will not repeat the exercise written so clearly in AvW (2003). For a more detailed discussion, please see the original paper.

Author (Year)	Empirical/Theoretical/Econometric	Contribution
Tinbergen (1962) and Poyhonen (1963)	Theoretical	Major foundation of the gravity model, linking flows of trade with distance, income, and border
Linnemann (1966)	Theoretical	Addition of population variable
Aitken (1973)	Empirical	Applied per capita income to free trade agreements
Anderson (1979)	Theoretical	Full derivation of the gravity model including Armington assumption of specialisation
Bergstrand (1985)	Theoretical	More complete foundation including a detailed explanation of the supply side of the economies and including prices
Helpman (1987)	Theoretical	Derived a model based on the assumption of increasing returns to scale and monopolistic competition
Bergstrand (1990)	Theoretical	Generalised the model by incorporating the Linder hypothesis
Matyas (1997)	Econometric	Proves that all gravity models are miss-specified if they do not include country and time effects (either one or two way effects). Illustrates the importance of using specific country effects
Deardoff (1998)	Theoretical	Proved the gravity equation could be derived from multiple standard theories, merging both old and new trade theory.

Table 2.2: Important Empirical, Theoretical, and Econometric Literature

Martinez-Zarzoso (1999)	Empirical	Assesses MERCOSUR, European, and Mediterranean trade flows. Predicts trade potentials for Mexican and Spanish exports.
Nitsch (2000)	Empirical	Proposes a method for calculating inter-country distances as a function of country size, and a new remoteness measure
Eaton and Kortum (2003)	Theoretical	Provided a microeconomic foundation for the model by developing a Ricardian trade model with realistic geographic features into a general equilibrium
Anderson and van Wincoop (2003)	Theoretical	Provided the most comprehensive derivation of the gravity model, including multilateral resistance terms to improve the fit of the model by capturing unobserved heterogeneity.
Redding and Venables (2004)	Empirical	Applied a fixed effects gravity to produce a market access measure as a variable for income inequality between countries.
Martinez-Zarzoso and Suarez-Burguet (2005)	Empirical/Econometric	Transporation costs as a function of weight to volume ratio and distance
Martinez-Zarzoso and Marquez-Ramos (2005)	Empirical/Econometric	Assessed the pooling assumption in a gravity model augmented with infrastructure and cultural variables.

Table 2.2 continued

Cheng and Wall (2005)	Econometric	Discusses the various specifications of the gravity model, shows that heterogeneity must be accounted for. Otherwise the gravity model can overestimate the effects of integration on the volume of trade.
Santos, Silva, and Tenreyro (2006)	Econometric	Highlights the problems with heteroskedasticity and zero trade flows, proposes utilising Poisson Psuedo-Maximum Likelihood for dealing with heteroskedasticity.
Nowak-Lehmann et al (2007)	Empirical	Uses transport costs instead of distance to study the customs union between the EU and Turkey from 1988 to 2002.
Lee and Park (2007)	Empirical	Uses tariffs and other cultural proxies to capture barriers to trade flows.
Baier and Bergstrand (2007)	Theoretical/Econometric	Followed the AwC (2003) methodology to incorporate time-varying fixed effects that capture unobserved individual country heterogeneity.
Iwanow et al (2007)	Empirical	Utilised remoteness instead of distance to study a panel of 124 developed and developing countries to assess the impact of trade facilitation on manufacturing export performance.
Kepaptsoglou et al (2009)	Empirical	Use transport costs to analyse the EMFTA, instead of distance within the model.

Table 2.2 continued

Pelletiere and Reinart (2009)	Empirical	Uses tariffs explicitly to measure trade costs instead of distance
Gomez (2011)	Econometric	Compares the widely used estimators for the gravity model to a panel covering 80% of world trade, proving that the Heckman sample selection model performs better overall for specification of the gravity model with large zero trade flows.
Martinez-Zarzoso (2011)	Econometric	Reviews SST (2006) work and prove that more work on the econometric performance of other methods is required.

Table 2.2: Important Empirical, Theoretical, and Econometric Literature[7]

2.4.2 Econometric Specification

Although AwC (2003) is close to the econometric specification, the original Tinbergen (1962) model is useful for understand the original gravity variables. The original, simplified gravity model from Tinbergen (1962) is:

$$X_{ij} = \alpha_0 {Y_i}^{\beta^1} {Y_j}^{\beta^2} {N_i}^{\beta^3} {N_j}^{\beta^4} {DIST_{ij}}^{\beta^5} {ADJ_{ij}}^{\beta^6} \mu_{ij} \qquad (2)$$

Y_i and Y_j proxy for the economy size of country *i* and country *j* and represent the consumption and demand level of a country. Population (N_i and N_j) of both countries are also utilised in this model, and sometimes are used instead of GDP. Another instance of this is to use GDP per capita instead of population and GDP. $DIST_{ij}$ is measured as the great-circle distance in kilometres between the capital cities of country *i* and *j* and is expected to be negative. The capital cities are seen as the economic centres of each country. As distance is used to proxy for trade costs, such as transportation, information, and communication costs, this sign is expected to be negative especially at increasing distances. However, this may be a misspecification for trade costs. For example, to measure the great circle distance between the capital cities between countries, one must assume that the capital city is necessarily the economic capital of the country. In some countries, this can be difficult to assume. The main resistance factor is transportation costs between

[7] This provides a concise outline of the available literature for the gravity model. Considering the extensive literature for the gravity, this provides a clear picture of the literature for the gravity. This will only be completed for the gravity literature in Chapter 2.

two countries, including freight transportation costs, tariffs, and quality of infrastructure. Thus, a few studies use different proxies for trade costs. Nowak-Lehmann et al (2007) use transport costs to study the customs union between the EU and Turkey while Kepaptsoglou et al (2009) use transport costs to analyse the Euro-Mediterranean free trade area (EMFTA). Other authors noted the difficulty in using distance as a proxy for the abovementioned costs and have attempted to propose new methods to use instead of distance. For example, Nitsch (2000) proposed a method for calculating intra-country distances as a function of country size. Pelletiere and Reinert (2004), Fukao, Okubo, and Stern (2003), Wilson et al (2003), and Lee and Park (2007) used tariffs explicitly to measure trade costs instead of distance.

Other problems for using transportation costs or other border barriers are that prices must differ internationally, which contradicts early work on the gravity equation, which assumed identical prices across countries. As soon as researchers began to utilise the model in different ways based on theoretical assumptions, issues arose from the underlying assumptions of the gravity model clashing with the econometric methods used for applying the gravity model. For example, to use different prices or other border barriers, one must use country fixed effects to measure the border effect between countries. For example, Martinez-Zarzoso and Suarez-Burguet (2005) use transportation costs as a function of weight to volume ratio and distance to study the relationship between trade flows and transport cost. Another measure for impedance that is used often in the literature is remoteness. This includes the geographical position between countries as well as weighted GDP. Introduced by Deardorff (1998), remoteness is defined as the GDP weighted negative of distance between countries. Nitsch (2000), Iwanow et al (2007), and Feenstra et al (2001) utilised remoteness instead of distance and found some success. However, the difficulty in calculating transport costs and finding another method was highlighted in each analysis given the necessary data needed for each country, for each year of the panel. This would be especially difficult in a panel as large as the one used in this analysis. Therefore, this analysis uses the more widely used method to proxy trade costs by using kilometres between countries.

The last variable from the simplified gravity model is ADJ_{ij}. This is a dummy variable, representing whether the countries share a national border and is of great interest in this analysis. The literature has attempted to understand whether national borders still exist, and if they still project a border effect. For example, McCallum (1995) provided a case study of the impact of the Canada-U.S. border on regional trade patterns, to determine whether the border separating the U.S. and Canada exerts an impact on continental trade patterns. This study was particular important because Canada and the U.S. are similar on other cultural and political variables such as language, culture, and institutions. Therefore, it’s important to determine whether the border still exerts a considerable force in light of the signing of a new free trade agreement between Canada and the USA (1988). In this analysis, after conducting multiple sensitivity and specification tests, McCallum (1995) concludes that the U.S.-Canada border still exerts a decisive force on continental trade patterns and thus national borders still matter. Given the country of interest in this study is

Mexico, specifically studying the changes in trade flows and determinants over the last 50 years in which they signed multiple trade agreements, including NAFTA; it's an important topic of discussion. It can answer whether, after multiple decades of liberalisation, if national borders still inhibit trade.

Over the last fifty years, the gravity model has been employed in numerous studies. As noted in Table 2.2, there are three types of studies in the literature on the gravity equation; theoretical advancements, empirical studies explaining policy impacts on trade flows (such as trade potentials, trade impacts of RTAs, and border effects), or econometric specification advancements. Given the gravity model's ability to predict trade flows, the applications of the gravity model have been utilised for predicting trade within and outside the OECD, between Canada and the USA, within the European Union, within and outside the MERCOSUR, and within ASEAN countries. A growing number of applications are to evaluate the effect of a regional trade agreement, or trade area. In the last decade, over 55 papers were published applying the gravity model to policy evaluation. It is now considered one of the empirical workhorses of trade policy evaluation[8]. The purpose of using the gravity model to assess Mexico's trade flows is due to its ability to properly predict trade determinants between partners. As well, the model allows for cultural, historical, and political variables that can affect trade. This is especially important as crises and political instability may have affected Mexico's exports and imports and are of focus in this analysis.

2.4.3 Modelling Trade Agreements

As detailed above, the gravity model is an empirical workhorse for analysing the change in trade flows in countries. However, the literature does not come to a consensus when analysing the short and long-term impacts of the trade agreements. Given the introduction of the free trade agreements, trade unions, and integrated areas, it's important to analyse whether they impacted Mexico relative to the entire panel. The estimation includes important cultural, geographic, and historical factors that increase the probability of a country trading, as detailed in the literature. Specifically, by including these factors, it is possible to analyse whether signing regional agreements emphases a cultural, historical, or geographic bias. If a cultural, historical, or geographic link cannot be formulated or no longer impacts trade, is it possible that a trade agreement will still impact trade? It is important to note, out of the 25 countries in LAIA, only two members are represented on this panel, Chile and Brazil. Therefore, only two of the Latin American countries are of their top exporting markets. This is compared to the EUTA, where almost every EUTA member is represented in Mexico's top 20 trade markets and all NAFTA members are represented[9].

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[8] Anderson (2010) is one of the many experts in the gravity model that considers it the workhorse of trade policy evaluation. Others include Aitken (1973) Bergstrand (1985), Helpman (1987), McCallum (1995), Eaton and Kortum (2003), Feenstra (2004), and Bellos and Subasat (2013).

[9] Per suggestions by the literature, the author utilised other cultural variables to describe the determinants of trade between countries, other than language and religion. These include having a

$$lnX_{ij} = \alpha_0 + \alpha_t + \alpha_i + \alpha_j + \beta_1 LnY_i + \beta_2 LnY_j + \beta_3 N_i + \beta_4 N_j + \beta_5 LnDIST_{ij} + \beta_6 ADJ_{ij} + \beta_7 LANG_{ij} + \beta_{10} REL_{ij} + \beta_{11} STAB_{ij} + \gamma_1 NAFTA + \gamma_2 EUTA + \gamma_3 LAIA + \mu_{ij} \quad (3)$$

This chapter utilises Equation (2) for Mexico and the total panel's exports and imports. Both cultural variables are defined similarly. Language is equal to 1 if both countries share a common national language and 0 otherwise. Religion is defined similarly. These are to understand if sharing a language or religion has any effect on exports and imports over a long period of time. This is also to understand why these countries decided to sign the trade agreements. These agreements will be discussed below. All of the policy questions, such as the effect of certain trade agreements are represented in the above estimation as binary variables. 1 if both countries are in the agreement, 0 otherwise.

2.4.4 Economic Crises

Mexico was affected by multiple crises before and after trade liberalisation. Therefore, this analysis studies the 1982-1985 Mexican and Latin American debt crisis, 1994 Tequila Crisis, 1997 Asian financial crisis, and the 2007-2009 Global Recession. The effects of these crises were seen in the drop in growth throughout those years, as seen in Chart 2 for Mexico. The estimated equations include the variables Equation (2) with the addition of each independent variable interacted with the important years (1981, 1982, 1983, 1985, 1986, 1994, 1995, 1997, 2007, 2008, and 2009). Therefore, each year interacts with GDP for country *i*. The motivation for discussing the crises is detailed below.

Considering one of the main motivations for liberalising trade in the 1980s was to receive funding from the IMF, World Bank, and USA to recover from their debt crisis, it's important to understand how these crises affected their exports and imports before and after trade liberalization. Was the 1982 crisis so damaging that it detrimentally affected Mexico's trade? The origins of the 1982 crisis began in the late 1970s and 1981. The early 1980s recession affected the world with the US and Japan escaping early but it affected the rest of the world through 1985. The long-term effects of this recession contributed to the Latin American debt crisis. A sharp increase in oil crisis, coupled with rising interest rates in the US and Europe meant that Latin American countries, such as Mexico, continued to increase their debt by borrowing from foreign countries flush with oil revenues.

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similar political institution, being a colony, sharing a common colonizer, being an island, and or being a landlocked country. These were explored in further tests but did not show any additional explanatory power. The only variables that exhibited any explanatory powers were language and religion. Thus those two variables are utilised for the rest of the analysis.

Over time, debt grew and led to the eventual deterioration of their exchange rate with the US dollar. Due to this, it exacerbated their repayments in their own currency, and contributed to a loss of purchasing power. A further contraction of 1981 world trade caused prices for Mexican goods to fall. By the end of 1981, Mexico could no longer meet their debt payments and requested renegotiation. Due to this economic crisis, the effect was profound in Latin America and is described as one of the most severe debt crises to hit an economic region in history. Incomes dropped, growth stagnated, imports fell, and thus unemployment rose. However, for Mexico, a condition of their debt renegotiation and bailout meant partial opening. Thus, exports increased directly after their debt crisis. Other conditions for the eventual loans included trade liberalisation and reconstruction. Due to this debt crisis, the coefficient on 1983 and Mexico's GDP is expected to be positive. Given the conditions for the debt relief was to increase exports, the interaction of 1983 and GDP should contribute to an increase in Mexico's exports. In contrast, imports should show a decline in the 1980s, as Mexico was reducing their reliance on imports to improve their current account.

The other crises studied include the 1994 Tequila Crisis. In 1994, Mexico experienced a currency crisis sparked by Mexico's sudden devaluation of the peso against the U.S. dollar. At the beginning of the year, NAFTA entered into effect and Mexican businesses began to enjoy access to new foreign capital and outside investors were eager to lend money. Previously, Mexico's central bank maintained the Mexican Peso through an exchange rate peg to the US dollar. Their strategy included issuing short-term public debt instruments in U.S. dollars, and then using the new capital to purchase pesos in the foreign exchange market. This increased the value of the peso, leading to speculation that it was overvalued. A higher valued currency led to an increase in imports, and eventual capital flight out of Mexico.

In addition, political instability began to shift international risk perception of Mexico. The newly inaugurated President Zedillo announced in December 1994, that the Mexican central bank would devalue the Mexican Peso around 13-15%. To avoid large capital flight, the Mexican central bank also raised interest rates, which began to hinder economic growth prospects. Once Mexico attempted to rollover its maturing debt obligations, few investors purchased new issues of public debt. Instead, the central bank had to purchase dollars with its severely weakened pesos to repay the maturing debt obligations. Within a few days of devaluing the Mexican peso, the government allowed the currency to float, further depreciating the peso another 15%. Prices rose by 24% in Mexico and hyperinflation reached 52%. Mutual funds began to liquidate their assets in Mexico and other emerging markets. By the beginning of 1995, Mexico signed another bailout package from the IMF and Bank for International Settlements (BIS). The Mexican economy suffered a severe recession due to this crisis, and the peso declined in value, recovering by the end of 1995. GDP declined in 1995 by over 6.2%. Therefore, this analysis is interested in the interaction with 1994 and 1995, especially on GDP. Although NAFTA entered into effect in early 1994, it is possible that the immediate benefits of NAFTA meant that Mexican exports were not as affected by this crisis. However, imports would have been affected, initially because of the overvalued currency and then the depreciated currency. To capture the effects of the Tequila Crisis, 1994 and 1995 will be estimated specifically[10]. Finally, the effects of the 2007-2009 Global Recession are tested. The Global Recession of 2007-2009 affected many of the emerging and developed countries in this panel; it'd be important to see the actual effect on trade. Finally, these results are compared to the entire panel to determine if the effects necessarily affected Mexico more than the other countries in the panel.

2.4.5 Econometric Specification Issues

The literature has highlighted the problems with using OLS for analysing the gravity model. These issues include unobserved individual country heterogeneity, heteroscedasticity, and information bias due to zero trade flows. As such, further econometric specification must be discussed before estimating the gravity model. One of the benefits of using panel data is that it controls for individual heterogeneity, including unobserved time and country variables that may affect trade. This heterogeneity may vary by country pair and may be a country-specific variable that is distinctive for the country without omitting observations. Since the estimated equations include the multilateral resistance terms, such as exporters, importers, and time effects, this capture heterogeneity for each country that may affect trade.

Therefore, different methods are utilised in addition to the standard regression analysis. First, importer, exporter, and year fixed effects are utilised to capture unobserved heterogeneity. Second, the OLS uses robust standard errors to control for heteroscedasticity as well as a feasible generalised least squares method. Finally, in this analysis, a Heckman Sample Selection is utilised. It is well regarded in the literature that a Heckman Sample Selection, robust standard errors, and Heckman Sample Selection provide a robust check for the two major problems with the OLS estimation of the gravity model[11]. Lastly, a Poisson Pseudo-Maximum Likelihood estimator is estimated used to check the results robust standard errors controlling for heteroscedasticity. A summary and discussion of the available methods are below, justifying the reasons for this chapter using the estimation methods.

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[10] Previous literature on the 1982 and 1994 debt crises includes Beneria (1992), Teichmann (1989), and Smirlock and Kaufold (1987). The literature focuses on the financial aspect of the crises, with little or no attention to the effect on trade. This is just a brief overview of the Mexican debt crisis as provided by the authors below. For a more detailed revision of the 1982 Latin American debt crisis, see Jaime Ros "Mexico's Trade and Industrialization Experience since 1960: A Reconsideration of Past Policies and Assessment of Current Reforms." (1993). Other authors have written extensively on this subject including Judith Teichman (1988), Smith et al (1994), and Kehoe (1995), (2002), and (2010). However, Ros (1993) provides one of the most comprehensive analyses in the literature and is an important starting point to research on the debt crisis.

[11] Martinez-Zarzoso (1999) and (2003)

2.4.5.1 Estimation Methods

We need to account for the inherent heteroscedasticity and information bias in the model by utilizing a few different methods. There are a few options available in the literature with various advantages and disadvantages. To deal with the unobserved heterogeneity in the country pairs, the literature suggests using panel fixed effects due to its assumption that there is an unobserved heterogeneous component that is constant over time and varies by country or the two way shows that it varies over time and by country. Heteroscedasticity arises from taking logarithms. The standard procedure in estimating the gravity model is to take logarithms, and estimating by OLS. This can lead to inconsistent estimates due to the change of the error term, violating the homoscedasticity assumption for OLS. Thus, the first and most important problem in estimating the gravity model is dealing with the presence of heteroscedasticity. Santos, Silva, and Tenreyro (2006), suggest that OLS estimation would not be consistent and thus nonlinear methods, such as Poisson pseudo maximum likelihood, should be used. Data exhibiting heteroscedasticity would be a major violation of the homoscedasticity assumption for OLS.

While using trade data, heteroscedasticity is a consistent problem, as there exists a difference in the quality of the data being reported and thus used. While the data is collected and given to UN Comtrade, a repository of official international trade statistics, it relies on the individual countries to collect and report the data. This may lead to inconsistent reporting techniques by different countries, such as between a developing and developed country. Those countries within the European Union may differ in how they collect and report their trade data. It also explains why, for example, the UK may report a value of imports from the USA but this may not match what the USA reports as exports to the UK. There may be data collection errors from each country that leads to inconsistent data for the panel. Therefore, the error variances would not be constant for all country pairs.

Another source for the heteroscedasticity may be in the grouped data. For example, with each observation being the average of micro data, which combines data from throughout the country, such as the USA, the means computed from larger samples are more accurate and the disturbance variance for each observation is known up to a factor of proportionality. As well, in modelling the income or GDP of different countries, the disturbance for variance of high-income countries is usually larger than that of lower GDP countries. It is related to the measure of scale. Heteroscedasticity renders the standard errors unusable. If there is homoscedasticity conditional on the regressors, the conditional variance of the error process does not depend on the explanatory variables. The conditional mean of the squared disturbances should not be a function of the regressors and so a regression of the squared residuals on any country pairs should not have any meaningful explanatory power. The Anderson and van Wincoop (2003) model includes discussion of the multilateral resistance terms may matter for heteroscedasticity considerations. As GDP increases, remote countries will diversify their production and can become less open to trade. Furthermore, if they are located near to other countries, their trade flows can become more frequent. Therefore, this divergence in trade patterns can lead to a higher variance, which is thus associated with higher levels of income.

After conducting the Breusch-Pagan test for the heteroscedasticity, the null hypothesis of homoscedasticity is strongly rejected with a p-value of the chi^2 test of 0.0041 for Mexico[12]. Therefore, with the BP test, heteroscedasticity exists in the panel. It is important to note that heteroscedasticity does not result in parameter estimation error, but bias in the confidence intervals and test statistics. This results in the inability to trust the subsequent f-tests and therefore OLS is no longer BLUE, as there is a loss of efficiency. Another option in the literature for comparing the results from OLS is a Poisson Psuedo-Maximum Likelihood Estimator (PPML), as argued by Santos, Silva, and Tenreryo (2006). There is a discussion by other researchers, such as Martinez-Zarzoso et al (2007, 2011), there is a concern this may not be the best estimator. In order to fully estimate the model, the OLS results and the PPML results are compared to confirm the original results, or show the PPML was the preferred estimator. However, this model does not deal with zero trade flows; indeed, it drops zero trade flows and could lead to sample selection bias as well as loss of information.

A popular and well-utilised method in the literature is to use a two-step estimation method. The Heckman sample selection model uses a Probit equation to define whether two countries trade or not. In the second step, the expected values of the trade flows are estimated via OLS, conditional on that country trading. The advantages of this model are that no multi-collinearity problems exist and it provides a rationale for zero trade flows. Different sets of variables and coefficients are used to determine the probability of censoring and the value of the dependent variable[13]. Although it may be difficult to find an identification restriction and exclusion variables as required, the literature utilises a few different types of exclusion variables. The exclusion variable can be difficult to find because it should only affect the decision to trade, not necessarily the level of exports. Therefore, it should be related to a country's propensity to export but not with its current level of exports. For some countries, this may be difficult. However, the literature provides a few examples for the exclusion variable. For example, Helpman et al (2008) use common language and common religion variable; Sheptylo (2009) use governance indicators of regulatory quality, and Bouet et al. (2008) use the historical frequency of positive trade between two countries. Furthermore, Linders and de Groot (2006) determined that the same variables should be included for both equations. The model provides some positive correlation between both error terms to better reflect the real decision process. In this panel, there are a few countries that did not report all trade flows for all years, creating a bias in selection and information bias. OLS simply drops the zero trade flows and estimates based on the available observations. Therefore, this chapter utilises a Heckman sample selection, in addition to the other methods discussed above.

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[12] Table 2.16
[13] Bikker and de Vos (1992), Linders and de Groot (2006), and Martin and Pham (2008).

Variable:	Description:	Estimation:	Expected sign:
Country I/Mexico's GDP	Proxy for the economic size of the country. Represents consumption of the home country.	World Bank estimation of the GDP in 2005$, in natural log form.	Positive
Country J's GDP	Proxy for the economic size of the trading partner. Represents the demand level of the trading partner.	World Bank estimation of the GDP in 2005$, in natural log form.	Positive
Country I/Mexico's Population	Another proxy for economic size	Estimated utilising the natural log of population for each year.	Positive
Country J's Population	Another proxy for economic size	Utilises the natural log of the population for each year.	Positive
Distance	Utilised as a proxy for trade costs, such as transportation, information, and communication costs	Kilometres between the capital cities of country i and j, in natural log form.	Negative, especially at increasing distances
Adjacency	Major variable in a gravity model, adding to the overall discussion on whether borders are a geographic hindrance for trade (McCallum, 1995)	Dummy, 1= countries share a border, 0 otherwise	Negative, given McCallum (1995). However, this sign is expected to change over time.
Colony	Representing a historical or cultural affinity.	Dummy, 1= countries were both colonised, 0 otherwise	Positive
Common coloniser	Utilised as a proxy for historical links between countries. For example, the USA and India would represent a common coloniser link.	Dummy, 1= countries were colonised by the same colonising power, 0 otherwise	Positive

Political instability	Political Strife is defined as a country experiencing a coup, disputed elections, dictatorship, or protests resulting in death (Economist Intelligence Unit)	Dummy, 1= country experienced political strife, 0 otherwise	Negative
NAFTA	North American Free Trade Agreement (1994), between the USA, Mexico, and Canada.	Dummy, 1= both countries are in NAFTA, 0 otherwise	Positive
EUTA	European Union Trade Agreement (2000), between Mexico and multiple European countries	Dummy, 1= both countries are in EUTA, 0 otherwise	Negative, but there is a lack of literature on the effects of the EUTA, and thus this sign could be positive at certain points in time.
LAIA	Latin American Integrated Area (1982), between Mexico and multiple Latin American countries.	Dummy, 1= both countries are in LAIA, 0 otherwise	Negative, given the quantity of trade to NAFTA for Mexico, we expect this trade agreement to have a negative effect on their exports.
Religion	Capturing countries that share the same religion, representing cultural affinity between countries.	Dummy, 1= both countries share the same religion as a majority, 0 otherwise	Unsure, there is little literature on the effect of cultural affinity in developing countries.
Landlocked	Capturing the trade costs for a country without a water border, representing geographic hindrance for trade.	Dummy, 1= either country is a landlocked country, 0 otherwise	Negative
Language	Capturing the effect between countries that share the same language, representing cultural and historical	Dummy, 1= both countries share the same language, 0 otherwise	Positive, Spain is one of Mexico’s top trading partners, outside the

	affinity between countries.		USA and Canada.
Island	Capturing the effect of economic geography on trade between countries.	Dummy, 1= either country is an island, 0 otherwise	Negative, the only two islands in this panel are the UK and Japan. The trade between Mexico and these countries is not significantly large.

Table 2.3: Original Gravity Variables
Variables utilised in the gravity analysis, with the independent variable as exports or imports.

2.4.6 Summary

Table 2.3 details all of the individual variables utilised in this analysis with the type of variable, estimation, and expected sign for the variable. Considering the crises, those will be constructed as interaction variables of the individual years of interest and the variables above. Furthermore, this chapter utilises importer, exporter, and year effects to capture unobserved heterogeneity, a Heckman Sample Selection model for capturing the effect of zero trade flows, and a Poisson Psuedo-Maximum Likelihood Estimator (PPML) to account for inherent heteroscedasticity in the model. This follows on from the literature, however this analysis is distinctly different from the literature mentioned above. On the case of Mexico, there does not exist a single analysis that reviews the effects of the crises as well as the trade agreements over a long period of time. Once again, the only gravity model conducted in the literature is by Martinez-Zarzoso (2003), who did not utilise such a robust method to analyse the data, and also did not conduct the analysis over a longer period of time. Martinez-Zarzoso (2003) also projected the further effect of NAFTA, but did not reference the 1994 Tequila Crisis. This chapter analysis Mexico's trade flows over a longer period of time, utilises a more robust method. Other discussions in the literature about the debt crises include Teichman (1988), Ros (1993), Lustig (1990), and Kehoe (1995). However, these discussions do not attempt to address the differences in trade due to these changes in the economy. This chapter provides a long term discussion of the trade agreements and interacting effect of debt crises. Trade agreements, especially NAFTA, has been highlighted in the literature including work by Villarreal (2012) and Kehoe (1995, 2002, 2004, 2010, and 2011). This chapter also provides evidence on NAFTA, but includes the EUTA and LAIA. Again, as discussed above, this chapter differs distinctly from the literature, as it combines all three of the main topics surrounding the debit crisis, Mexico's trade, and trade agreements, to further understand the changes to the economy after a structural change in policy.

2.5 Results

2.5.1 Gravity

Table 2.4 details the various analyses related to the effects of the free trade agreements. Specifically, the trade creation effects of NAFTA, EUTA, and LAIA are of great importance. These three trade agreements represent trade between three separate continents and Mexico. It's important to confirm that the regional trade agreements created trade between the members. The North American Trade Agreement (NAFTA) is notoriously one of the most overall beneficial trade agreements in history. For the entire panel and Mexico, we expect a highly positive and significant result for NAFTA and EUTA. However, for LAIA, we expect it to be positive and significant in the 1980s, but declining after that.

Outcomes	(1) 1962-2011	(2) 1972-1981	(3) 1982-1991	(4) 1992-2001	(5) 2002-2011
Country j's GDP	1.035***	1.028***	0.972***	0.871***	0.845***
	(0.0459)	(0.058)	(0.068)	(0.0613)	(0.075)
Mexico's GDP	-0.0384	-1.567***	-0.514*		
	(0.0265)	(0.345)	(0.277)		
Country j's Population	0.033	0.223***	0.0492	-0.082	0.0457
	(0.0482)	(0.0774)	(0.0685)	(0.0649)	(0.0781)
Mexico's Population	0.539***		0.579***		
	(0.203)		(0.206)		
$Distance_{ij}$	-1.410***	-1.589***	-1.744***	-0.279	-0.845***
	(0.111)	(0.205)	(0.147)	(0.215)	(0.0802)
ADJ_{ij}	-0.629***	-1.085***	-0.929***	0.538**	-0.17
	(0.188)	(0.408)	(0.326)	(0.227)	(0.171)
Colony	-0.751***	-1.765***	1.828***	0.537**	0.0957
	(0.217)	(0.419)	(0.386)	(0.233)	(0.207)
Common Coloniser	2.099***	2.650***	0.405	1.333***	1.466***
	(0.17)	(0.316)	(0.37)	(0.203)	(0.182)
Political Instability	-0.631		0.176	0.102	0.620***
	(0.474)		(0.231)	(0.173)	(0.201)
NAFTA	0.424**			2.268***	1.597***
	(0.175)			(0.259)	(0.149)
LAIA	-0.576***	-0.45	0.193	0.745***	0.0703
	(0.144)	(0.773)	(0.249)	(0.163)	(0.138)
EUTA	-0.692***			-0.669***	-0.687***
	(0.128)			(0.128)	(0.147)
Constant	-7.606**	40.72***	11.04	0.0706	4.147***
	(3.739)	(9.391)	(8.384)	(2.448)	(1.221)
Observations	958	197	200	200	200
R-squared	0.885	0.847	0.825	0.882	0.886

Table 2.4: Mexico's Exports, 1962-2011, gravity results

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. Colony and common coloniser, represented as dummies in this analysis, are cultural and historical proxies for the trading partners. Political instability is defined as a country experiencing political strife, as defined in Chart (5). NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

These results are a very important addition to the literature. The gravity results for Mexico's exports, with multilateral resistance terms are in Table 2.4. There are almost 1000 observations for the pooled estimation, 1962-2011, and a high R^2 at 0.885. This confirms that the model explains a high amount of the variability of the response data around the mean. The three trade agreements provide interesting results. First, NAFTA is highly positive, but this effect decreases in the 2000s (Columns 4 and 5). LAIA, positive only in the 1990s, is again insignificant in the 2000s. This confirms the above results with regards to the cultural, political, and historical results for trade. Mexico's exports with countries share a border are only positive in the 1990s (Column 4). For the European Union Trade Agreement, as Mexico shares very few cultural links with Europe, other than being a former colony of Spain, the European Union Trade Agreement is negative for the years after signing the trade agreement. For LAIA, it is had an insignificant effect for exports and imports. NAFTA, on the other hand, is negative for imports, and highly positive for exports. Considering 81% of Mexico's exports go to NAFTA countries in 2011, and 52% of imports come from NAFTA, this is not that surprising. What is surprising is the decreasingly waning power of NAFTA, as Mexico begins to export differently to other countries, such as Asian countries.

However, it is important to note that previously, exports to the USA was higher and in 2004 88% of exports went to the USA but this has declined to 76% by 2010. A decline in exports to the USA from Mexico is also coupled with an increase in exports to Canada and China. This is important for showing the diversification of exports for Mexico, and reflects the diversification seen by multiple countries in the entire panel. For example, the highest share of exports to any market is 19%, showing that they trade to more countries in higher quantities to each country. The coefficient on NAFTA could show that there was an exploitation of the regional and economic benefits that were already in place.

The above analysis explains possible reasons for trade as well as signing a trade agreement. For the European Union trade agreement (EUTA), results are negative and significant. If the purpose of the European Union-Mexico trade agreement were to decrease tariffs and barriers to trade and thus increase exports and imports between the countries, it would be possible to find insignificant trade between them before the trade agreement was enacted. There are very few cultural similarities with the European Union, except for religion. Their colonising country was

Spain, and they share a language. Spain is their highest trade partner in Europe. NAFTA is incredibly high and significant at the same time, confirming the importance of distance and importing country's GDP.

Furthermore, the cultural factors for trade are a bit of a puzzle. For example, for Mexican exports, political instability was completely insignificant until the 2000s, a period with the least amount of observations for that variable (Column 5). Sharing a religion is insignificant in the 1960s-70s but highly positive by the end of the sample. Sharing a language is still positive for exports for the entire sample while LAIA is negative or insignificant. In addition, the EUTA is insignificant or negative for the decade it has been in force. As discussed in the literature, there are different reason or signing a free trade agreement, either geography or cultural/historical links. Given distance is negative for the beginning of the sample, Mexico could have decided to enhance trade with countries that are closest, enforcing their pre-determined trade links, hence signing NAFTA. As well, the religious and language links promotes the trade between Mexico and Europe, although this is not borne through their enacted trade agreement, EUTA.

LAIA provides dubious benefits to Mexican exports and diverts exports and imports out of the integrated area. Considering 76% of Mexican exports go to NAFTA (2010), this may not be completely surprising. LAIA should be changed to further improve the exports and imports benefits to Mexico and the other LAIA countries. Within the panel, the LAIA does not provide benefits to the two observed countries in the integrated area. Once again, this is the first analysis to include three trade agreements in the policy discussion. By including the EUTA, LAIA, and NAFTA it is possible to get a clearer picture of the trade changes before and after trade liberalisation. When some researchers just focus on NAFTA, for example, this may not show the complete changes of the trade over time, and can omit other circumstances that could influence their trade determinants. Considering the major reason for entering in to a trade agreement with the US and Canada can be due to proximity, it is obvious that LAIA, which was possibly signed on cultural links (such as language and religion), has not had the effect long term. Therefore, based on the new trade patterns, cultural affinity does not translate to long-term trade links for Mexico.

Variables	(1) 1962-2011	(2) 1972-1981	(3) 1982-1991	(4) 1992-2001	(5) 2002-2011
Country j's GDP	1.674***	1.637***	1.488***	1.261***	1.395***
	(0.0616)	(0.104)	(0.132)	(0.0669)	(0.113)
Mexico's GDP	0.145***	1.434***	-0.724		
	(0.0255)	(0.547)	(0.787)		
Country j's population	-0.814***	-0.458***	-0.759***	-0.613***	-0.623***
	(0.065)	(0.0927)	(0.184)	(0.0581)	(0.0927)
Mexico's population	-0.469		-0.184		
	(0.432)		(0.449)		
$Distance_{ij}$	-0.158	-0.555**	-0.406	0.36	0.522***
	(0.142)	(0.233)	(0.275)	(0.218)	(0.162)
ADJ_{ij}	1.339***	-0.0642	1.950***	2.635***	2.155***
	(0.246)	(0.539)	(0.507)	(0.268)	(0.269)
Colony	-0.352	-1.395***	1.617***	0.643**	-0.181
	(0.227)	(0.46)	(0.462)	(0.271)	(0.315)
Common Coloniser	0.998***	1.750***	-0.831**	0.256	0.695**
	(0.208)	(0.377)	(0.401)	(0.238)	(0.294)
Political Instability	0.243		-1.638***	0.366***	-0.0646
	(0.532)		(0.547)	(0.134)	(0.262)
NAFTA	-0.909***			-0.0366	0.0128
	(0.209)			(0.302)	(0.311)
LAIA	0.167	0.968*	1.671***	0.762***	0.807***
	(0.202)	(0.575)	(0.351)	(0.222)	(0.292)
EUTA	-1.296***			-0.917***	-1.124***
	(0.153)			(0.169)	(0.221)
Constant	-7.912	-51.02***	21.1	-6.336***	10.39***
	(7.701)	(15.18)	(22.5)	(2.264)	(1.577)
Observations	958	196	200	200	200
R-squared	0.86	0.814	0.72	0.87	0.806

Table 2.5: Mexico's Imports, 1962-2011, gravity results

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. Colony and common coloniser, represented as dummies in this analysis, are cultural and historical proxies for the trading partners. Political instability is defined as a country experiencing political strife, as defined in Chart (5). NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

Another aspect of this chapter is to analyse the effect of these policies on their imports. In Table 2.5, the periods detailed in Column (2) and (4) show a huge difference in the determinants of their imports. Again, the model explains a large amount of the variability of the response data around its main. First, sharing a border, in Column (2) is insignificant, but by the 1990s this is highly positive. Being colonised in the past is also negative in the 1970s, switching to positive in the 1990s. Furthermore, the EUTA is negative and significant, while the LAIA is positive for the entire period. NAFTA, on the other hand, is insignificant for imports after being enacted. This could show that previous imports from the NAFTA area were already significant, that signing the trade agreement did not necessarily increase their overall imports. Indeed, for the entire pooled time period, NAFTA is negative and significant. In the 2000s, their imports came from the USA, China, South Korea, Japan, and Germany. In fact, the share of the total imports declines for the USA from 67.7% in 2001 to 49.8% in 2011. On the other hand, China's share grows from 2.4% in 2001 to 14.9% in 2001. Similar results show for Japan, South Korea, and Germany. In 2001, Canada's share was 2.5%, by 2011 this was still around 2.7%.

Variables	(1) 1962-2011	(2) 1962-1971	(3) 1972-1981	(4) 1982-1991	(5) 1992-2001	(6) 2002-2011
Country i's GDP	0.188***	0.0301***	-0.302	-0.199**	0.242***	0.331***
	(0.0495)	(0.0102)	(0.293)	(0.0881)	(0.0777)	(0.0626)
Country j's GDP	0.807***	2.419**	0.595*	0.132	0.765***	0.163***
	(0.0466)	(1.073)	(0.359)	(0.0887)	(0.0979)	(0.0548)
Country i's population	2.230***	3.804	4.080***	0.262**	0.03	1.199*
	(0.207)	(2.321)	(1.411)	(0.115)	(0.156)	(0.719)
Country j's population	0.871***	-0.231	2.675	0.173	0.968***	0.0943
	(0.149)	(2.439)	(1.877)	(0.137)	(0.356)	(0.07)
$Distance_{ij}$	-0.747***	-0.326***	-0.639***	0.756***	0.866***	-0.815***
	(0.0205)	(0.0674)	(0.0483)	(0.0317)	(0.0238)	(0.032)
ADJ_{ij}	0.207***	0.691***	0.208**	0.103*	0.169**	0.213***
	(0.0415)	(0.140)	(0.092)	(0.0582)	(0.0564)	(0.0543)
Common Coloniser			0.567***	0.540***	0.433***	0.190***
			(0.119)	(0.0746)	(0.0488)	(0.0402)
Political Instability			-0.0689	0.239***	0.0699**	0.0124
			(0.122)	(0.0536)	(0.0305)	(0.0239)
Religion	0.810***	2.274***	1.114***	0.490***	0.143***	0.161***
	(0.0562)	(0.201)	(0.18)	(0.0916)	(0.0484)	(0.0472)
Language	0.477***	0.500***	0.0135	-0.0608	0.107*	0.339***
	(0.0434)	(0.145)	(0.12)	(0.0831)	(0.0579)	(0.053)
Landlocked			20.75***	1.385**	2.769***	1.287***
			(7.112)	(0.627)	(0.269)	(0.395)
Island			6.652**	2.190***	4.814***	-0.505
			(2.62)	(0.399)	(0.657)	(2.367)
NAFTA	0.431***				0.863***	1.073***
	(0.0747)				(0.0975)	(0.0959)
LAIA	0.158*		0.608**	0.319*	0.284**	0.233**
	(0.0869)		(0.288)	(0.165)	(0.115)	(0.103)
EUTA	-0.202***				-0.0227	0.429***
	(0.0442)				(0.0564)	(0.0603)
Constant	-62.63***	-95.13*	-124.2***	18.10***	-16.68***	-9.31
	(4.907)	(52.29)	(44.47)	(4.27)	(6.286)	(11.2)
MRTs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,219	2,588	3,954	4,108	4,173	4,180
R-squared	0.779	0.716	0.702	0.841	0.904	0.923

Table 2.6: Total Panel Exports

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities), adjacency (dummy, 1= sharing a border, 0 otherwise), landlocked (dummy), and island (dummy) represent geographic hindrances for trade. Colony, common coloniser, religion, and (sharing a) language represented as dummies in this analysis, are cultural and historical proxies for the trading partners. Political instability is defined as a country experiencing political strife, as defined in Chart (5). NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners. MRTs are the multilateral resistance terms, as discussed in Anderson and van Wincoop, which captures unobserved heterogeneity between countries. These include year, importer, and exporter dummies.

It's important to understand Mexico's results in comparison to the rest of the panel. Table 2.6 includes the total panel's export results. While the panel model has a large number of observations at 19,219, it has a lower pooled R^2 at 0.779. However, this is still a very high result for the model, and confirms the literature for how well-suited this model is to the data. For the panel, NAFTA is positive and significant in both the 1990s and 2000s. Unlike Mexico's results, this effect has increased in the 2000s. The LAIA also stays positive for the entire panel, while the EUTA is also positive and significant in the 2000s. Distance is positive and significant in the 1980s and 1990s, yet is negative and significant in the 2000s. Finally, sharing a border is also positive and significant for the entire period. Other cultural variables such as sharing a religion and language are positive and mostly significant. However, other geographic variables such as being an island country are also highly positive. Sharing a colonising power is also highly positive and significant, pointing to similar cultural and historical links. This does confirm that for the wider trading community, these links are still important determinants for trade, even if cultural links are not significant for Mexico. Multi-lateral resistance terms were utilised in this analysis, including importer, exporter, and year effects. The R-squared are very high for the panel, increasing in the later decades, as there are more observations. Other variables such as GDP and population are as expected from the literature. A similar result is shown in Table 2.7, which represent imports for the total panel. A country's GDP and population are highly positive and significant for imports, which distance is negative. Sharing a border is significant in the 2000s, as is NAFTA and EUTA, in Column (6). Again, reviewing the total panel results show that cultural, historical, and geographic links are still important for trading. Combining the results from the trade agreements, countries that have any of the above historical, geographic, or cultural links, still trade and can improve or increase this by signing trade agreements based on these links. The R^2 increase for each estimation for each decade, with the highest fit for the last decade in the database. In the robustness checks, an analysis is done to determine whether the MRTs increase the R^2.

Variables	(1) 1962- 2011	(2) 1962- 1971	(3) 1972- 1981	(4) 1982- 1991	(5) 1992- 2001	(6) 2002- 2011
Country i's GDP	0.172***	0.0461***	0.452*	0.0873	0.430***	0.506***
	(0.0398)	(0.0105)	(0.250)	(0.0941)	(0.0825)	(0.0614)
Country j's GDP	1.009***	2.399***	-0.178	0.371***	0.423***	0.124***
	(0.0485)	(0.919)	(0.248)	(0.0778)	(0.0847)	(0.0475)
Country i's	2.444***	4.747*	1.647	0.18	-0.0116	1.942***
population	(0.212)	(2.444)	(1.512)	(0.15)	(0.123)	(0.688)
Country j's	1.228***	-3.425	7.022***	0.181	1.435	0.0159
population	(0.199)	(2.324)	(1.672)	(0.144)	(0.91)	(0.0468)
$Distance_{ij}$	-0.755***	-0.429***	-0.664***	-0.831***	-0.849***	-0.882***
	(0.0214)	(0.0674)	(0.0466)	(0.0375)	(0.0236)	(0.0294)
ADJ_{ij}	0.0418	0.194	-0.175*	-0.0281	0.0679	0.221***
	(0.0423)	(0.139)	(0.0907)	(0.0619)	(0.0562)	(0.0627)
Common Coloniser	0.243***			0.540***	0.433***	0.190***
	(0.0677)			(0.0746)	(0.0488)	(0.0402)
Political Instability	-0.0317			0.239***	0.0699**	0.0124
	(0.0346)			(0.0536)	(0.0305)	(0.0239)
Religion	0.709***	2.296***	1.019***	0.184	0.00818	0.0959**
	(0.061)	(0.186)	(0.184)	(0.148)	(0.0524)	(0.0458)
Language	0.263***	0.796***	0.584***	-0.148	0.0353	0.276***
	(0.0648)	(0.133)	(0.0997)	(0.1)	(0.0607)	(0.057)
Landlocked	11.73***			0.582	-2.454***	-0.910**
	(1.035)			(0.815)	(0.516)	(0.389)
Island	3.999***			1.716***	-0.944***	-5.100**
	(0.345)			(0.497)	(0.131)	(2.29)
NAFTA	0.566***			0.553***	0.737***	0.442***
	(0.0793)			(0.103)	(0.124)	(0.14)
LAIA	0.113		0.793	-0.0877	0.252**	-0.0344
	(0.0945)		(0.721)	(0.176)	(0.106)	(0.0922)
EUTA	-0.237***				-0.075	0.166***
	(0.0463)				(0.0601)	(0.0569)
Constant	-76.41***	-71.81	-155.3***	5.337	-16.48	-20.81*
	(5.352)	(77.99)	(39.48)	(4.434)	(14)	(10.85)
MRTs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,274	2,611	3,599	4,132	4,175	4,180
R-squared	0.787	0.733	0.723	0.854	0.903	0.913

Table 2.7: Total Panel Imports

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities), adjacency (dummy, 1= sharing a border, 0 otherwise), landlocked (dummy), and island (dummy) represent geographic hindrances for trade. Colony, common coloniser, religion, and (sharing a) language represented as dummies in this analysis, are cultural and historical proxies for the trading partners. Political instability is defined as a country experiencing political strife, as defined in Chart (5). NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners. MRTs are the multilateral resistance terms, as discussed in Anderson and van Wincoop, which captures unobserved heterogeneity between countries. These include year, importer, and exporter dummies.

2.5.2 Economic Crises and Business Effects

The results from interacting crisis years with variables are in Tables 2.8 and 2.9 for Mexico's exports and imports, and Tables 2.10 and 2.11 for total panel exports and imports. The variables of interest are the interaction variables for crisis years. Mexico's GDP in 1981 is negative for exports and positive for imports. However, in 1994, the beginning of the Tequila crisis, it is negative for exports and positive for imports, again.

Variables	(1) 1982	(2) 1985	(3) 1994
Country j's GDP	-0.0264	0.403**	0.124
	(0.212)	(0.203)	(0.128)
Mexico's GDP	0.411	-0.23	-0.331**
	(0.351)	(0.188)	(0.165)
Country j's population	-0.205	-0.425*	-0.269***
	(0.274)	(0.217)	(0.0781)
$Distance_{ij}$	-0.391	0.734**	1.314***
	(0.787)	(0.324)	(0.42)
ADJ_{ij}	-0.963	-1.524*	0.719
	(1.443)	(0.789)	(0.546)
Country j's exchange rate	0.0011	-0.00102**	0.000770***
	(0.00109)	(0.000382)	(0.000132)
NAFTA			2.172***
			(0.397)
LAIA	1.667***	1.661***	1.490***
	(0.557)	(0.313)	(0.273)
Observations	958	958	958
R-squared	0.898	0.882	0.934

Table 2.8: Mexico's Exports, Crisis Years

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. Exchange rate is the exchange rate of the trading partner (Penn World Tables, per year). NAFTA and LAIA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners. All of the R-squared estimations are very high, consistent with the literature.

For Mexico, the change in exchange rate had a minimal effect on imports and exports in the crisis years. This is profound; three of the crises resulted or originated in a large devaluation in currency. It would be expected that would affect imports, as it would be more expensive to import. In 1982, 1994, and 1997, the exchange rate for the partner country does not have any effect, or is marginally negative. The LAIA is largely positive for exports and imports over the crises, as is NAFTA. For imports, NAFTA and 1995 shows a positive coefficient. On the other hand, the positive coefficient for NAFTA during these crises for exports decreases in effect in 2007, the beginning of the Global Recession. The European Union Trade Agreement is completely insignificant for all of the crisis years it was in effect (the Global Recession).

In comparison to the Total panel, Column (1) of Table (7) shows how the 1982 Mexican debt crisis did not affect world exports. However, comparing Mexico's results with the entire panel (representing over 70% of world trade), the effects of these crises were not nearly as significant than for Mexico. On the other hand, the interaction between 2008 and the exporters GDP had a negative effect on exports, as to be expected. However, for the entire panel, the other financial crises, such as the 1994 Tequila crisis did not have any negative or positive effect on exports. The majority of the interactions are insignificant, and determines that this did not affect exports. The R-squared for this model is high, confirming the high R-squares seen in the literature.

Variables	(1) 2007	(2) 2008	(3) 2009
Country j's GDP	-0.218	-0.254**	-0.192
	(0.133)	(0.107)	(0.171)
Mexico's GDP	0.0297	0.0274	-0.065
	(0.123)	(0.117)	(0.14)
Country j's population	0.105	0.160	-0.0243
	(0.112)	(0.0938)	(0.117)
$Distance_{ij}$	0.418*	0.391**	0.767***
	(0.247)	(0.177)	(0.254)
ADJ_{ij}	0.0875	0.0458	0.466
	(0.513)	(0.418)	(0.547)
NAFTA	1.021***	1.041***	1.300***
	(0.336)	(0.28)	(0.41)
EUTA	-0.0639	0.222	0.0655
	(0.4)	(0.364)	(0.457)
LAIA	0.389*	0.641***	0.924***
	(0.219)	(0.225)	(0.188)
Observations	958	958	958
R-squared	0.898	0.882	0.934

Table 2.9: Total Panel Exports, Crisis Years

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

Variables	(1) 1982	(2) 1985	(3) 1994
Country I's GDP	0.11	0.0758	0.102*
	(0.0717)	(0.0678)	(0.0572)
Country j's GDP	-0.0519	-0.0878	-0.0532
	(0.0541)	(0.057)	(0.0359)
Country I's population	-0.111	-0.00216	0.0335
	(0.106)	(0.0942)	(0.0314)
Country j's population	0.156***	0.234***	0.0891**
	(0.0583)	(0.0615)	(0.0396)
$Distance_{ij}$	0.00564	0.0105	-0.0614
	(0.0927)	(0.0848)	(0.0505)
ADJ_{ij}	-0.168	-0.0734	0.206
	(0.22)	(0.241)	(0.198)
NAFTA			0.0194
			(0.296)
LAIA	-0.265	-0.273	-0.107
	(0.615)	(0.456)	(0.471)
Observations	19,219	19,219	19,219
R-squared	0.783	0.783	0.783

Table 2.10: Total Panel Exports, Crisis Years

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. NAFTA and LAIA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

Variables	(1) 2007	(2) 2008	(3) 2009
Country I's GDP	-0.223***	-0.251***	-0.269***
	(0.0497)	(0.0455)	(0.0505)
Country j's GDP	-0.180***	-0.208***	-0.350***
	(0.0408)	(0.0402)	(0.0527)
Country I's population	0.262***	0.319***	0.393***
	(0.0401)	(0.045)	(0.0585)
Country j's population	0.274***	0.300***	0.448***
	(0.0419)	(0.0408)	(0.0501)
$Distance_{ij}$	0.0211	0.0172	-0.0938
	(0.0653)	(0.0638)	(0.0707)
ADJ_{ij}	0.217	0.284*	0.199
	(0.18)	(0.16)	(0.179)
NAFTA	0.307	0.21	0.282
	(0.319)	(0.309)	(0.355)
EUTA	0.659***	0.661***	0.684***
	(0.144)	(0.138)	(0.145)
LAIA	0.317	0.367	0.246
	(0.319)	(0.251)	(0.355)
Observations	19,219	19,219	19,219
R-squared	0.783	0.783	0.783

Table 2.11: Total Panel Exports, Crisis years
GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

2.5.3 Robustness checks

The major concerns for the gravity model include zero trade flows, heteroscedasticity, and misspecification of some of the variables. Another aspect is the use of multi-lateral resistance terms. First, Table 2.12 shows Mexico's results without the Multi-Lateral Resistance terms (importer, exporter, and year effects). The R-squared is lower than in Table 2.4, and some of the variables turn to expected results, such as GDP and distance. Previously, sharing a border was positive in the 1990s, but in the model without MRTs, this is now insignificant. By capturing for any business, source, and destination effects it can clearly change the results, as seen in Anderson and van Wincoop (2003).

Variables	(1) 1962- 2011	(2) 1962- 1971	(3) 1972- 1981	(4) 1982- 1991	(5) 1992- 2001	(6) 2002- 2011
Mexico's GDP	-0.118	-0.0472	-2.271***	-0.256	-0.371	0.752
	(0.0846)	(0.0472)	(0.375)	(0.187)	(0.367)	(0.617)
Country j's GDP	0.747***	0.989***	0.763***	0.914***	0.521***	0.506***
	(0.0343)	(0.131)	(0.0509)	(0.0501)	(0.0541)	(0.0539)
Mexico's population	4.730***	-0.441	11.48***	0.412*	7.303***	4.763
	(0.366)	(1.352)	(0.982)	(0.216)	(1.596)	(3.181)
Country j's population	0.167***	-0.242	0.202***	0.0457	0.193***	0.317***
	(0.0401)	(0.239)	(0.0699)	(0.0681)	(0.0636)	(0.0677)
$Distance_{ij}$	-2.121***	-2.009***	-2.479***	-1.962***	-1.887***	-2.008***
	(0.0973)	(0.322)	(0.232)	(0.157)	(0.162)	(0.134)
ADJ_{ij}	-1.003***	-0.891	-2.061	-1.312***	0.417	-0.115
	(0.23)	(0.747)	(0.529)	(0.35)	(0.335)	(0.303)
Constant	-67.92***	21.11	-129.9***	11.08*	-105.1***	-89.56**
	(4.649)	(23.26)	(18.54)	(6.401)	(24.13)	(44.69)
Observations	958	161	197	200	200	200
R-squared	0.81	0.66	0.783	0.759	0.774	0.806

Table 2.12: Mexico's Exports, without Multi-Lateral Resistance Terms
GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. These

results are without the multilateral resistance terms, representing unobserved heterogeneity between trading partners.

In the literature, it is now standard to include different specifications for GDP, population, and distance. For example, when analysing exports, the import countries GDP represents that country's demand and preferences and the export country GDP represents productivity. The literature also uses GDP per capita to represent income and productivity. This originates from the theoretical basis for the gravity model. Therefore, Table 2.13 shows exports when replacing GDP and population for both countries with GDP per capita. As well, a dummy will be used to show the banded distances in kilometres, as utilised in Eaton and Kortum (2002). The bands are detailed below.

- DIST1:0-375
- DIST2: 376-750
- DIST3: 751-1500
- DIST4: 1501-3000
- DIST5: 3001-6000
- DIST6: 6001-9000
- DIST7: 9001-maximum

As well, it can confirm other results in the literature that distance can be positive at some levels, and then increasingly negative. Eaton and Kortum (2002) used boundaries for distance to detail the increasing negative impact of distance on trade. DIST1-3 was dropped due to collinearity. Table 2.12 details the changes utilised. All of the previous results are confirmed with very little differences. The distance bands show the highly negative effect of distance on exports. Furthermore, utilising GDP per capita exhibits a similar result than utilising GDP and population separately. Therefore, our analysis can continue to utilise GDP and population as individual variables, as more commonly utilised in the literature.

Variables	(1) 1962-2011	(2) 1962-1971	(3) 1972-1981	(4) 1982-1991	(5) 1992-2001	(6) 2002-2011
Mexico's GDP per capita	-0.0556	-0.0436	-4.343***	-0.628**		
	(0.0417)	(0.0382)	(0.472)	(0.27)		
Country j's GDP per capita	-0.0545	0.369*	-0.151	-0.108	-0.334***	-0.412***
	(0.0696)	(0.191)	(0.181)	(0.141)	(0.0823)	(0.108)
DIST4	-2.397***	-0.375	-1.141***	-3.316***	-3.912***	-3.909***
	(0.201)	(0.419)	(0.392)	(0.4)	(0.278)	(0.215)
DIST6	-1.565***	0.0577	-0.300*	-1.898***	-2.728***	-2.860***
	(0.133)	(0.212)	(0.162)	(0.2)	(0.143)	(0.158)
DIST7	-1.430***	0.225	-1.003**	-1.068***	-2.377***	-2.746***
	(0.175)	(0.349)	(0.434)	(0.25)	(0.212)	(0.174)
DIST8	-3.704***	-3.247***	-3.639***	-4.254***	-4.669***	-4.445***
	(0.266)	(0.746)	(0.7)	(0.489)	(0.255)	(0.318)
ADJ_{ij}	5.705***	4.646***	5.076***	6.162***	6.830***	6.579***
	(0.186)	(0.446)	(0.404)	(0.431)	(0.295)	(0.251)
Constant	18.10***	12.96***	56.38***	26.43***	25.75***	28.56**
	(0.691)	(1.69)	(3.709	(2.496)	(0.868)	(1.173)
Observations	958	161	197	200	200	200
R-squared	0.759	0.647	0.62	0.614	0.727	0.672

Table 2.13: Mexico's Exports, using distance bands and GDP per capita
GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities, represented with bands as described above) and adjacency (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade.

A Heckman Sample Selection method addresses the zero trade flows in the data. As noted in Sections 2.3 and 2.4, there are zero trade flows that could impact these results. In Table (11), comparing Mexico's results between the Heckman and OLS method, there is very little difference. By utilising the zero flows to impute the selection equation, the Heckman method has 981 observations compared to 958 for OLS. In both methods, NAFTA exports and imports are highly significant and language is also highly significant as expected. Sharing a religion and border increases the probability of trade, and in the trade equation, increases trade. It is possible this captures the high exports to the USA, of which Mexico shares a border and religion. Mexico and the USA do not, however, share a language. As expected the importing country's GDP is high and significant. This confirms that the demand and productivity of the importing country has a positive effect on Mexico's exports. Mexico's GDP, however, is insignificant and negative, confirming previous results.

	(1)
Variables	1962-2011
Mexico's GDP	-0.0444 (0.0711)
Country j's GDP	1.060*** (0.0358)
Mexico's Population	0.565 (0.356)
Country j's population	0.0111 (0.0357)
Distance	-1.430*** (0.118)
Adjacency	-0.671*** (0.233)
Colony	-0.752*** (0.226)
EUTA	-0.647*** (0.115)
LAIA	-0.525*** (0.158)
NAFTA	0.457** (0.198)
Constant	-3.236 (8.413)
Inverse Mills Ratio, Lambda	0.457 (0.339)
Observations	981

Table 2.14: Mexico's exports, Heckman

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities), adjacency (dummy, 1= sharing a border, 0 otherwise), landlocked (dummy), and island (dummy) represent geographic hindrances for trade. Colony, represented as dummies in this analysis, is a cultural and historical proxy for the trading partners. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners. Lambda is the estimated coefficient of the inverse mills ratio, and the standard error is in parentheses below.

Variables	(1) Poisson	(2) OLS
Mexico’s GDP	1.216	0.145***
	(0.788)	(0.0255)
Country J’s GDP	1.200***	1.674***
	(0.0628)	(0.0616)
Mexico’s Population	-1.706	-0.469
	(4.871)	(0.432)
Country J’s Population	-0.144***	-0.814***
	(0.0491)	(0.065)
Distance	-1.060***	-0.158
	(0.154)	(0.142)
Border	0.850***	1.339***
	(0.330)	(0.246)
NAFTA	1.194***	-0.909***
	(0.0904)	(0.209)
EUTA	0.0744	-1.296***
	(0.0848)	(0.153)
LAIA	1.293***	0.167
	(0.215)	(0.202)
Constant	-4.937	-7.912
	(82.09)	(7.701)
MRTs	Yes	Yes
Observations	981	958
R-squared	0.998	0.86

Table 2.15: Mexico’s exports 1962-2011, Poisson Psuedo-Maximum Likelihood Estimator
GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities), border (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners. MRTs are the multilateral resistance terms, as discussed in Anderson and van Wincoop, which captures unobserved heterogeneity between countries. These include year, importer, and exporter dummies.

As in Table 2.15, Poisson Psuedo-Maximum Likelihood estimators are included, with multi-lateral resistance terms, compared to ordinary OLS estimates. In Column (1), the Poisson estimators have a higher R-squared and include more observations. The estimates are relatively close, with notable differences in the trade agreements. Given the original results in Column (2) show that NAFTA is negative and significant; the Poisson results confirm other literature on the effects of NAFTA on Mexico’s exports. Other than the trade agreements, distance between two countries is still negative, but significant and Mexico’s GDP is still positive, yet insignificant. While the Poisson results have a high R-squared, the OLS results are still very robust when compared to the Poisson estimator. To confirm the model is specified correctly, RESET tests were conducted for the fully augmented model with MRTs, cultural, political, and historical proxies, as well as the trade agreements. As seen in Table 2.16, the null hypothesis of no omitted variables cannot be rejected, thus the model is specified correctly. Furthermore, there is no multi-collinearity of the results for Mexico.

Model	Collinearity	Homoscedasticity	RESET test for omitted variables
Mexico: Exports with multilateral resistance terms and trade agerements	Reject null hypothesis for collinearity for exports. Mean VIF: 1.46	Reject null hypothesis for homoscedasticity for exports. Prob>chi2= 0.0041	Cannot reject null hypothesis of no omitted variables for exports. Prob>F = 0.1570

Table 2.16: Robustness Checks for Collinearity, Homoscedasticity, and Omitted Variables
All RESET and homoscedasticity checks were conducted at a significance level of 0.05. For the collinearity checks, a VIF of over 10 would induce the researcher to accept there is multi-collinearity.

2.6 Summary and Conclusions

This chapter used a well-regarded and robust gravity model to reflect on the policy and cultural questions for Mexico over the last fifty years by using a panel of 20 countries. By applying well-used variables as suggested in the literature, it was possible to scrutinise the policy implications of trade agreements and crises. The analysis was completed for a diverse panel, including multiple developing and developed countries over 50 years. The cultural, historical, and political factors create the reasons for trade and trade agreements, as highlighted by the above results and the Heckman Sample Selection results, as highlighted by Lee and Park (2007) and Martinez-Zarzoso (1999). This analysis also exploited country effects, as suggested by Matyas (1997), and multi-lateral resistance terms, which was suggested by Anderson and van Wincoop (2003). The results confirm the necessity of using those terms for the robustness of the model. Finally, this analysis also used a Poisson Pseudo-Maximum Likelihood method, as suggested by Santos, Silva, and Tenreyro (2006), to confirm the original results. After the analysis, it’s important to highlight the most interesting implications. While language, religion, and colony are positive, it provides evidence for a cultural discrimination with regards to trade and while the geographic coefficients reflect the continued barrier to exports, with regards to distance. Therefore, the coefficients on NAFTA, EUTA, and LAIA are especially interesting. NAFTA clearly reflects a propensity to trade with those closest to Mexico and countries with a higher GDP. The negative coefficient on EUTA and distance for exports reflect the increasing cost to export at a larger distance, even with a trade agreement to reduce those costs. The EUTA has not increased exports over the last ten years and the effect of LAIA has declined over the last thirty years. There are clear policy implications.

First, it is apparent that the EUTA has not increased trade, and could reflect the cultural dissimilarities. However, Mexico does have cultural similarities with Brazil, Chile, and Costa Rica, LAIA countries. This is not reflected in exports and imports to LAIA in recent years. The only positive and highly significant coefficient for trade agreements is for NAFTA, and reflects geographic similarities. It is an interesting implication that cultural and geographic similarities, borne through LAIA, adjacency, and NAFTA resulted in a highly significant and positive coefficient in the 1990s for all three variables. Then in the 2000s, this effect already waned, and country *j*'s GDP remains positive but adjacency, distance, and other geographic variables do not have as much of a higher impact. These results show that Mexico's trading preferences are changing over time, and are reflected in the decrease in NAFTA's coefficient for exports and imports and the positive distance coefficients for imports. The obvious implication is that the competition from Asia for exports and imports are borne through in the results in the 2000s. Therefore, Mexico needs to continue to exploit the geographic and cultural similarities as seen in the 1990s.

This contributes to the overall research question, by providing the evidence necessary to understand the changes in the Mexican economy, in light of the trade changes. It also provides confirmation of the importance of economic geography in Mexico's trade flows. The contribution to the literature comes in two strengths of the chapter. First, the econometric application employs multiple specifications for the gravity method, and analyses 50 years of trade, for 21 trade partners with up to 21,000 observations. There are very few papers in the literature that are as thorough as this chapter. Second, this chapter utilised a gravity model to also analyse the crisis years, which has not been seen in the literature, for any country. The depth of the analysis is a great importance for research in the change in trade agreements, as it is important to capture all aspects of a changing economy, due to trade.

While this chapter is an important addition to the literature about changing trade patterns in light of crises and trade agreements, it does not answer whether the change in trade patterns adversely affected the welfare of Mexico. Have the trade liberalisation policies implemented after the economic crises in the 1980s adversely or positively impacted Mexico's income and living standards? There is an importance of trade within the Mexican economy, and this aspect must be explored in relation to their income. This analysis, however, provides an important addition to the literature and can be considered a starting point in analysing welfare implications of changing trade patters over a long period of time.

Chapter 3: Have Mexico's Trade Liberalisation Policies Impacted their Income?

3.1 Introduction

This chapter analyses the changes in Mexico's income before and after their trade liberalisation and globalisation period (1962-2011). The motivation arises from their changes in trade determinants, as highlighted in Chapter 2, as well as their increase in trade policies. As stated in Chapter 1, this was a significant change in their previous policies, which included important substitution and oil-led growth policies. Mexico's subsequent signing of multiple trade agreements, including NAFTA, is also related to their increase in economic trade. Furthermore, the subsequent growth in economic trade in the rest of the world has led many scholars to question the relationship between this globalisation period and income changes for those countries. The literature claims there is a link between globalisation policies, especially trade, and income (Nissanke and Thorbecke, 2006; Bourguinon and Morrison 2002; Santos-Paulino, 2012). However, this relationship depends on multiple factors, which provides an important opportunity to understand them fully for Mexico. Given the results in Chapter 2, what were the effects of the changes in trade determinants on the income determinants?

Research including Gallup et al (1998), Nissanke and Thorbecke (2010), Dollar and Kraay (2002), and Redding and Venables (2004) have attempted to explain the cross-country variation in income between countries, which include geographic and other exogenous differences that may impact a country's access to markets and sources of supply. Globalisation is defined as integration through international trade of markets in goods and services. This could be through a variety of measures, such as tariffs and transport costs and trade volumes. The effects of the increasing integration and interdependence are seen in increasing trade volumes between trade partners, large flows of international capital, and the wide and rapid spread of technologies. In the literature, income inequality between countries has been discussed, with globalisation being related to differences in income between countries. However, in relation to Mexico, there is a lack of understanding of how these policies have impacted Mexico's income in relation to countries similar to them, such as Indonesia. How has Mexico's income determinants changed over a significant period of time, especially given their trade liberalisation policies?

Section 3.2 reviews the income and trade literature. Section 3.3 describes the data and improvements on the database from Chapter 2 for analysis in Chapter 3. Section 3.4 explains the theoretical framework for the two-step market access measure (Redding and Venables 2004) to estimate trade flows using a gravity model to construct market access measures for each country. This measure is one of the important variables for explaining income differences between Mexico and its trading partners over a 50-year period. This analysis utilises other variables such as institutions, technological differences, endowments, trading intensity, health, education, and physical geographic differences, as recommended in the literature. Section 3.5 shows that Mexico's market access measure is significantly lower than any other country in the database, and that the impact of foreign market access on their GDP per capita is insignificant. The effect, on the other hand, on their manufacturing wages is positive after trade liberalisation period. Section 3.5 also includes a discussion of the crisis years specifically will be conducted to fully understand how liberalisation policies impact their income for the entire period of the analysis. Section 3.6 concludes with a policy discussion and implications for future research.

3.2 Literature review

The link between trade liberalisation and income distribution is investigated in the literature. Given the amount of globalisation and trade liberalisation policies in the last thirty years, the link between these trade liberalisation policies and the effect on income is a very important question. Standard trade theory asserts that those in the non-tradable sector, such as agriculture, will lose relative to those in the abundant sector, such as manufacturing, through wage and income changes. In the literature, there is discussion that this difference in income changes due to trade can be due to development status, geography, role of institutions, technological differences, and endowments. However, the results are mixed and can depend on development status, skill level, and geographic location. For example, Santos-Paulino (2012) reviews the empirical work of income inequality between countries and trade policies. In Sub-Saharan African, full trade liberalisation policies can lead to a rise of poverty; yet can decrease income inequality between those countries and the rest of the world. Furthermore, due to an increased openness in these lower development countries, it can lead to higher volatility and vulnerability. This shock can impact a country's income (output), thus leading to a change or rise of poverty in these countries.

However, the overall effect of these shocks could reduce the income inequality between these countries and the rest of the world. Dollar and Kraay (2002) argue that trade related growth can lead to higher wages and less poverty. Bourguinon and Morrison (2002) detail the effect of globalisation, claiming that globalisation has been a force for between country convergence. Another mechanism by which economic integration can affect income differences between countries is through a change in prices. Trade policy that increases economic integration can result in an increase in prices, and thus impact real wages in a country. This would be unequal impact between countries, especially if the countries are at a different development level. According to Santos-Paulino (2012), the distributional effect of trade policies is significantly different amongst countries in different development status due to the effect of a change in prices. Given the analysis review's Mexico's income determinants before and after integration, it is possible to confirm this link.

Bhargava (2010) also highlights the importance of sector and skill-level differences between countries. Including variables related to trade in his analysis of 41 countries of two cross-section periods from 1990-2000 (every five years), the author finds a significant effect of a high skilled workforce. Having a relatively low skilled labour force exhibited an insignificant effect on income growth; medium skilled labour showed a negative effect, and a high skill labour force exhibited a positive effect. Furthermore, the pattern of imports, specifically importing advanced technology, exhibited a positive and distinctive effect for income growth. This is due to enhancing the productivity and economic growth of workers in that country. The author chose this period due to the increase in trade intensity levels. According to the OECD, in 1990, 14% of Mexico's manufacturing exports were considered low skilled, and 6.8% were considered high skilled[14]. By 2000, 28% of exports were high skilled and 15.5% were considered low skilled. The highest amount of exports is medium high skilled manufacturing exports. These are goods such as electrical machinery, motor vehicles, and transport equipment. Given the pattern of skilled manufacturing trade, it would be important to test whether this had an effect on their manufacturing wages. If, due to the trade liberalisation, there were a shift in skills and thus the return to education in the manufacturing sector in Mexico, this would be vital to understanding if the technology pattern of their trade were impacting their income.

According to Nissanke and Thorbecke (2010), there is a significant difference in the distribution of globalisation effects between regions. For example, Sub-Saharan Africa (SSA) has relatively high terms of trade, with significant amounts of liberalisation policies similar to Mexico and Indonesia. However, there is a dismal comparative income performance for the region. They also allude to differences between sectors in SSA. Many of the countries in SSA are natural resource rich, like oil-rich Nigeria. UNCTAD (2002) determine that there is a possible low-income trap with relation to high natural resource led growth and liberalisation policies. Given Mexico's increase in oil exports in the 1970s, this would provide an important point of comparison. The data utilised in this analysis provides the opportunity to review a country that moves from an oil export based trade pattern to more liberalised manufacturing trade. Furthermore, SSA could also have a problem with comparative income growth as a consequence of globalisation policies due to a fundamental disadvantage in location. Specifically, SSA countries are more likely to be tropical country with a harsh environment, leading to higher disease rates than most countries. They also can suffer from inadequate institutions, poor governance, and underdeveloped physical infrastructure. Bhargava (2010) analysed 41 developing countries, including all SSA countries. The author finds that the effects of literacy rates and a measure of openness in addition to life expectancy were also very important for income growth in these countries. Given the relatively low literacy rates and life expectancy in SSA, this is also an important indicator for comparative income growth.

Mexico is in a different location, both developmentally and geographically than SSA countries. However, they also report a dismal comparative income performance after trade liberalisation. Pre- trade liberalisation, 1960 to 1980, Mexico's economy grew at an average annual rate of over 6.5% (Villareal 2010). Wages increased in the 1980s and early 1990s, before falling post-NAFTA. From 1960-1980, Mexican real GDP per person grew by 98.7%, while 1994-2013 it grew by 18.6% (Weisbrot et al 2014). The changes in trade policies were supposed to provide a higher income growth to the country than their previous policies of oil-led growth and import substitution. However, given this performance, it is important to compare pre and post liberalisation periods, as well as attempt to understand if other variables mentioned are also important for their income performance.

Nissanke and Thorbecke (2006; 2010) review the links between income and globalisation policies. Their finding is that the distributional gains from globalisation policies are very uneven in certain regions. For example, Asia has seen a reduction in income inequality between other regions, while Africa has seen an increase. The authors point to a limited convergence between certain regions, and thus a regional disparity in trends of globalisation policies and income. They also determine that certain Latin American countries (such as Brazil, Argentina, and Mexico) experienced a deterioration of their terms of trade due to a commodity crisis in the 1980s, resulting in a 'lost decade' in terms of trade, growth, and income. Mexico, especially, has been very susceptible to exogenous credit shocks, which can affect their balance of payments. This phenomenon is seen in mostly Latin American countries, again suggesting a regional effect of liberalisation policies.

Other variables related to social infrastructure, natural geography, and economic geography can impact their income. Social infrastructure can include a measure of openness to international trade, development status, population differences (rural vs. urban), and language (Hall and Jones 1999). Natural geography can affect per capita income determinants in different ways. First, Gallup et al (1998) utilised a sample of 83 developed and developing countries to review the effect of natural geography on income. The authors find that countries with a large percentage of their population close to the coast, low levels of malaria, large hydrocarbon endowments, and low levels of transport costs have higher levels of income per capita. As according to Gallup et al (1998), technology spill over can impact the effect of per capita income depending on the distance between economic agents. Furthermore, a countries' distance from the markets in which they sell output and from sources of supply can also impact per capita income. Given trade costs can reduce export receipts and increase prices of inputs, the expectation would be that higher trade costs would reduce income per capita. The effect is due to these extra costs would squeeze the value added attributable to domestic factors of production, reducing income in these sectors.

The effect of trade liberalisation, or globalisation and economic integration, on income distribution has also been explained due to geographic reasons. According to Rodriquez and Rodrik (2000), geography is a determinant of income through trade and other channels, but geography plays an important role in determining income. If economic geography can be altered, through a change in the spatial concentration of economic activity, this could result in higher real incomes within a country, thus impacting income determinants for each country. Trade policy can affect income distribution in multiple ways. For example, trade liberalisation can change the structure of protection through a reduction in tariffs between countries. This would result in a decline in trade costs between countries, thus improving the ability to access that new market. The concept of market access impacting income distribution between countries is shown to be an effective determinant of income differences between countries in work such as Head and Mayer (2008), Anderson (2005), Redding and Venables (2004), and Hanson (2005). Countries with a poor market access/potential can result in a decline in GDP per capita, especially if the country has a high output of agriculture, or an agrarian economy. Furthermore, most empirical studies of income differences between countries and economic geography relates the location of production to wages, determining that the reduction in costs due to the agglomeration of production within a country is positively related to income differences between countries. These physical and natural differences between regions highlight the importance of a comparative analysis.

The question of economic geography and the impact on income has been highlighted in the literature. According to Overman, Redding, and Venables (2003) the fundamental determinants of the geographic differences of per capita income is related to natural geography, geography of access to markets, suppliers, and ideas, and finally the effects of social infrastructure. These can affect income directly as well as changing the incentives to make investments and accumulate factors of production. Starting with access to markets, past work has brought attention to this issue (Balassa 1961, Dixit and Stiglitz 1977). The literature proceeded to question the role of economic geography in monopolistic competition as a factor as to why countries trade, especially trade that could not be explained by old trade theory (comparative advantage). The literature discusses the importance of market access or potential and integration.

Early contributions to the literature on this subject were Harris (1954) who developed a measure to study the market as a factor in the localisation of industry in the US. In this method, the author develops a market potential term that is defined as the summation of markets accessible to a point divided by their distances from that point. Utilising retail sales data from the United States to proxy accessible markets and transport costs to proxy for distance, confirms an agglomeration of industry and firms in certain areas, such as New York City and the rest of the East Coast of the United States. There is a general decline in the market potential from New York City, only interrupted by regional markets of Cleveland, Chicago, and Los Angeles.

This work is highly important in establishing the role of access to market potential. As well, given the geography of the United States, these regional centres are not surprising given their location. As discussed by Harris (1954), it is only natural that areas in favourable positions for supply, such as Los Angeles and New York City, would become the centre of activity on their respective sides of the country. After this important work, the focus of this literature is related to Krugman (1979, 1991, and 1995) seminal contributions to the field. Krugman (1979, 1991, and 1995) established the foundations of new economic geography (NEG). Specifically, with increasing returns to scale and transport costs, it can explain the emergence of an agglomeration of activity. There are two options used in the literature for estimating this effect. One includes estimating the effect directly in a wage equation, while the other utilises a two-step approach to estimate this effect[15].

[15] Other applications include Hanson (2005, 2008, 2010), Mion (2004), Brakman et al (2004), Clark et al (1969), Keeble et al (1982), Harris (1954), Faina et al (2001), Lopez-Rodriguez (2002), and Roos (2001).

The literature provides a mix understanding of the impact of globalisation policies on Mexico's GDP per capita. Many authors compare the impact of NAFTA on income between the USA and Mexico. Blecker (2014) argues that NAFTA did not make Mexico converge with the USA, as previously forecasted. In addition, it did not solve their migration nor employment problems. There was a stagnation of real wages, yet increased productivity and higher profit shares. There was a lack of convergence on relative wages. Blecker (2014) does allude to the fact that an increase in imports to Mexico may have negatively impacted their income in relation to other countries, and Mexico's inability to diversify their exports to other countries, like Asia, may have had a negative impact on their national income. Weisbrot, Lefebvre, and Sammut (2014) review the performance of the Mexican economy after NAFTA. They find that Mexico ranks the lowest in Latin America in relation to growth in real GDP per person. They also determined that the growth of GDP per capita between 1994 and 2013 grew by 19%, which is an annual growth of 0.9%. This is slower than most developing countries. They argue that given the absence of a natural disaster or war in Mexico, their poor income growth is due to the distributional effects of NAFTA. Other work including Esquivel (2011), Ros (2013), and Vidal (2014) also review the income implications of NAFTA, focusing on the change in employment and income between sectors[16].

However, these analyses lack an understanding of how the determinants of income for Mexico have changed over a long period. Furthermore, there were other policies and crises that would have impacted the performance of the Mexican economy, which is not controlled for in the analyses mentioned above. This chapter utilises more controls for the 1982 Debt Crisis, 1994 Tequila Crisis, and the 2007-2009 Global Recession to fully understand the differences in income between Mexico pre and post liberalisation. A significant discussion in the literature only relates the changes due to NAFTA, ignoring the changes in trade determinants in this period due to subsequent change in their exports (composition of exports, and recently export destination). While a large amount of manufacturing trade is exported to the USA, the composition of manufacturing to the rest of the economy has changed significantly in this period (especially related to technology), and this is not discussed in most of the papers mentioned above. Lastly, the effect of education, health, geography, and institutional differences is not in these papers, which do not give a complete picture of the changes in Mexico due to these policies.

Therefore, this chapter is a distinct contribution to the literature for multiple reasons. First, this chapter combines an economic geography approach in addition to the remaining variables in the literature to determine the income differences between countries. Second, this chapter develops other measures to reflect political, trade, and population differences. The role of institutions, health outcomes, education, skills, and research and development are explored, over a longer period of time than any other analysis in the literature. There are very few instances of this analysis in the literature, and this chapter provides the necessary discussion. Third, this chapter considers

[16] Kehoe (2003) and Astorga (2015) also review income inequality, however mostly looking at Latin America as a whole without significant attention to Mexico.

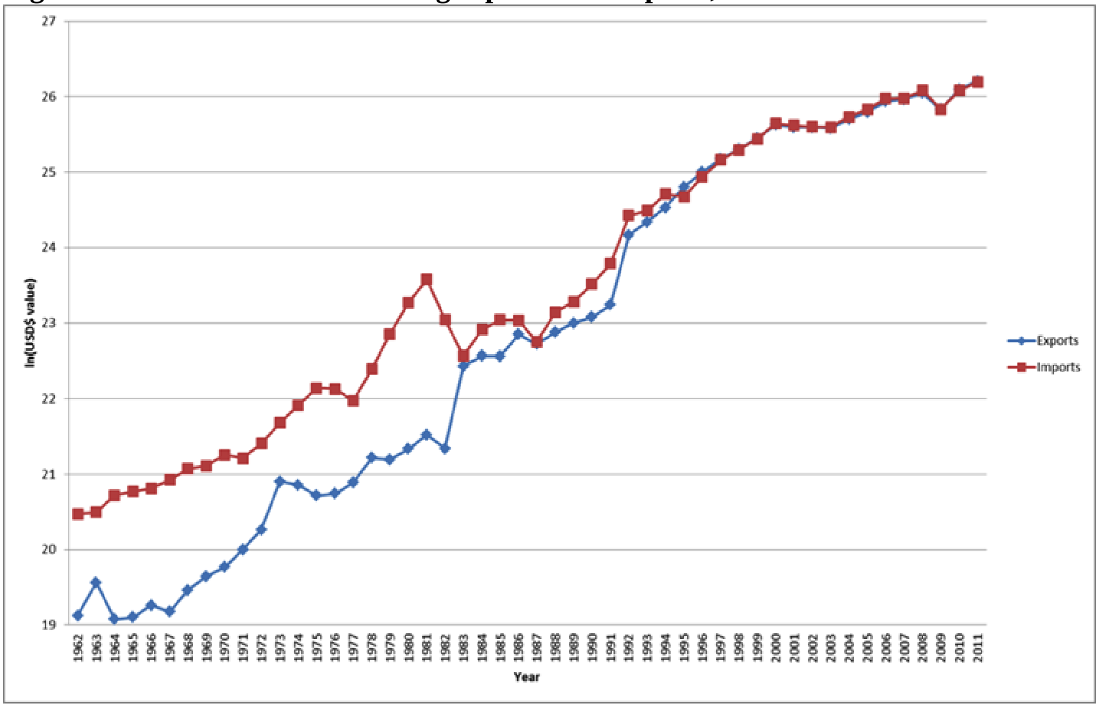
Mexico's economic history and attempts to understand the importance of the economic geography literature as well as the importance of trade agreements and multiple crises. The current discussion of Mexico's economic history in the literature is most geared to understanding NAFTA (Esquivel (2011), and Ros (2013)) without discussing the role of institutions, health outcomes, education, skills, and development. This type of analysis is missing from the literature, and thus this chapter is a distinct contribution to the literature. Finally, this chapter utilises this model over a 50-year period, in comparison to the other countries in the panel, which represent over 70% of world trade. There are a few instances of this in the literature, namely Head and Mayer (2008) and Redding and Venables (2004) provide an analysis of a large cohort of countries. However, these analyses do not separate out a developing country from the rest of the panel, to provide a deep understanding of these effects on a developing country.

In summary, this chapter utilises an economic geography approach in addition to the variables that usually help explain income differences between countries. This is due to the link between international trade and income in developing countries. Furthermore, openness to international trade is linked to raising the average income for countries (Dollar and Kraay, 2002). Mexico increased trade openness in the last 30 years, and thus it's important to analyse this link. Given Mexico's strong relationship between economic geography and trade, a gravity model is utilised to exploit this relationship and explain the cross-country differences in income between them and their trade partners. In addition to economic geography links (such as island status, effect of border and distance for trade costs, etc.), other measures are developed to reflect political, trade, and population differences. These include the role of institutions, health outcomes, education, skills, and research and development. In the economic geography literature, multiple authors have utilised some of these variables to describe the differences in determinants of income between countries. However, when Mexico's economic history is considered, it is important to illustrate the importance of these variables as well as the effect of trade agreements and crises. The augmented gravity trade model captures the effects of trade agreements, trade liberalisation policies, in addition to cultural and geographic variables and Mexico's income equation will reflect this. Therefore, after estimating market access using Redding and Venables (2004) methodology, this chapter analyses the augmented version of the gravity trade equation to re-formulate market access measures. First, a review of the data used in the analysis follows.

3.3 Data

The analysis utilises a panel of 21 countries, for 1962 to 2011. Countries in the panel include Mexico, Canada, the USA, China, and most of the European Union countries. These countries were chosen because they represent 98% of Mexico's manufacturing exports. There are over 21,000 observations and 420 country pairs for the trade equation analysis. The improvements from Chapter 2 include manufacturing trade data, and 15 more variables, including physical geography, social infrastructure, and economic geography variables. The manufacturing trade data is in 2005 USD, compiled by UN Comtrade, under SITC Revision 4. Geographic, political, and cultural variables are from CEPII. GDP (PPP) and population statistics originate from the World Bank, via their World Development Indicators database. There is manufacturing trade data missing from this panel, however. For example, China did not report manufacturing trade data before 1984. India also did not report trade data before 1975. Other countries, such as Malaysia and Thailand have random missing years.

Figure 3.1: Mexican manufacturing exports and imports, 1962-2011



Source: UN Comtrade, in natural log form

Mexico's manufacturing exports (in natural log form, 2005 USD$) is available in Figure 3.1 above. It is possible to detail the rise of manufacturing exports after their trade liberalisation period. For the wage equation, GDP per capita arises from the above data. Manufacturing wages are defined as nominal wage per hour for each manufacturing employee (total, men and women), in USD (2005) dollars. For the economic indicators for the augmented wage equation, such as Forest Area (km) and Rail (in km), originate from the World Development Indicators database. However, multiple years are missing from those measures, such as rail and forest. Political Instability is a dummy variable, 1 if country *i* experienced an attempted or successful military coup, disputed elections, political strife.

3.4 Theoretical Framework and Methodology

3.4.1 Theoretical Framework

To analyse the change in Mexico's income before and after trade liberalisation, this chapter employs an economic geography and trade model augmented with other variables suggested in the literature. The empirical estimation method follows three stages. First, the gravity model is specified to form the country and partner effects, and the distance and border effects. For the fully specified model, it includes other information related to trade costs, such as trade agreements. Second, the market access measure is defined utilising the country, partner, distance, and border effects. Finally, the newly formed variable is added to the wage equation, including other variables such as health, education, political stability, and social and physical infrastructure. The importance of the market access measure is to quantify the change in trade before and after trade liberalisation as an implicit variable in determining their wages.

The theoretical framework follows a trade and geography model, as outlined in Fujita et al (1999) in Chapter 14. The theoretical framework is based on standard new trade theory, but is extended to have transport frictions in trade and intermediate goods in production. The world consists of i = 1,….,R countries, composed of firms that operate under increasing returns to scale and produce differentiated products. There is a constant elasticity of substitution, σ, between pairs of products, so products enter both utility and production through a CES aggregator below:

$$U_j = \left[\sum_{i}^{R} \int_{n_i} x_{ij}(z)^{(\sigma-1)/\sigma}\, dz \right]^{\sigma/(\sigma-1)} = \left[\sum_{i}^{R} n_i x_{ij}{}^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)} , \sigma > 1 \tag{1}$$

Z denotes manufacturing varieties. N_i is the set of varieties produced in country i, and $x_{ij}(z)$ is the country j demand for the zth product from the set. In the second part of the equation, all products produced in each country i are demanded by country j in the same quantity. Due to this, the index z is dispensed with and the integral is rewritten as a product. The price index for manufactures in each country, G_i, defined over the prices of individual varieties produced in i and sold in j, p_{ij}:

$$G_j = \left[\sum_{i}^{R} \int_{n_i} p_{ij}(z)^{1-\sigma} dz\right]^{\frac{1}{1}-\sigma} = \left[\sum_{i}^{R} n_i p_{ij}{}^{1-\sigma}\right]^{\frac{1}{1}-\sigma} \tag{2}$$

The second part shows the symmetry in equilibrium prices. Country j's total expenditure on manufactures is denoted as E_j. Country j's demand for each product is:

$$x_{ij} = p_{ij}^{-\sigma} E_j G_j^{(\sigma-1)} \tag{3}$$

Own price elasticity of demand is σ and E_jG_j gives the position of the demand curve facing each firm in market j. This is the market capacity of country j and it depends on the total expenditure in j and on the number of competing firms and the prices they charge. The firms in country i has profits that depends on an iceberg transport cost factor, internationally mobile primary factor, a composite intermediate good with price G_i and input share $\propto$, and Cobb-Douglas technology. With the demand function described above, profit maximising firms set prices and given the pricing behaviour, profits of each country i firm are:

$$\pi_i = (p_i/\sigma)\ \lfloor \quad x_i - (\sigma - 1)F] \tag{4}$$

Firms break even if:

$$\bar{x}(G_i^{\alpha} w_i^{\beta} v_i^{\gamma} c_i \sigma/(\sigma - 1))^{\sigma} = \sum_j^R E_j G_j^{\sigma-1} T_{ij}^{1-\sigma} \tag{5}$$

According to Fujita et al. (1999), this is the wage equation. It is an equation for the price of the composite immobile factor of production. The maximum value of the wage that each firm in country i can pay is a function of the sum of distance weighted market capacities. The distance weighted market capacities are referred to as "market access" of country i in the econometric specification below.

The full general equilibrium model involves specifying factor endowments and factor market clearing conditions to determine income and expenditure. Output levels of manufacturing are specified, as well as the payments balance. Expenditure and output levels are treated of exogenous[17]. For demand, each firm's product is differentiated from products of other firms and used in consumption and as an intermediate good. There is constant elasticity of substitution. The model defines a gravity-like relationship for bilateral trade flows between countries. The gravity equation is considered the empirical workhorse of trade policy, with over 55 papers published utilising the method over the past decade. It is highly effective with notable theoretical origins of Tinbergen (1962) and Poyhonen (1963) and empirical work by Anderson and van Wincoop (2003) and Martinez-Zarazoso (2003)[18]. It is extended with transport frictions in trade and intermediate goods in production. In this framework, E_i and n_i are exogenous and the model answers the question, given the locations of expenditure and production, what wages can firms in each location afford to pay?

[17] For further information on Fujita (1999)'s general equilibrium, see Chapter 14 Fujita (1999), Redding and Venables (2004), and Head and Mayer (2008).

[18] For further discussion on the gravity model, see Aitken (1973), Helpman (1987), McCallum (1995), Feenstra (2004), and Bellos and Subasat (2013).

3.4.2 Methodology and Econometric Specification

The equation utilised for bilateral trade flows between each country takes a gravity-like relationship.

$$n_i p_i x_{ij} = n_i p_i^{1-\sigma} (T_{ij})^{1-\sigma} E_j G_j^{\sigma-1} \qquad (6)$$

To understand this relationship, it's important to understand the components of the bilateral trade flows equation. Bilateral exports from country *i* to country *j* depends on the number of manufacturing varieties produced, and the price of each variety ($n_i p_i^{1-\sigma}$). This is also known as the supplier index for country *i*, s_i. Another component of this relationship is the characteristics of the importer, m_i. This includes expenditure on manufacturing and the price index of manufactures ($E_j G_j^{\sigma-1}$). Anderson and van Wincoop (2003) determine that multilateral resistance terms are an important determinant of trade flows. These terms include the price index of manufactures. In this relationship, the manufacturing price index is seen as an important determinant of market access, and is also included in determining market access. Finally, the last component of bilateral exports is trade costs $\left(T_{ij}^{1-\sigma}\right)$. Trade costs vary bilaterally between exporter and importer, captured in the estimation utilising border and distance variables.

The restricted gravity model first estimated in this analysis is as follows:

$$\ln\left(X_{ij}\right) = \alpha_0 + \mu_i cty_i + \lambda_j ptn_j + \delta_1\left(lndist_{ij}\right) + \delta_2 bord_{ij} + u_{ij} \qquad (7)$$

X_{ij} are manufacturing exports from country *i* and country *j*. Cty_i and ptn_j are country and partner dummies denoting exporting and importing country characteristics. These characteristics are inherent to each country, and can include prices, as they depend on bilateral resistances. A rise in trade barriers between trading partners can raise the index. These are barriers which each country *i* and *j* face in their trade with all their trading partners. Also, year dummies controls are included to denote any business or time effects that can impact trade between the countries. When these terms are not included, as Anderson and van Wincoop (2003) demonstrate, there is a significant omitted variable bias. Thus, the restricted model will be used to capture country and partner effects. Finally, country dummies are utilised to estimate these multi-lateral resistance terms since it is not possible observe all economic variables that correspond to all components of transport costs and trade policies. It is well established in the literature to utilise this method to capture these individual effects.

Distance is expected to be negative and significant for the entire panel, as well as Mexico. Given the literature, it is expected that border will be positive for Mexico, specifically after 1994. However, the above gravity model utilised to estimate market access measures is not considered the augmented version, even including the year dummies and multilateral resistance terms. Bilateral exports, in the gravity model, also depend on other factors, such as sharing a language, market size, religion, and population size. According to previous gravity work, the effect of trade agreements and the other variables are important for explaining their trade flows. Therefore, the second method is utilised for Mexico's market access measure as the second gravity model accurately describes a significant amount of information about the trade costs between countries, which the first method does not. The second version of the gravity model utilised in this analysis will include different terms such as sharing a language, religion, colonising power, etc...

$$\boldsymbol{lnX_{ij}} = \alpha_0 + \alpha_t + \alpha_i + \alpha_j + \beta_1 lnY_j + \beta_2 N_j + \beta_3 lnDIST_{ij} + \beta_4 BOR_{ij} + \beta_5 LANG_{ij} + \beta_6 REL_{ij} + \gamma_1 NAFTA + \gamma_2 EUTA + \gamma_3 LAIA + \mu_{ij} \quad (8)$$

Given previous results for Mexico's trade determinants, sharing a language and religion are expected to be positive. Mexico's income (Y_j) and population (N_j) are also expected to be positive and significant. According to the gravity literature, country *i*'s income and population are usually considered in this equation. However, it is not in this analysis as previous results determined it was insignificant for Mexican exports. Representing trade creation, *NAFTA*, *EUTA*, and *LAIA* are binary variables, 1 if both countries are in the trade agreement/union and 0 otherwise. As this is for manufacturing exports, and given the large increase in manufacturing exports to NAFTA countries, *NAFTA* is expected to be highly positive and significant from 1994-2011. On the other hand, *EUTA* is expected to be insignificant, given the lack of manufacturing exports to Europe after the trade agreement. *LAIA* is uncertain as the significance of this trade area changed over the last 50 years.

The next step is to construct the market access. Market Access (MA) is the sum of distance weighted market capacities. It measures the market potential of export demand in each country. The inherent heterogeneity in each country is utilised in the estimation of the market access measures. Combined with information on trade costs to importing countries, this provides information on what each country faces when attempting to export. The distance and border coefficients from (6) provide estimates of the bilateral transport cost measures. The partner and country effects provide the multilateral measures. These are also the basis of the spatial variation in market access. The empirical predictions for the variable are constructed using the values of trade costs from the previous trade equation.

Therefore, market access is defined as:

$$MA = (\exp(cty_i))^{\widehat{\lambda}}(T_{ii})^{1-\sigma} + \sum_{j\neq i}(\exp(ptn_j))^{\widehat{\lambda_j}} dist_{ij}^{\widehat{\beta_1}} bord_{ij}^{\widehat{\beta_2}} \quad (9)$$

Market access is a combination of foreign and domestic market access. This is due to the need to measure intra country transport costs. The trade cost measure provides weights that combine market capacities in the construction of market access. Given the literature on economic geography and income, including Redding and Venables (2003), Head and Mayer (2006, 2008, 2010), and Hering and Poncet (2010), foreign market access is expected to be positive when utilised in the wage equation[19]. Foreign market access contains information on the importing country that could affect multilateral trade between the importer and any country in the panel. It also contains trade cost information that country *i* faces when exporting manufactures to country j. This is the distance and border coefficients that are estimated in the gravity equation. This measure is simply estimating the ability for country *i* to export to country *j* given trade costs and country effects that are inherent to that country, and provide a barrier to trade (similar to trade costs). A lower foreign market access measure means that country *i* faces higher trade costs to export to other countries as well as large barriers to trade from country *j*. For example, given the majority of Germany's manufacturing exports go to France, UK, Netherlands, Austria, Italy, and Switzerland, this would mean a positive border coefficient, providing them with a higher foreign market access, as well due to the number of countries they export to. European Union policy would also provide a higher FMA for these countries. There are fewer barriers to trade between these countries, thus reflected in their market measure. After estimating the measure, it is used as a determining factor in the wage equation as well as multiple other variables.

$$lnw_i = \zeta + \varphi_1 \widehat{FMA} + \varphi_2 Urban_i + \varphi_3 Stability_i + \varphi_4 Rail_i + \varphi_5 Malaria_i + \varphi_6 YrsSch_i + \varphi_7 Ores_i + \varepsilon_i \qquad (10)$$

The wage equation is an equation for the price of the composite immobile factor of production, labour. It is recommended to add additional physical characteristics for the full model of the wage equation from the literature based on fundamental determinants of cross-country income levels (Acemoglu et al 2003, Gallup et al 1998). These physical characteristics will measure a country's primary resource endowments, such as a country's land area, and arable land per capita. Similar to a fully augmented gravity model, studies including Acemoglu et al (2003) have noted the importance of adding social infrastructure and the role of institutions. Thus the wage equation utilises political instability. In the literature, it is standard to utilise years of education or literacy rates to understand the income differences between countries due to education differences. Therefore, years of schooling is utilised in this analysis. Given the literature, it is expected to be positive and significant. Social infrastructure variables will be added, such as health (incidence of malaria), population differences, and a measure of trade openness, as suggested in the literature by Gallup et al (1999), Hall and Jones (1999), and

Bhargava (2010). Health and population differences are expected to be positive. The measure of trade openness utilised in this analysis is their terms of trade (as defined by the World Bank). Trade openness is expected to be positive and significant.

These variables are utilised for manufacturing exports and wages. Also, according to the literature, there is the possibility of a difference in the determinants in income due to development status. Therefore, this analysis utilises an extra variable to understand the differences between developed and developing countries. This analysis applies binary variables, *developed* and *developing* representing the development status for all of the countries in the panel. *Developed* is 1 if they are considered a post-industrial country (as defined by the World Bank), 0 otherwise. *Developing* is 1 if they are not considered are usually going through the process of industrialisation, 0 otherwise. For example, South Korea is considered a developing country until 1995, but then lose developed status from 1997-2001, where they regain it again, possibly as a result of the Asian Financial Crisis in 1997. Mexico, on the other hand, is considered a developing country for the entire time of the analysis. The variables are utilised in the income equation only as an interaction variable with FMA. Given the criticism by Mayer (2008), the above framework for market access may not fully explain the differences in income between developing and developing countries. Therefore, this effect could explain any differences in results between Mexico (a developing country) and other countries in the panel and is thus analysed in this chapter. At this time, the combined effect of development status and market access on income per capita is unknown for Mexico.

3.4.1 Crises

Finally, this chapter explores the importance of crises and Mexico's income determinants. Given the length of the analysis in this chapter, there are quite a few crisis years that must be controlled for and analysed to understand the impact on income. The important years for Mexico's analysis are 1982, 1985, 1994-1995, and 2007-2009. These crises were different for Mexico. The 1982-1985 crises were a debt crisis, which spread to the rest of Latin America. A sharp increase in oil crisis, coupled with rising interest rates in the US and Europe meant that Latin American countries, such as Mexico, continued to increase their debt by borrowing from foreign countries flush with oil revenues. The 1994 Tequila crisis was a combined political and exchange rate crisis. In 1994, Mexico experienced a currency crisis sparked by Mexico's sudden devaluation of the peso against the U.S. dollar. At the same time, Mexican President Zedillo raised interest rates and devalued the Mexican peso by about 13-15%. This resulted in large capital flight out of Mexico and a decline in GDP by over 6% in 1995. As such, it will be important to understand the effect of the above crises on Mexico's income. Therefore, the year dummy interacts with FMA and regressed against manufacturing wages and GDP per capita. A difference in the response to those dummies to manufacturing wages and GDP per capita is expected, as the crisis would have impacted wages and the wider economy differently. For example, the 1982-1985 crises impacted the entire economy and decreased GDP per capita significantly.

However, the 1994-1995 crises also intersected with the beginning of NAFTA, which was expected to increase manufacturing wages. The Tequila crisis of 1994 resulted in a 17% drop in GDP per capita in agriculture, 48% drop in the financial sector, and 35% drop in construction. These sectors did not recover until 2001. However, manufacturing slowed slightly in 1995, but rebounded in 1996. Employment doubled in manufacturing in a year, with employment declining in agriculture and an overall increase in unemployment from 3.9% in 1994 to 7.4% in 1995 (Lederman, Maloney, and Serven, 2003). To understand the effect of these crises in manufacturing, year dummies estimated above are exploited with the variables in the wage equation (4) for Mexico. Specifically, the interaction between the crises and the foreign market access measure, representing trade access, and that effect on income are of great interest. If Mexico were more integrated, then this would exhibit more pressure on their GDP per capita as well as manufacturing wages.

3.4.2 Robustness checks

As highlighted by the literature on the gravity model, there are certain econometric specification problems when utilising the gravity model. Although these are not the main results for our consideration, since these results will be utilised for estimating market access measures, it is still very important to confirm these results are fully robust. The three major problems here could be heteroscedasticity, heterogeneity, and information bias through zero trade flows. The first problem, heteroscedasticity arises from taking logarithms and different sources for trade data. Thus, to solve for the problem, the trade equation was calculated using robust standard errors via the Huber White sandwich errors. For heterogeneity, the literature recommends utilising panel fixed effects. This is important and necessary for the second step in this method, and thus by allowing for importer and exporter effects, the model accounts for an unobserved heterogeneous component that is constant over time. In addition, unobserved business effects are captured via year effects in the trade equation.

Furthermore, the last problem is zero trade flows and the resulting information bias in the results. As noted above, certain countries did not report all of the manufacturing data for multiple years in the sample. As well, it is possible that two countries in this panel did not trade manufacturing goods between each other for individual years. As the model is completed via OLS and OLS drops the zero trade flows and estimates based on the available information. This can lead to important information being lost. There would be a lot of missing information due to zero-trade flows in the panel, especially in the 1960s and manufacturing sector. Countries such as China, Indonesia, and India did not report manufacturing exports in the 1960s, 1970s and part of the 1980s. However, in a database of over 21,000 observations 20,505 are utilised in this analysis for total trade, and 19,500 for manufacturing. This is a very low percentage of missing trade flows and should not adversely affect the results. Previous results from this gravity model and database confirm that the missing trade flows did not affect the results. These previous results utilised a Heckman self-selection model to test the coefficients on border and distance without any discernible difference.

A significant problem highlighted in the literature is simultaneity arising from the market access measure. With simultaneity, there's a bias with a system of structural equations being utilised if a change in the error term in the first equation can cause a change in the outcome of the first equation. Then if the outcome of the first equation is utilised in the second equation as a predictor, it can cause a change that feeds back into the first equation. This violates an assumption of OLS that there is no correlation between the error term and explanatory variables.

Other measures also exhibit this problem, such as Head and Mayer (2010)'s real market potential measure (RMP). This is addressed in the Redding and Venables (2004) method by summing market access over all countries, except country *i*. To still confirm that simultaneity will not be an issue, instrument variables will be utilised to measure market access and estimated using 2SLS. 2SLS creates IVs to replace the endogenous variable where they may appear as an explanatory variable. In Redding and Venables (2004), the method depends on the distance between country *i* and the three largest manufacturing markets in the world (United States, China, and Germany). The IV could be weak and the explanatory power of each instrument needs to be checked. After conducting the IV analysis, it is necessary to test for endogeneity. If there is no endogeneity, then both IV and OLS estimates are consistent but IV is inefficient. Utilising the Wu-Hausman test, it's possible to determine if the estimates between OLS and IV are different. If the estimates differ significantly, then the variable is an endogenous variable. The Sargan-Hansen test of the model's over identifying is utilised as well to confirm that there are not any unmodelled third variables not captured that have an independent effect on manufacturing wages but are correlated with distance from other countries. A related problem is with the generated regressors from the first equation is utilised in another equation. The presence of generated regressors means that the OLS standard errors are invalid. Thus bootstrap techniques were utilised to obtain the correct standard errors to take into account the generated regressors.

3.5 Results

3.5.1Trade Equation

Variable:	Description:	Estimation:	Expected Sign:
Mexico's GDP	Proxy for the	World Bank	Positive

	economic size of the country. Represents consumption of the home country.	estimation of the GDP in 2005$, in natural log form.	
Language	Capturing the effect between countries that share the same language, representing cultural and historical affinity between countries.	Dummy, 1= both countries share the same language, 0 otherwise	Positive, Spain is one of Mexico's top trading partners, outside the USA and Canada.
Border	Major variable in a gravity model, adding to the overall discussion on whether borders are a geographic hindrance for trade (McCallum, 1995)	Dummy, 1= countries share a border, 0 otherwise	Negative, given McCallum (1995). However, this sign is expected to change over time.
Distance	Utilised as a proxy for trade costs, such as transportation, information, and communication costs	Kilometres between the capital cities of country i and j, in natural log form.	Negative, especially at increasing distances
NAFTA	North American Free Trade Agreement (1994), between the USA, Mexico, and Canada.	Dummy, 1= both countries are in NAFTA, 0 otherwise	Positive
EUTA	European Union Trade Agreement (2000), between Mexico and multiple European countries	Dummy, 1= both countries are in EUTA, 0 otherwise	Negative, but there is a lack of literature on the effects of the EUTA, and thus this sign could be positive at certain points in time.
LAIA	Latin American Integrated Area (1982), between Mexico and multiple Latin American countries.	Dummy, 1= both countries are in LAIA, 0 otherwise	Negative, given the quantity of trade to NAFTA for Mexico, we expect this trade agreement to have a negative effect on their exports.

Table 3.1: Gravity variables
Variables utilised in the gravity analysis, the independent variables are manufacturing exports

On the manufacturing trade equation for Mexico, seen in Table 3.2, distance is negative and border is positive, as expected from the literature. Mexico's border coefficient is incredibly high, at odds with its total trade results. For the pooled years, distance is very negative; reflecting the effect of trade costs on Mexico's manufacturing exports. There's a significant drop in the 1970s in the effect of the border. At this time, Mexico reduced their import substitution policies and reduced production on manufacturing goods. Distance and border coefficients increase in the 1960s and 1970s. The border effect increases during the 1980s and 1990s, finally stabilising in the 2000s. At this point, over 70% of Mexican manufacturing exports go to the USA, and another 15% to Canada. Exports to Canada would not be reflected in border, but may explain the decline in the negative distance effect between 1990s and 2000s. This also may be reflected in the increase in manufacturing exports to NAFTA, and very little manufacturing exports to Asia and Europe. Another major development in the 2000s was the passage of the EU-Mexico trade agreement. This trade agreement was mostly for the exports of cars and machinery to Europe. However, this is not reflected in the results from the gravity equation.

Variables	(1) 1962-2011	(2) 1962-1971	(3) 1972-1981	(4) 1982-1991	(5) 1992-2001	(6) 2002-2011
Mexico's GDP	2.344	4.936***	3.823***	5.164***	4.133***	6.614***
	(3.133)	(1.101)	(0.651)	(1.147)	(0.670)	(1.241)
	(14.85)					
Language	4.808***	5.062***	5.589***	4.989***	5.160***	5.039***
	(0.397)	(0.820)	(1.421)	(0.703)	(1.378)	(0.857)
Border	-0.128	-0.738	-0.464	-0.831	-0.0941	-2.059
	(0.629)	(1.718)	(1.551)	(1.802)	(1.423)	(1.896)
Distance	-18.71***	-20.24***	-19.27***	-21.83***	-19.86***	-25.65***
	(2.297)	(5.985)	(5.498)	(6.204)	(4.947)	(6.895)
NAFTA	0.0795	0.0629	0.103	-0.212	0.0487	-0.329
	(0.253)	(0.565)	(0.594)	(0.561)	(0.540)	(0.664)
EUTA	-1.239***	-1.041	-1.331**	-1.402**	-1.101*	-1.517**
	(0.267)	(0.658)	(0.609)	(0.616)	(0.586)	(0.632)
LAIA	-2.840***	-3.369***	-3.288***	-3.687***	-3.207***	-4.039***
	(0.292)	(0.875)	(0.838)	(0.887)	(0.753)	(0.972)
Constant	1,005***	-74.72***	-46.45**	-77.19***	-53.23**	-108.9***
	(250.8)	(24.98)	(21.34)	(25.60)	(21.53)	(27.97)
Observations	1,000	200	200	200	200	200
R-squared	0.670	0.686	0.711	0.688	0.727	0.692

Table 3.2: Mexico's gravity results, manufacturing exports

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and border (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

Mexico did enact trade liberalisation policies in the early 1980s as a consequence of a debt crisis. In the pre-liberalisation period (1962-1982) Mexico's border effect was quite high for manufacturing, and this increased after liberalisation (1983-2011). The crisis years (82, 86, 94, and 07-09) did have an effect on their manufacturing exports. The 1982 debt crisis was crippling for Mexico's exports and GDP per capita. There was distinct currency devaluation as Mexico re-valued their currency under the new peso (1 new peso = 1000 old peso). In Table (2), the variables are interacted with the crisis years. By 1985, Mexico had regained some of their manufacturing exports and had a trade surplus, therefore it would be important to detail 1982 and 1985 in the sample. Looking at the trade results for this period in Table 3.3, in 1985, the effect for GDP is insignificant, with a positive effect on trade within the Latin American Integrated Area.

In 1994, Mexico enacted NAFTA with the USA and Canada yet at the end of 1994 they suffered another severe debt crisis. This could be reflected in their results for 1994, as the effect of border for manufacturing exports is insignificant but NAFTA trade is positive and significant. On the other hand, GDP is negative yet insignificant. Therefore, the 1994-year effect combined with the effect of GDP on trade is insignificant, which is a contrast to the normal effect of GDP on trade for manufacturing exports. The crisis and RTA years will be very important to note in the wage results as well. It would be important to compare these results with the subsequent income results for Mexico, to determine if there was truly an effect on GDP per capita and manufacturing wages due to the crises.

VARIABLES	(1) 1982	(2) 1985	(3) 1994
Distance	-1.479***	-0.350	-0.354
	(0.190)	(0.437)	(0.434)
Border		-	-
Population	-0.198***	-0.0578	-0.0616
	(0.0637)	(0.184)	(0.183)
GDP	1.218***	1.575***	1.579***
	(0.0622)	(0.154)	(0.153)
Language	1.366***	6.618***	6.630***
	(0.158)	(1.066)	(1.056)
Religion	-2.866***	1.719	1.700
	(0.223)	(1.147)	(1.143)
LAIA	3.730***	-1.591***	-1.609***
	(0.155)	(0.195)	(0.194)
NAFTA	4.351***	1.143***	1.106***
	(0.181)	(0.217)	(0.213)
EUTA	2.238***	-0.978***	-1.003***
	(0.132)	(0.227)	(0.225)
Distance*	0.320	-0.146	0.956***
	(0.800)	(0.181)	(0.340)
Border*	-0.996***	-0.967**	0.127
	(0.336)		
Religion*	-1.512	-0.553*	0.620*
	(1.277)	(0.312)	(0.351)
GDP*	0.854	0.207*	-0.0469
	(0.741)	(0.112)	(0.120)
Language*	-1.533	0.0740	0.745***
	(1.203)	(0.220)	(0.246)
LAIA*	-1.743***	0.579***	0.0838
	(0.664)	(0.182)	(0.251)
NAFTA*	2.444*		1.758***
	(1.467)		(0.419)
Constant	2.671	-25.54**	-29.54***
	(1.742)	(10.12)	(10.01)
Observations	887	887	887
R-squared	0.735	0.922	0.922

Table 3.3: Mexico's gravity, interaction of crisis years, 1982, 1985, 1994

GDP (2005$, World Bank) and population (World Bank) for both countries are proxies of economic size. They are both represented in natural log form. Distance (natural log of kilometres between capital cities) and border (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade. Religion and (sharing a) language represented as dummies in this analysis, are cultural and historical proxies for the trading partners. NAFTA, LAIA, and EUTA (dummy, 1=both countries are in the trade agreement) are trade agreements between Mexico and some of its trading partners.

Manufacturing exports for the total panel is reported in Table 3.4. From these results, it is clear that the effect of sharing a border and distance is not as similar to the previous results. The effect of distance isn't as profound as in total trade. Sharing a border is highly significant and positive for all of the years, increasing for all the years and peaking in the 1990s. By the 2000s, this effect has declined. However, distance stays negative even increasing in the 2000s. Considering there was missing manufacturing data in the sample (China pre-1984, India pre-1975), a Heckman sample selection model was utilised, as it is possible the missing trade flows have altered the results of the trade equation. This did not affect the results of the trade equation.

Variables	(1) 1962-2011	(2) 1962-1970	(3) 1971-1980	(4) 1981-1990	(5) 1991-2000	(6) 2001-2011
Distance	-0.895***	-0.887***	-0.857***	-0.820***	-0.862***	-0.962***
	(0.0132)	(0.0340)	(0.0266)	(0.0228)	(0.0192)	(0.0158)
Border	0.351***	0.183***	0.244***	0.300***	0.441***	0.391***
	(0.0356)	(0.0702)	(0.0645)	(0.0565)	(0.0619)	(0.0595)
Constant	24.40***	17.99***	17.09***	16.62***	23.98***	25.90***
	(0.178)	(0.547)	(0.346)	(0.275)	(0.216)	(0.162)
MRTs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,140	2,402	3,297	3,780	4,085	4,576
R-squared	0.849	0.864	0.862	0.879	0.892	0.900

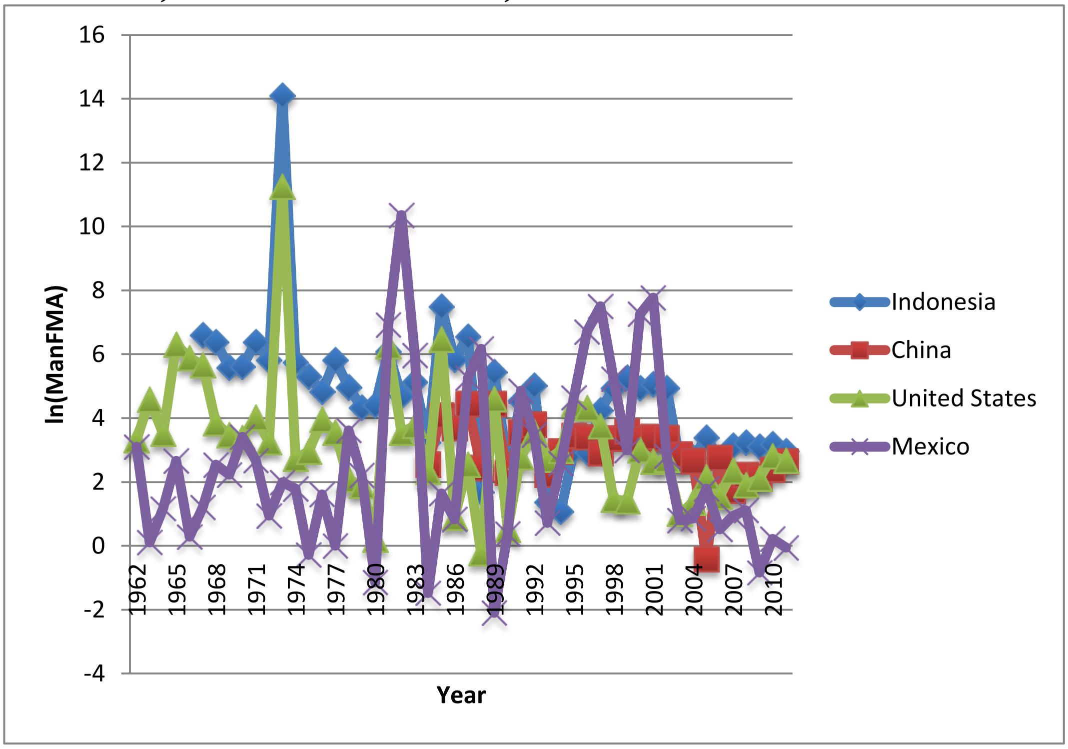
Table 3.4: Total Panel, gravity
Distance (natural log of kilometres between capital cities) and border (dummy, 1= sharing a border, 0 otherwise) represent geographic hindrances for trade.

In addition, country and partner dummies were utilised in this trade equation in order to estimate the market access measure. These results will be utilised to form market access/market capacity measures to analyse the effect of economic geography on income inequality. Again, this is important, as according to the literature, the role of economic geography is a leading indicator in income inequality between countries. It will be very important to control for all differences between countries, to understand Mexico's income determinants over the globalisation period.

3.5.2 FMA

Once again, predicted values of market access are a sum of domestic and foreign market access. The distance and border coefficients measure transport costs and give the weights to the market access measure. In this model, distance and border coefficients are the basis of the spatial variation of market access. Combining this information with market and supply capacities for each country (exporter and importer effects), the market access measures are constructed. The market access measures utilise the exporter and importer effects to quantify all costs that determine a country's propensity to supply exports and demand imports. In Redding and Venables (2004), Head and Mayer (2008), and Nissanke and Thorbecke (2006), a clear positive link between income and economic geography exists, it's important to understand if Mexico shows a similar relationship when also controlling for other variables of interest.

Figure 3.2: FMA, Mexico vs. other countries, 1962-2011



As seen in Figure 3.2, Mexico's foreign access measure is lower than the USA. As such, there is still the possibility that the USA's foreign market access measure is misidentified. However, standard new economic geography theory explains that the USA with a large domestic market may satisfy all of the domestic suppliers, and thus reduce the amount of foreign markets available. This is known as the home market bias effect, and this certainly may be explaining the USA's FMA results. On the other hand, 98% of Mexican manufacturing exports are represented in this panel, and thus allows for a clearer picture. After NAFTA, Mexico's foreign market access increases significantly but is prone to rise and decline due to the subsequent crises. Before trade liberalisation, their foreign market access measure was highly volatile, but also higher on average than after liberalising trade. Given Mexico has signed a significant amount of regional trade agreements, it is possible after trade liberalisation; they now rely on trade between its regional partners, thus affecting their foreign market access measure.

This FMA construction includes trade agreements and more variables for transport costs between Mexico and its trading partners. It is significantly more volatile, and seems to be affected by crisis years, such as the drop around 1997 (Asian Financial Crisis), and 2007-2009 Global Recession. Most importantly, 1982-1984 show a deep decline in FMA, with it rebounding in 1985, as reflected by the manufacturing trade patterns. Including the linear trend, however, shows there is very little change in their market access since the early 1960s to now, even with increasing trade agreements. It supports the gravity results, of a high border coefficient, namely a significant amount of trade to a few countries close to Mexico, and very little trade to other countries. Furthermore, comparing these results with the original FMA in Redding and Venables (2004), our measures are lower than the original paper. This is described in Head and Mayer (2006) as they also show lower measures than the original paper. They show that this is due to the difference in database utilised for the analyses. On the other hand, the original paper does not include long-term foreign market access measures, as completed here. Therefore, it would be difficult to determine if they show the same long-term trends. In Redding and Venables (2004) and Head and Mayer (2006), they do show the USA with a higher FMA, yet not as high as previously thought. This matches with this work. However, it is very important to understand how this change has affected overall income per capita in Mexico. Specifically, given the lack of real change in foreign market access for Mexican manufacturing exports, is there any effect on their income per capita? Also, instead, are other variables more important for their income per capita, such as education and skills, health, and infrastructure, as supported by the literature?

3.5.3 Wage equation

Variable:	Description:	Estimation:	Expected Sign:
Foreign Market Access (FMA)	Estimating the ability for country *i* to export to country *j* given trade costs and country effects that are inherent to that country, and provide a barrier to trade.	Constructed using the information from the gravity model, where distance and border coefficients provide estimates of the bilateral transport cost measures, and partner and country effects provide multilateral measures.	Positive
Stability	Political stability is defined as a country experiencing a coup, disputed elections, dictatorship, or protests resulting in death (Economist Intelligence Unit	Dummy, 1= country experienced political strife, 0 otherwise	Negative

Ores	Exports in ores or other metal, related to natural geography and trade	World Bank estimation, per year in natural log form	Negative
Arable Land	% of total land, representing agricultural output, related to natural geography	World Bank estimation, per year in natural log form	Negative
Urban population	Those living in an urban setting, related to social infrastructure	World Bank estimation, in natural log form	Positive
Rural population	Living in a rural setting, related to social infrastructure	World Bank estimation, in natural log form	Negative
Life expectancy	Number of years, health infrastructure	World Bank estimation	Positive
Rail	Access to railway, access to infrastructure	World Bank estimation, in natural log form	Positive
Developing Status	Developing or developed	Utilising the World Bank definition of a developing country. Represented as a dummy, 1= developing, 0 otherwise	Positive
Medium-Low technology	Basic metals, refined petroleum, related to the skill-level differences	UN Comtrade estimation of exports with that level of technology, in 2005$. Also in natural log form.	Unclear
Medium-High Technology	Motor vehicles and electrical machinery, related to the skill-level differences	UN Comtrade estimation of exports with that level of technology, in 2005$. Also in natural log form.	Positive
Low Technology	Food, beverages, tobacco, and textiles, related to the skill-level differences	UN Comtrade estimation of exports with that level of technology, in 2005$. Also in natural log form.	Negative
High Technology	Computing machinery, aircraft and spacecraft, and medical instruments, related to the skill level	UN Comtrade estimation of exports with that level of	Positive

	differences	technology, in 2005$. Also in natural log form.	

Table 3.5: Wage equation variables

Variables utilised in the income analysis, independent variables are GDP per capita and manufacturing wages

Variables	(1) 1962-2011	(2) 1962-1981	(3) 1982-2011
FMA	-0.00110	0.00574	-0.00358*
	(0.00343)	(0.00641)	(0.00207)
Stability	0.0239*	0.00618	0.0371***
	(0.0135)	(0.0175)	(0.0110)
Ores	-0.0153	-0.0339	-0.0212*
	(0.0165)	(0.0281)	(0.0103)
Arable Land (%)	-0.577***	0.847**	-0.395**
	(0.0976)	(0.366)	(0.173)
Urban	0.225***	1.437***	0.351***
	(0.0612)	(0.330)	(0.0510)
Constant	3.987***	-15.37**	1.967**
	(1.008)	(5.328)	(0.745)
Observations	50	20	29
R-squared	0.975	0.982	0.927

Table 3.6: Mexico's wage equation, GDP per capita

Foreign Market Access (FMA) estimates the ability of a country to export to another country given trade costs and country effects inherent to that country. It's a measure of their ability to access foreign markets, given the above description. Stability is defined as political stability, while ores and arable land are natural geographic hindrances that impact income. Urban population are related to social infrastructure.

The first analysis uses GDP per capita as a proxy for manufacturing wages. Available in Table 3.6 an evaluation of the pre trade liberalisation period (1962-1981) shows that the second measure for manufacturing foreign market access is insignificant in explaining GDP per capita in Mexico, while urban population is significant and political stability is insignificant. Arable land is significant and positive for Mexico. During the trade liberalisation period, from 1983-2011, manufacturing foreign market access is still insignificant, while political stability is positive and significant. Urban population is positive and significant, as expected and arable land is negative and significant. More arable land refers to higher crops, and more agricultural output in the country. Therefore, higher agricultural output shows a negative effect on GDP per capita in Mexico. This is very important considering Mexico's previously high output in agriculture before trade liberalisation. As well, significant criticism of the NAFTA trade agreement with the US and Canada is that it did not specifically protect smaller Mexican farmers from competition from abroad (Ros 2013, and Blecker 2014). Therefore, these results show that before trade liberalisation, arable land was positive, yet after trade liberalisation it is negative. Agricultural output in Mexico is now having a negative effect on their GDP per capita. This also confirms other work completed by Yunez-Naude (2002) who confirms the decline in importance for agriculture with regards to Mexico's GDP.

To control for differences in resource endowments, Table 3.6 includes a variable for exporting Ores and other Metals. For the period after trade liberalisation, higher exports in ores and metals has a negative effect on GDP per capita, as expected (Gallup et al 1999). However, including the incidence of malaria as a proxy for population health is insignificant for both periods of study and was not included. Although the literature shows a negative relationship between malaria and GDP per capita, it was not expected to have an effect with regards to Mexico, as their incidence of malaria is one of the lowest in all developing countries in the panel. Instead, as expected, the measures related to population differences, stability, and sector differences have a more significant effect on their GDP per capita. However, FMA is insignificant for Mexico's GDP per capita, which was not expected. Dollar and Kraay (2002) detailed the importance of trade growth for GDP, while Redding and Venables (2004) highlight the necessity to include economic geography when analysing changes in GDP per capita. On the other hand, other literature alludes to an insignificant effect for Mexico. For example, given Hall and Jones (1999) and Nissanke and Thorbecke (2010) highlight that development status can be a significant indicator for differences between countries. This is an important question that must be explored to fully understand the changes in income for Mexico. Santos-Paulino (2012) alludes to a difference in skills as an important factor for between country incomes, which can be an important factor for Mexico. Mexico exports a significant amount of motor vehicles, which is considered medium technology goods, and may not be absorbing any technological spill overs from high technology imports (roughly 16% in 2000). To understand this, a comparison to the entire panel is necessary for fully analysing Mexico's results.

Variables	(1) 1962-2011	(2) 1962-1971	(3) 1972-1981	(4) 1982-1991	(5) 1992-2001	(6) 2002-2011
FMA	-0.0309***	0.0201**	-0.0126	-0.0400***	-0.0624***	-0.0351
	(0.00889)	(0.00841)	(0.0129)	(0.0113)	(0.0122)	(0.0219)
Urban Population	0.342***	0.481***	0.290***	0.189***	0.242***	0.311***
	(0.0285)	(0.0366)	(0.0334)	(0.0242)	(0.0211)	(0.0214)
Rural Population	-0.448***	-0.473***	-0.452***	-0.451***	-0.451***	-0.434***
	(0.00287)	(0.00339)	(0.00385)	(0.00584)	(0.00517)	(0.00388)
Stability	0.0465	0.260***	-0.110	0.211	0.0788	0.0167
	(0.0496)	(0.0861)	(0.113)	(0.168)	(0.0843)	(0.0614)
Life Expectancy	0.0717***					
	(0.00443)					
Rail	-0.0198					
	(0.0261)					
Developing	-1.390***	-1.815***	-2.031***	-2.063***	-1.954***	-1.862***
	(0.0687)	(0.0831)	(0.0856)	(0.0713)	(0.0616)	(0.0540)
Constant	6.264***	8.959***	12.36***	14.21***	13.62***	12.12***
	(0.570)	(0.617)	(0.559)	(0.396)	(0.357)	(0.371)
Observations	564	154	194	207	208	208
R-squared	0.974	0.982	0.964	0.964	0.969	0.972

Table 3.7: Panel Wage Results, with developing status

Foreign Market Access (FMA) estimates the ability of a country to export to another country given trade costs and country effects inherent to that country. It's a measure of their ability to access foreign markets, given the above description. Urban and rural population are related to social infrastructure. Life expectancy is the proxy for health, and its impact on income. A higher life expectancy represents a higher impact on income. Rail access represents infrastructure and developing status is a dummy, 1 meaning developing, 0 otherwise.

Table 3.7 details the panel's wage results. More variables are employed for this analysis due to data availability. However, they were proxies for the same variables utilised in Mexico's wage equation. As expected from the literature, foreign market access is positive and significant for the entire panel for all years. Political stability is insignificant yet positive. A high urban population, as in Mexico's results, is positive and significant. Life expectancy is positive, as is access to railway (infrastructure). After interacting FMA with the development status variables (*developing and developed)*, the picture is slightly clearer, especially with regards to Mexico. In Table 3.7, the binary variable for developing countries is included. In the entire panel, it's a negative effect on GDP per capita, for all years. What's very important is the interaction with foreign market access and development status. This could help explain the results from Mexico's wage equation. Combining foreign market access with being a developing country, there is a significant and negative effect on GDP per capita. This effect is for all years.

Variables	(1) 1962-2011	(2) 1962-1971	(3) 1972-1981	(4) 1982-1991	(5) 1992-2001	(6) 2002-2011
FMA	0.0374**	0.227***	0.120***	0.0651***	0.0282	0.146***
	(0.0152)	(0.0248)	(0.0297)	(0.0216)	(0.0264)	(0.0375)
Urban	0.226***	0.597***	0.363***	0.174***	0.197***	0.299***
	(0.0328)	(0.0520)	(0.0510)	(0.0413)	(0.0307)	(0.0300)
Rural	-0.437***	-0.487***	-0.472***	-0.449***	-0.434***	-0.421***
	(0.00399)	(0.00616)	(0.00793)	(0.00750)	(0.00747)	(0.00582)
Stability	0.000267	0.321***	-0.144	0.0580	0.134	0.0165
	(0.0554)	(0.115)	(0.182)	(0.185)	(0.119)	(0.0921)
Life Expectancy	0.0977***					
	(0.00569)					
Rail	0.0926***					
	(0.0262)					
Developing * FMA	-0.193***	-0.241***	-0.256***	-0.345***	-0.382***	-0.490***
	(0.0171)	(0.0164)	(0.0221)	(0.0182)	(0.0169)	(0.0230)
Constant	4.575***	5.952***	10.52***	13.73***	13.56***	11.39***
	(0.732)	(0.866)	(0.869)	(0.679)	(0.512)	(0.506)
Observations	564	154	194	207	208	208
R-squared	0.960	0.962	0.918	0.927	0.943	0.950

Table 3.8: Panel wage results, with interaction of development status and FMA
Foreign Market Access (FMA) estimates the ability of a country to export to another country given trade costs and country effects inherent to that country. It's a measure of their ability to access foreign markets, given the above description. Urban and rural population are related to social infrastructure. Stability is defined as political stability, while ores and arable land are natural geographic hindrances that impact income. Life expectancy is the proxy for health, and its impact on income. A higher life expectancy represents a higher impact on income. Rail access represents infrastructure and developing status is a dummy, 1 meaning developing, 0 otherwise. The interaction of FMA and developing status is just representing the interaction of having a low or high FMA and being a developed or developing country.

This confirms Nissanke and Thorbecke (2006; 2010) who alluded to a developmental difference between the income distributional gains of trade. Given Mexico is a developing country for the entire period; their status inhibits their income even before and after trade liberalisation. On the other hand, using GDP per capita does not show any distributional effect of the policies on manufacturing wages. Considering the increase in exports is in the manufacturing sector, an increase in FMA could be positive for manufacturing wages only. It is also possible that the income distributional effect of the trade policies is in manufacturing wages, rather than GDP per capita. Meaning, the distributional effect of a change in trade policy has not been equally distributed amongst the entire economy, but only those working in manufacturing. Furthermore, the effect of the urban population has diminished over time but the statistical significance has remained very high.

Variables	(1) 1962-1981	(2) 1982-2011
FMA	0.0287**	0.0675**
	(0.0121)	(0.0274)
Stability	0.0116	-0.503***
	(0.0767)	(0.175)
Ores	0.0469	-0.0124
	(0.0961)	(0.152)
Arable Land (%)	4.753**	9.385***
	(1.680)	(1.491)
Urban Population	8.121***	10.04***
	(1.550)	(0.545)
Constant	-142.6***	-168.2***
	(25.12)	(8.764)
Observations	13	29
R-squared	0.990	0.961

Table 3.9: Mexico's wage equation, using Manufacturing wages (nominal wages)
Foreign Market Access (FMA) estimates the ability of a country to export to another country given trade costs and country effects inherent to that country. It's a measure of their ability to access foreign markets, given the above description. Stability is defined as political stability, while ores and arable land are natural geographic hindrances that impact income. Urban population are related to social infrastructure.

Redding and Venables (2004) utilise manufacturing wages as a robustness measure for utilising GDP per capita. However, this chapter determines utilising manufacturing wages is vital for understanding how Mexico's income changed over time. In Table 3.9, the analysis shows that manufacturing foreign market access has a positive effect on manufacturing wages. For those working in the manufacturing sector, access to foreign markets has a positive and significant effect. This alludes to a difference in the distributional gains from income within Mexico. However, other variables, such as a high urban population are incredibly high and positive. Other than the change in FMA, there is very little difference in the results between GDP per capita and manufacturing wages. There is also the problem with the distributional differences in the skill level required for exports, and thus those within the country with different skill levels. Stability is a negative impact on manufacturing wages in the period after trade liberalisation. The statistical significance for stability changes from the first period to the second period and this is the only variable for which this happens. This differs from the panel's results for stability. Most of the variables show an increase in the coefficient from the pre trade liberalisation to post trade liberalisation, including statistical significance.

Variables	(1) 1982-2011
FMA	0.0439**
	(0.0156)
Medium-Low Technology	-0.741**
	(0.301)
Arable Land (%)	0.357
	(2.208)
Urban Population	0.584***
	(1.493)
Medium-High Technology	0.388**
	(0.168)
Low Technology	0.408***
	(0.122)
High Technology	0.155*
	(0.0767)
Constant	-161.2***
	(22.52)
Observations	22
R-squared	0.953

Table 3.10: Mexico's Technology level, post trade liberalisation (1982-2011)
Foreign Market Access (FMA) estimates the ability of a country to export to another country given trade costs and country effects inherent to that country. It's a measure of their ability to access foreign markets, given the above description. Arable land are natural geographic hindrances that impact income. Urban population are related to social infrastructure. All technologies represent the amount of that technology that is exported by Mexico, in natural log form.

When looking at the different skill level required for their exports, this provides few answers to the Mexican puzzle. Table 3.10 shows the results when adding *high*, *medium-high*, *medium-low*, and *low* skill exports as a function of income. In line with the literature, *medium-low* technology manufacturing exports (basic metals, refined petroleum) has a negative and significant effect on manufacturing wages. The effect for technology, FMA, and urban population is highly significant. The rest of the results are slightly different to the literature but is significant considering Mexico's exports. A significant amount of their exports are *medium-high* manufacturing exports (motor vehicles and electrical machinery), and *low* technology manufacturing exports (food and beverages, tobacco, and textiles). Most of the maquiladora firm growth has been in *low* and *medium-high* technology manufacturing.

Given the trade agreements reduce the tariffs and quotas on textiles, motor vehicles, and manufactured food and beverages to Europe and North America; it is not surprising that these two areas show a positive and significant effect on manufacturing wages for the entire period. Finally, *high* technology manufacturing exports (computing machinery, aircraft and spacecraft, and medical instruments) has a smaller, yet still positive effect on manufacturing wages. When utilising these variables with GDP per capita, these variables are insignificant, proposing the effect on these exports is in manufacturing wages and not the wider income per capita for the country. Although this provides more information about Mexico's income determinants, another important factor is the impact of the crises in the last fifty years.

3.5.4 Crises

The next step was to analyse the effect of crises in Mexico and the panel on GDP per capita and foreign market access. Given the previous literature on the effects of regional and free trade agreements on volume of trade, it is an important step in understanding if these also altered the effect of foreign market access on income. There were significant developments in that time period, with oil crises, and slow worldwide economic development. In that period, FMA would decline, as it is a measure of market capacity/potential. As seen in Graph (2), it is evident that in 1982 Mexico's FMA measure declines sharply. It is also important to note that this declines for every country in the sample as multiple other countries were experiencing an economic decline. Another important date is 1994, with the signing of NAFTA and the Tequila Crisis. Table 3.11 shows the differences due to the crises. When utilising GDP per capita for all of the above dates, I find that 1994 and 1995 had a negative effect on GDP per capita, 2008 and 2009 are insignificant yet 2007 is positive. A negative effect on GDP per capita is expected with regards to the Tequila Crisis. As stated above, GDP per capita did not recover to previous levels until 2001. However, 1994 also coincided with NAFTA, and an increase in employment in the manufacturing sector. Therefore, manufacturing wages are used to interact foreign market access with the crisis years. When utilising manufacturing wages for all of the above years, the results change significantly. The beginning of the Tequila Crisis, 1994, becomes positive and significant for manufacturing wages, while 1995 is insignificant. The Global Recession (2007-2009) shows different results as well, with 2007 is negative and 2009 is positive, both significant. This reflects the increase in wages in 1994 due to NAFTA, as well as in 2009 when their manufacturing exports recovered to previous levels.

Variables	(1) GDP per capita	(2) Manufacturing Wages
FMA* 1982	0.00974*	-0.117*
	(0.00486)	(0.0671)
FMA *1985	-0.0316	0.216
	(0.0137)	(0.196)
FMA * 1994	-0.0168***	0.440***
	(0.00443)	(0.0586)
FMA * 1995	-0.0198***	0.0903
	(0.00614)	(0.0744)
FMA * 2007	0.0926***	-0.587*
	(0.0208)	(0.291)
FMA * 2008	0.0282	-0.0572
	(0.0221)	(0.325)
FMA * 2009	-0.00206	0.0628**
	(0.0323)	(0.0225)
Constant	1.304	-142.9***
	(1.587)	(25.75)
Observations	24	24
R-Squared	0.744	0.907

Table 3.11: Mexico's FMA with Crises, GDP per capita and Manufacturing wages

It is possible that being in close to an economic centre gives a highly positive link for income during a crisis. There is of course a drop in demand, but given lower trade costs, the demand will still be fulfilled by exporters close to the economic centre. Looking at Mexico's exports and GDP during the global crisis, they recovered more quickly than other countries, including the USA and Europe. This would be reflected in their results for manufacturing wages, as those in that sector would recover quicker than the rest of the economy. It does confirm the distributional differences in the effect of these changes on the entire economy.

3.5.5 Robustness measures

There could be additional variables that are not modelled which are correlated with manufacturing wages. There is also the concern that the econometric results for GDP per capita in Mexico is being explained using measures of demand and supply capacity in other countries that are likely to be correlated with their GDP. For the pooled results, are the results just picking up the rich countries that tend to be near other rich countries, particularly with Europe? Redding and Venables (2004) address this issue by instrumenting market access with distance to economic centres. They're also concerned with whether the model does not completely model the fundamental determinants of levels of technical efficiency. There are three IVs utilised in this analysis, for distance to USA, China, and Germany. Therefore, instead of an over estimation of the effect of being within an economic centre, such as Europe, these dummies instead represent the distance from three large economic centres. These IVs could still be weak; therefore, the explanatory power of each instrument will be checked. The results for all of the alternative IV measures are in Table 3.12. It was completed for the entire panel in 1996 to confirm the robustness of the measures. The coefficients are similar, positive and significant. The other economic variables barely change significance and sign. Therefore, the variation in income across developing countries can be explained by the variables in the model, which includes the differential access to economic centres. Furthermore, conducting a Hausman test for endogeneity confirms that the IV's are not endogenous. A Sargan test follows, with the p values available in Table 3.13. The null hypothesis that the excluded exogenous variables are uncorrelated with the wage equation residuals cannot be rejected.

Variables	(1) 1996	(2) 1996
FMA	0.767*	0.726**
	(0.411)	(0.678)
Rail	0.558	0.444
	(0.419)	(0.419)
Forest	-0.620*	-0.419
	(0.312)	(0.347)
Stability	-0.537	-1.054
	(1.051)	(1.701)
Landlocked	0.945	2.466
	(0.613)	(2.643)
Constant	8.166**	1.952
	(3.578)	(5.942)
IV's included	No	Yes
Observations	19	19
R-squared	0.537	0.160

Table 3.12: IV results for wage equation, 1996

	Test	Scores
Sargan test of over identified model, using IVs	Test of overidentifying restrictions	Sargan score $Chi^2(2)$= 0.387996 (p = 0.9237) Basmann $Chi^2(2)$ = 0.229312 (p = 0.8917)
Wu-Hausman and Durbin tests for endogeneity, using IVs	H_o: Variables are Endogenous	Durbin score: $Chi^2(1)$= 4.73841 (p =0.0295) Wu-Hausman F(1,12) = 3.987 (p=0.0690)

Table 3.13: Sargan and Hausman tests, 1996

3.6 Summary and Conclusions

In summary, this chapter analysed the distributional effects of a change in trade policy on income in Mexico from 1962-2011. Utilising a gravity equation on manufacturing exports, the results were an increase in the border effect after NAFTA, and a decrease in the distance effect. The preferred composition of FMA, which was slightly different than the original Redding and Venables (2004) construction, showed very little overall change in Mexico's foreign market access. Therefore, they are not trading with any new partners, only the same partners with higher volumes. The effect on their GDP per capita was insignificant pre and post trade liberalisation while the effect on manufacturing wages was positive and significant, pointing to a distributional difference in the effect of the policies within Mexico (Blecker, 2014; Esquivel, 2011). Other variables such as urban population, development status, arable land, and ores and metals had a significant effect on their income, fitting in with the literature (Hall and Jones, 1999; Acemoglu, 2001; Bhargava, 2010; Dollar and Kraay, 2002). Their crises in the 1980s and 1994 Tequila Crisis impacted their GDP per capita significantly with respect to foreign market access. However, the impact on manufacturing wages was shorter and quickly rebounded.

In light of the changes in trade to their trade determinants from Chapter 2, this chapter was interested in the implications of these changes to their income. The change in manufacturing was supposed to provide higher growth than pervious policies, and therefore the motivation in this chapter was to conduct analysis on whether these policies changed their income. The chapter is an important addition to the literature, given the approach. The chapter combined multiple approaches to explaining between and within country income, while also providing analysis on the effects of crises. As well, this chapter applied a market access measure, for country not analysed, and for multiple years. This provided a continual understanding of the effects of trade on income. The difference in these results and Redding and Venables (2004), Head and Mayer (2010), or Hanson (2005), is due to the fact this chapter is one of the first to apply a FMA on a developing country (other than Hering and Poncet, 2008, 2009).

This chapter was also interested in the distributional effect of these changes, given the discussion in the literature. Therefore, given the above results there are a few questions and policy suggestions. First, higher technology exports have a positive and significant effect on GDP per capita and wages. Therefore, Mexico could use to enact programmes to increase the skill level of the country, to provide higher wages, also confirmed by previous work by Robertson (2006). These types of policies include social assistance subsidies to those in work, education subsidies, and apprenticeships. In addition, increased trade agreements to provide certain countries, such as the USA, with high skilled exports would also improve the skill level in the country. Second, as foreign market access matters to manufacturing wages, it would be important to continue to exploit this for those within manufacturing.

Given the overall research question, this has important implications. The distributional effect of the policies on income is not equal within the economy and it would be important to promote domestic policies to bridge the gap. Given the motivation for the thesis, this is a crucial chapter. This details the unequal distributional effects and therefore the focus is now on what kind of domestic policies could improve the unequal distribution within Mexico. For example, programmes such as *PROCAMPO* and *PROGRESA* provide subsidies to those in a lower income level within the country to promote higher health, compensate the farmers for loss of competition, improve agriculture output, and education levels in rural areas. *PROCAMPO* also addresses an often forgotten sector in the literature, agriculture. For multiple developing countries, agriculture can represent over 50% of income generated within the country (Kwa, 2001). When NAFTA was enacted, it also removed restrictions on importing agricultural products, resulting in a loss in competition for the farmers. PROCAMPO was an opportunity for the Mexican government to compensate the farmers, while also promoting a higher standard of living, reduction in poverty, and an increase in rural incomes and productivity. Therefore, an analysis of whether these policies have a positive effect on domestic standard of living would be very important. By improving their development level, it does provide a boost in income growth and stability, as discussed previously. Furthermore, the need to compensate these farmers from NAFTA is supposed to be addressed by *PROCAMPO*, yet it is possible more attention domestically is necessary.

Chapter 4: Have Subsistence Farmers Benefited from *PROCAMPO* Subsidies in Mexico?

4.1 Introduction

This chapter analyses the effects of an agricultural subsidy, *PROCAMPO*, on Mexican farmers in three waves (2002, 2005, and 2009) while utilising a propensity score matching method to look for treatment effects on specific outcomes, such as income, production, and consumption. Therefore, given the background of *PROCAMPO* and subsequent literature, what were the actual effects of *PROCAMPO* on all farmers from 2002-2009? Was there an increase in their income or production? Utilising this method, this chapter finds that the effects of the subsidy were not distributed equally on all of the farms, with the larger farms receiving a significant treatment effect when compared to the smaller farms.

The motivation arises from Mexico's change in economic policy in the 1990s. As discussed in Chapters 2 and 3, there was an obvious shift in income and trade related to the total economy and those within manufacturing. This contributed to an unequal distributional effect of the trade policies within the country. While the country liberalised trade in manufacturing and agriculture in the 1980s and 1990s, the most recent economic support given to the farmers were in the form of price controls in the 1990s, during their shift from import substitution policies to trade liberalisation. During the shift to liberalising their economy, Mexico signed NAFTA, which liberalised trade with the United States and Canada in agriculture. This prompted the Mexican government to provide support to previous farmers who might lose out due to competition from heavily subsidised US farmers. Therefore, they provided the subsidy, *PROCAMPO*, to be given only to farmers who historically farmed in the previous three seasons before winter 1993. This was a cash transfer, and the proposed effects were supposed to raise poor income, production, and credit access. Previous work on *PROCAMPO* has included work on the effect on migration (Gonzalez-Konig and Wodon (2005)), the multiplier effect using the 1994 and 1997 census (Sadoulet et al (2001), Cord and Wodon (2001)), and the effect of *PROCAMPO* on the indigenous population in the South (2004). However, there are not any discussions of the long-term impact of the programme in the last decade.

The analysis is an important aspect of the research question, as this attempts to understand the implications of trade policies on all aspects of the Mexican economy, with important lessons for other developing countries. This is a distinct contribution to the literature as my analysis goes further than the literature, and shows the aggregated and disaggregated effect of the subsidy. This also means it is possible to compare to the previous literature as well as use these results to propose further policies in this sector. Section 4.2 discusses further policy information on the agriculture sector before *PROCAMPO*. It also includes an overview of the subsidy programme and the intended effects. Section 4.3 reviews the literature on the effects of *PROCAMPO* and other similar subsidies. Section 4.4 describes the data utilised in the analysis and Section 4.5 describes the propensity score matching method. In Section 4.6 the treatment effect of *PROCAMPO* is analysed utilising a propensity score matching method. To understand the distributional differences between farms, four populations are studied within the farming industry in Mexico. First, the pooled effect of the subsidy is measured. Next the population is divided by farm size with small (less than 5 hectares), medium (5 to 10 hectares), and large (greater than 10 hectares). Contrary to the limited literature, treatment effects for *PROCAMPO* shows significant distributional differences. Specifically, smaller farms exhibited negative treatment effects for production, while large farms showed highly positive and increasing treatment effects for the entire period. Section 4.7 concludes with further options for the Mexican government, to continue to improve the conditions and income of farmers.

4.2 Background

Pre trade liberalisation (1980s), Mexico relied on import substitution and then oil-led growth for their overall economy. Table 4.1 details the policies utilised with the effects in the sector. In this period, Mexico was a net exporter of food and meat, especially wheat, rice, and beans. As seen in Figure 4.1, from 1962-1982, Mexico’s value of exported agricultural products stayed relatively the same. The second important period in this discussion is the debt crisis, trade liberalisation period from 1983-1993. This period of growth and the neglect of the agricultural sector set the tone for the response to the economic crisis. By the 1980s, after neglecting agricultural productivity for over two decades, Mexico was a net importer of food, as their demand had outstripped supply in the late 1960s. In Figure 4.2, there’s a large drop in agricultural imports after the 1982 debt crisis, which lasted until 1987. Exports increased slightly, but stayed relatively the same. There was an increase in total exports for Mexico during this period, but it was mostly in manufacturing as Mexico eliminated tariffs more significantly in the manufacturing sector than agriculture. However, by 1989, Mexico was a net importer of food. On the other hand, the majority of the agricultural sector remained heavily protected until the late 1980s. Import licenses covered 38% of agricultural products, accounting for 66% of all import licenses (OECD 2006). In Figure 4.3, Mexican imports declined, in part due to the Tequila Crisis of 1994. This resulted in a drop of overall imports as well as a decline in GDP per capita for Mexico. The performance of agriculture in the economy had been declining over the last 50 years. However, it began to recover in the 1990s. In the early 1990s, primary agriculture as a portion of GDP grew at 1.2%, while after the currency crisis (1994-1996) the agricultural GDP growth was 2.4% per year.

Period	Policies	Description of Sector
1910-1940s	· Land Reform and Distribution	· Over 20 million hectares of land distributed, mostly to ejidos.
1940s-1980s	· Very little protection and credit for agriculture sector · Import Substitution for the manufacturing sector	· Rise in imports, yet still a net exporter of food and meat
1982-1993	· GATT, Food subsidies · Maximum tariff for sorghum, oilseeds, etc. : 20%	· Net importer of food by 1989 · Procampo is signed in 1993, due to the incoming NAFTA
1994-present	· NAFTA · Procampo	· Net importer of food, mostly wheat and maize

Table 4.1: Timeline of key agricultural policies, 1962-present
Sources: Kehoe (1992), Lustig (1992), Yunez-Naude (2003), UN Comtrade

However, with the 1990s came rapid agricultural trade liberalisation. Quantitative restrictions on imports of 12 traditional crops were eliminated by 1991, except for maize and beans. There was an expensive combination of price support and general consumption subsidies based on trade barriers and direct intervention in the market. Mexico supported producers through a price floor policy on basic crops, especially maize and beans. There were subsidies for urban consumers, like tortillas. CONASUPO (the National Company of Popular Subsistence) would purchase, at a government determined prices, all major grains and oilseeds production for which no buyer was found. This provided a guarantee that producers would be able to sell all goods produced, at a set price. The 1990s also included marketing policies from CONASUPO. ASERCA (Agricultural Marketing Support and Services) in 1991 started a marketing payment system to cover the difference between an announced policy price and a price equivalent to the import price of the commodity

In the first two years post-NAFTA, the primary agricultural sector grew at a rate faster than the rest of the economy. However, the contribution of primary agriculture to overall GDP has decreased form 6.3% in 1990 to 5.4% in 2004. Primary agricultural goods trade has increased since policy changes starting in 1994. Trade in food, beverages, and tobacco has increased significantly over this period. On the other hand, agricultural imports have also increase since the early 1990s, at a trend rate of 7.1% a year. In comparison, the trend growth in Mexico’s trade of food, beverages, and tobacco over the period was 12.6% for exports and 9.5% for imports. This implies growing integration with foreign agricultural markets, as the growth rates of exports and imports of primary and process agricultural goods in real terms exceeded the rate of growth of real agricultural GDP in this period (1994-2005). Mexico's food consumption increased rapidly in this period, and thus relied on further imports of food products, even with the implementation of *PROCAMPO* subsidies to increase agricultural production. In every year since 1995, Mexico has had a trade deficit in primary agriculture and fisheries (OECD 2005). The majority of Mexico's imports originate from the US, while the US buys the vast majority of Mexico's agricultural exports. Canada's share of Mexico's total imports has doubled in this period, and the European Union's share has declined from 13.3% in 1990-1993 to 6% in 2003-2005.

Mexico's composition of agricultural imports and exports has changed in the last 20 years after NAFTA. Imports are highly diversified in composition; no single category of goods accounts for 10% of the total. The share of all the "others" is about 40% of agricultural imports, which is equal to the share of the top ten goods. The top ten exports account for about half of the total exports of agricultural goods. However, this has changed since NAFTA's implementation. For example, the share of coffee in the total is lower than 2003-05 than in 1993-95. From 1993-1995, coffee was the second highest export of agricultural goods from Mexico. By 2003-2005, coffee was barely in the top 15 export goods. The value had declined by more than half. The top exported agricultural good from Mexico in 1993-1995 was tomatoes, but in 2003-2005 it is beer. Overall, this depicts a situation where Mexico's agricultural exports are rising over this time period, with a shift to higher value products exports, such as processed food.

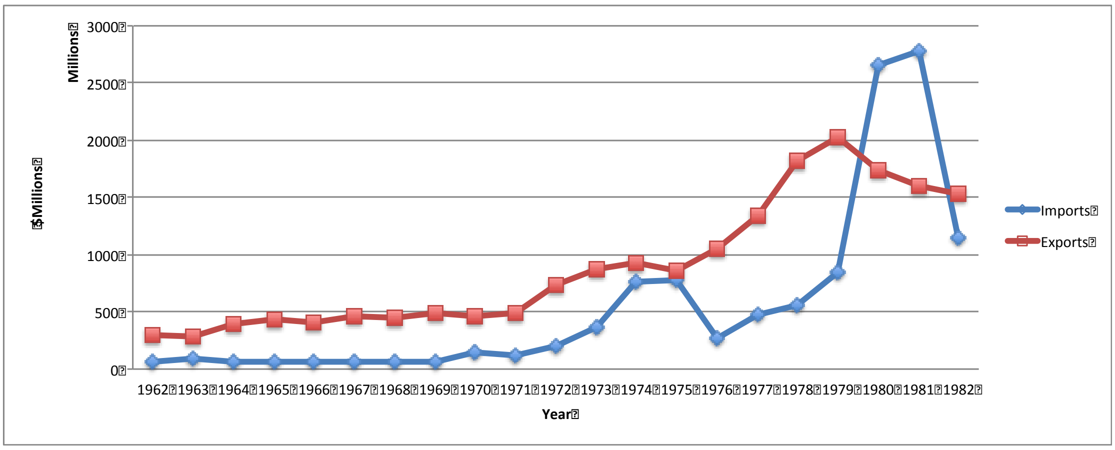


Figure 4.1: Mexico's agriculture imports and exports, 1962-1982
Source: UN Comtrade

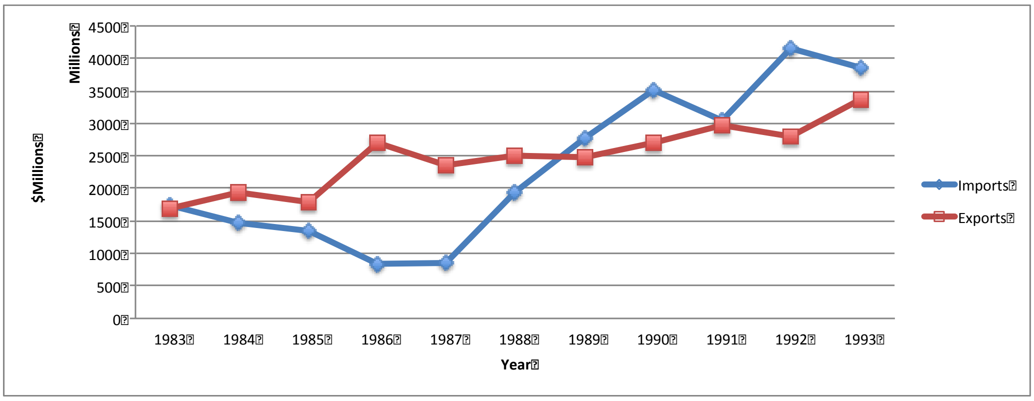


Figure 4.2: Mexico's agriculture imports and exports, 1983-1993
Source: UN Comtrade

Products covered under *PROCAMPO* subsidies included barley, wheat, beans, maize, cotton, rice, soy, sunflower oil, and sorghum. Of these products, only one product, wheat, is in the top 30 exported agricultural products from 2003-2005. By 2011, Mexico imports more agricultural products than they export, with wheat representing just 1.7% of their exports and 7% of their imports. Wheat represents 17.5% of all exported agricultural products and 34% of imported agricultural products. Previously, in 1993-1995, none of the products were in the top 30 exported agricultural products. However, after the implementation of the *PROCAMPO* subsidies, imports of some of the products have declined in this period. For example, in 1993-1995, sorghum, maize, wheat, and sunflower oil were in the top 10 imported agriculture goods. By 2003-2005, while the value of imports of maize, wheat, and cotton had increased in this period, sorghum had decline by almost half. The value of maize, wheat, and cotton imports had tripled in this period. Primary agriculture imports and higher value agriculture exports have increased.

4.2.1 Income and Agriculture

Rural population statistics related to income have changed in the last 50 years. In multiple developing countries attempting to reform their economy through trade agreements targeted to the manufacturing sector, 50-90% of income is dependent on agricultural activities (Kwa, 2001). The composition of income for the rural population is very different as well. It shows that rural income isn't dependent on agricultural wages or farm proceeds. In 2002, non-agriculture salaries and wages comprised 41% of rural income, with farming activities at 18%. Public transfers, such as *PROCAMPO*, comprise only 4.4% of rural income. Other studies on similar countries include Newham and Kinghan (2015), who show that countries like Vietnam point to a link between higher welfare and diversification of rural income. Specifically, this is the switch from agriculture to wage employment. These studies find that welfare is higher for those who diversify rather than those who specialise in agriculture. Therefore, the diversification after NAFTA and *PROCAMPO* is not surprising given the significant changes in trade regime and circumstances.

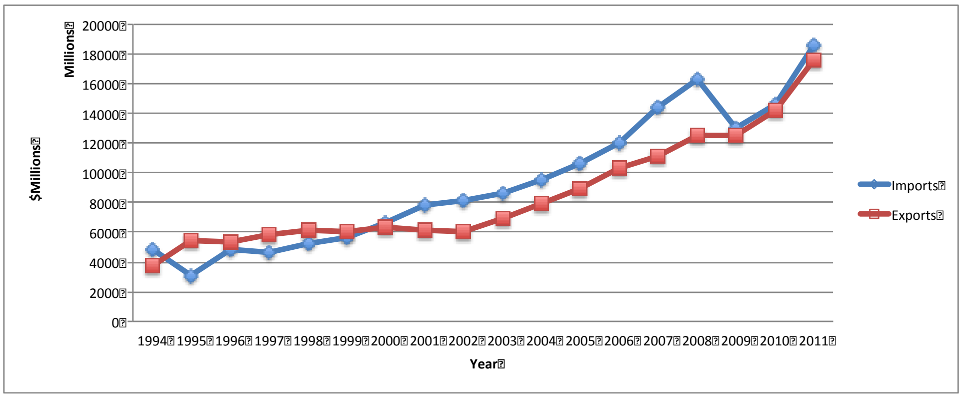


Figure 4.3: Mexico's Agriculture Imports and Exports, 1994-2011
Source: UN Comtrade

According to the IFAD (2004), the international trade regime, especially in agricultural products, impinges more directly on the economic lives of the rural poor. For many of the poorest in developing countries, agriculture is largely dominated by small-scale production. The IFAD (2004) concludes by stating that if trade is to serve as an instrument for development, it will need to be a different type of trade or further development policies will need to help compensate for the loses in development these poorer farmers will suffer. Furthermore, there is no guarantee that a liberalisation of trade in agricultural products (as seen in NAFTA) will result in a rise in income for the rural poor. In order for that to happen, smaller producers in these countries will need to be equipped with resources and partnerships so that they can access the new liberalised markets, therefore profiting from them. In effect, the new liberalised trade needs to result in the rural poor gaining a stronger bargaining position. This is vitally important for the Mexican producers. Very little income and employment is derived from local agro-processing in low-income countries. Although many of the rural poor are in the agricultural sector, they do so at a subsistence level, only producing what they need to survive with very little surplus. Therefore, when international agricultural prices for just a few commodities are good, their incomes can rise significantly and they can invest.

Finally, IFAD (2004) emphasises the importance that U.S. agricultural subsidies would have on the rural incomes of other developing countries, such as Mexico. In 2001, the U.S. provided subsidies for cotton producers, amounting to $3.4 billion. This encouraged over-production and drove world prices to a 30-year low. This resulted in losses for central and western African countries, amounted to $301 million, with smaller farmers being the hardest hit. According to the IFAD (2004), a 25% increase in cotton prices (equal to eliminating U.S. subsides for cotton) would lift 250,000 people out of poverty in Benin. These subsidies in industrialised countries create distortions and difficulties for local producers. In Mexico, it was estimated that NAFTA would result in a drop in domestic maize prices to fall into line with international prices, but this would take 15 years. However, it took only 30 months. The result is an increase in imports for maize from 1993 to 2000. One quarter of the corn consumed in Mexico comes from the United States, where it is heavily subsidised. Given the technological and subsidy advantage to large producers in the United States, producers in Mexico cannot keep up with the lower prices and competition from these producers. An estimated 700,000-800,000 rural livelihoods have been lost due to subsidised maize imports, equal to 15% of the economically active population employed in agriculture. Given the distortions in the market due to these subsidies as well as the decreasing prices, Mexico's government decided to provide their own subsidy to their producers. *PROCAMPO* is a subsidy provided to maize producers, as well, to help cushion the blow of allowing further trade in agriculture. However, with this example, it is possible that it is not having its intended effect.

4.2.2 PROCAMPO

PROCAMPO and other programmes are part of an overall policy attempt to relieve rural poverty, improve rural incomes, increase access to credit and other opportunities, and improve agricultural production. Given the trade changes in agriculture, the Mexican government thought that the easiest way to transition to free trade in agriculture was to provide cash transfers to farmers. Thus in August 1993, Mexico's government introduced *PROCAMPO*, or *Programa de Apoyos Directos al Campo* (the Programme of Direct Payments to the Countryside). Operated by *Apoyos y Servicios a la Comercializacion Agropecuaria* (ASERCA, Agricultural Marketing Support and Services), it was started to help farmers cope with lower trade protection and with the removal of direct price support programmes mentioned above.

There were multiple main objectives:

- To improve the competitiveness at the domestic and international levels in order to improve the living standards of rural families and to modernise the marketing system.
- Advance the adoption of advanced technologies and introduce production methods to increase efficiency and production.
- Increase the income of rural producers, especially the poorest producers (subsistence farmers).
- Develop an awareness of the importance of natural resources conservation
- Enable land conversion where possible to use the land for activities with higher returns to provide economic certainty to rural producers and improve their capacity to change and respond to economic shocks.

The eligible farmers are those who would be most affected by the change in price of crops, given the previous price support policies provided protection against foreign price changes. There were other options available to the government to provide a similar objective, such as a credit program, food subsidy, and an employment programme. The credit programme is especially important, as it would enable previous farmers who lacked the access to credit to improve technology and give them an opportunity to compete against foreign competition. In addition, for smaller farmers, the only available credit is informal local community credit programmes, which are not sufficient to invest in technology changes, which are needed to compete.

To achieve the objectives, Mexico determined that the *PROCAMPO* programme would provide a cash subsidy to farmers who had farmed previously and only in certain crops, such as maize, beans, wheat, rice, sorghum, soybeans, cotton, safflower, and barley during the three agricultural seasons previous to August 1993. Therefore, the programme was not linked to current production, but previous use of land. It also extended to subsistence farmers, as the programme did not require the farmers to be selling their goods, only those who produced goods. This is very important. Subsistence farmers are increasingly less likely to sell any of their produce, as they only produce what is necessary to survive. In that case, they are less likely to benefit from the previous price support policies. Therefore, this confirms *PROCAMPO*'s objective of increasing rural income, especially of the poorest producers.

Initially, the programme would provide the subsidies for a 15-year transition period after NAFTA trade and tariff changes. However, in 2008 it was extended to 2010, and then the government announced the end for 2014. Although *PROCAMPO* is specifically targeting poorer subsistence farmers, it is considered a regressive programme. The smallest farmers receive 10% of the overall allocation due to the area being used to crop. In 1997, each recipient received $329 on average, at about $68 per hectare. They initiated *PROCAMPO* in this way so that people couldn't start farming to take advantage of the cash transfers. However, it could change whether they kept the farm, or had a family member run it. The transfer goes to the farm, not the individual. As well, at least 50% of the transfer must be used on the farm, such as investment by improving technology or increasing their yield. *PROCAMPO* sets the entitlement according to historical area, minimises distortions in productive decisions, and transfers resources to farmers, including subsistence farmers. This follows the importance of lump-sum subsidies, tax the gainers and transfer income to the losers. Therefore, utilising *PROCAMPO* it is possible to redistribute gains from trade. However, there could be a negative effect of this, as any attempt by the government to achieve such a redistribution of income would lead people to change their behaviour. While the Mexican authorities attempted to avoid this by linking the subsidy to historic farming, it still raises questions on whether there were any other unintended consequences as a result of *PROCAMPO*. To date, there are very few studies comparing the results of the conditional cash transfers in Mexico.

4.3 Literature Review

There is little empirical evidence of the effects of subsidy programmes due to a lack of good data. The majority of work completed on *PROCAMPO* utilise the 1994 and 1997 ENCASH panel survey. As well, the majority of the academic work focuses on the changes in migration (Gonzalez- Konig and Wodon, 2005; Cortina, 2014; Davis, 2003; Cuecuecha and Scott, 2009).

Davis et al (2002) estimate the effects on consumption and investment for 1997 and 1998 using regression analysis. They find marginal effects on consumption and a positive effect on investment. They utilised pooled farms, did not distinguish between the sizes of farms, and did not capture the effect of their local state. They also attempted to quantify the effects of *PROCAMPO* on policy outcomes that were not their intended effects, such as education. Both Cord and Wodon (2001) and Sadoulet et al (2001) used the 1994 and 1997 survey to estimate the multiplier effect of PROCAMPO. While Cord and Wodon (2001) found a multiplier effect of *PROCAMPO*, they also determined that it reduces the probability that ejido households will be poor. On the other hand, Sadoulet et al (2001) found a high multiplier effect for large and medium producers, but also that it eased liquidity for small producers. Cardenas-Rodriquez et al (2004) reviewed data from Mexico's 2000 census to test whether indigenous peoples living in southern states benefited from *PROCAMPO*, *PROGRESA*, or *FISM*. They found that indigenous peoples benefit more than non-indigenous peoples from the programmes, which reduce poverty in a substantial way. Other studies have focused on production and cultivation, but it would be very important to highlight the overall increase in income in the region due to *PROCAMPO*.

In a report about the agriculture and fisheries policies in Mexico, the OECD (2006) recommended Mexico fully outline the objectives for the *PROCAMPO* programme, and if indeed it is to improve rural life, then reorient *PROCAMPO*'s expenditures to achieve this objective. They detail the problems with *PROCAMPO* in that the money could be used more efficiently and effectively to alleviate rural poverty and transfer income to producers. They identify that *PROCAMPO* was a transitional policy, which has been extended multiple times, betraying its initial objective of providing transitional support to farmers adversely affected by NAFTA. Furthermore, they detail different policies that could be used to solve the more prominent problems in Mexico, such as supporting the development of the sector as a whole by investing in technology and research, privatising the land, expanding property rights, eliminating remaining trade barriers, and stopping any target income subsidies. These create distortions that bias production towards historically planted crops, are not very effective as income support, can be regressive, and can provoke the over-exploitation of natural resources. One of the outcomes will test whether there is an increase in production of the *PROCAMPO* goods, which were historically planted crops. This chapter utilises more data sources than the previous work completed on *PROCAMPO*, and thus provides an excellent source of information on whether *PROCAMPO* was successful in increasing the production of *PROCAMPO* goods, as well as the effect of these farmers producing more of this good on their income, assets, and credit options.

Mexico is not the only country that provides direct subsidies to its agricultural sector. As mentioned before, the U.S. provides farming subsidies, and the European Union provide subsidies to farming industries. Of developing countries, in 2012, China provided over $160 billion in farming subsidies to improve production. Other countries such as Brazil, Russia, India, and Indonesia are now including subsidies to improve rural poverty and production. However, according to Tang, Wang, and Zhao (2015), there are other options available to improve market conditions and information within the agriculture sector. This includes providing direct agricultural advice to enable farmers to improve operations (such as cost reduction measures, quality improvement, and process yield increase) as well as providing market information about future price/demand to enable farmers to make better production planning decisions. This information would be provided without charge, and the farmers can use the market information to improve their production plans without incurring significant cost. However, this approach has been done by Mexico, in the form of price support policies. This did not directly impact smaller farmers, as they were unable to produce enough goods to sell on the international market. On the other hand, adopting agricultural advice to improve operations requires significant upfront investment, such as in purchasing equipment, fertilisers, pesticides, and higher quality seeds. This information could benefit mostly larger farmers with more access to credit or funds, while the poorer farmers would not be able to benefit from this new information. Therefore, this chapter provides another contribution to the literature. As one of our main variables is to review how the small producers are able to access more credit, it will be important to compare this outcome with medium to large scaled producers. Once this is complete, an overall comparison between Mexico's results and the above mentioned countries can be conducted. This chapter will provide more evidence to the ability of small producers to access credit, and how subsidies can aid this.

In India, among many of the subsidies provided, in the state of Punjab, they provide electricity subsidies to farmers. This promotes an incentive for farmers to adopt electric pumps and motors to support a successful green revolution. All the major farming inputs saw a big jump along with cropping intensity and irrigated area. The use of electricity for irrigation and shifting production to irrigated crops resulted in the two-fold growth in total food grain production in Punjab between 1960 and 2000. It encouraged production and productivity. However, Kaur et al (2010) determine that the subsidy encouraged wasteful use of scarce resources like water, and led to unsustainability within the agriculture sector. It is also obvious, like the previous policies, that these policies are only geared towards large-scale producers. As discussed above in the literature, there are very few programmes to aid small producers, other than providing direct subsidies and education opportunities. Given the previous work in India, this chapter analyses whether these subsidies, provided to large farmers, were mostly benefiting the large-scale producers in Mexico. This is a distinct contribution to literature, as this analysis is missing in the literature on *PROCAMPO* and Mexico. Different to other papers in the literature, this chapter compares the three types of producers, in order to determine if Mexico's larger farmers benefited the most from *PROCAMPO*.

Del Granado, Coady, and Gillingham (2012) review the effect of fuel subsidies on developing countries. They determine that more than half of this impact arises from the indirect impact on prices and goods and services consumed by households. The top income quintile captures six times more in subsidies than in the bottom quintile. This result is very important, especially when all subsidies are reviewed. NAFTA had an impact on prices, and thus the goods that households would consume. As well, *PROCAMPO* was supposed to compensate for this change. However, as in the previous work, *PROCAMPO* was also given to larger farms, and those at the top income quintile. While the poorer households received the subsidy, the wealthier households would receive the subsidy and possible positive spill over from a change in price as discussed in Del Granado et al (2012). Effectively, they benefit significantly more than the other households.

Hence, this chapter is a contribution to the literature because it provides a more distributive discussion of the programme effects, utilises more households, more years, and more variables than any of the previously mentioned work. As the majority of the academic work utilises the same surveys (1994 and 1997 ENCASH), this chapter is a unique contribution because of its ability to provide new evidence, using a new data source (Mexican Family Life Survey). Furthermore, it provides evidence of a larger spill over effect for larger/wealthier farms in comparison to poorer farms, as discussed by Del Granado et al (2012). This chapter also contributes to the literature by discussing the overall effect of producing PROCAMPO goods on small scale farmers, access to credit on these farmers, and whether any of the farmers were capable of seeing an income boost from the subsidy.

4.4 Data

The analysis uses data from the Mexican Family Life Survey (MxFLS), conducted over a 10-year period, in three waves (MxFLS-1, MxFLS-2, MxFLS-3). MxFLS-1 corresponds to interviews in 2002, while MxFLS-2 was collected in 2005-2006, and MxFLS-3 was collected in 2009-2012. It is a longitudinal, multi-thematic survey representing the Mexican population at the national, urban, rural, and regional level. It was conducted by researchers from the Iberoamerican University (UIA) and the Centre for Economic Research and Teaching (CIDE) with collaboration from Duke University the National Institute of Public Health (INSP), the National Institute of Statistics and Geography (INEGI) and the University of California, Los Angeles (UCLA). Implemented in 2002, the first wave collected information on the well-being of the Mexican population. The second wave MXFLS-2 and MXFLS-3 aimed to relocate and re-interview the sample of the MxFLS-1, including individuals who have moved within Mexico or immigrated to the United States. They also interviewed individuals or households that grew out of previous households. Due to their diligence, over 90% of the original sample households were located and interviewed in MxFLS-2 and MxFLS-3. There are over 35,000 observations, but the analysis is restricted by each wave as well as farm size.

	2002	2005	2009
Pooled		Mex$31,240.23 US$2,937.65	Mex$35,224.31 US$2,572.99
Small (<5 hectares)	Mex$16,974.77 US$1,626.04	Mex$24,395.61 US$2,294.02	Mex$26,851.51 US$1,961.39
Medium (>5 hectares and <10 hectares)	Mex$20,167.36 US$1,931.89	Mex$31,423.52 US$2,954.89	Mex$33,240.10 US$2,428.05
Large (>10 hectares)	Mex$36,485.68 US$3,495.03	Mex$37,347.97 US$3,511.99	Mex$44,426.52 US$3,245.18
GDP Per capita	Mex$72,536.53 US$6,948.41	Mex$83,201.7378 US$7,823.83	Mex$105,278.01 US$7,690.19

Table 4.2: Mean Income for each Farm size
Data: Mexican Family Life Survey, 2002, 2005, and 2009

Mexican pesos and US dollars

In order to compare between individual farm sizes, smaller farms are restricted to those with a plot size of below 5 hectares, medium farms are between 5 and 10 hectares, and large farms are over 10 hectares. This is very important because of the difference in the *PROCAMPO* payment for each farm. The observations for each outcome grouping will be detailed in the outcome tables. Tables 4.2 and 4.3 provide income and regional differences between the farm groupings. As seen in Table 4.2, the small farms earn significantly less than the medium or large farms. However, all of the groupings earn roughly half of the national income (GDP per capita). Table 4.3 provides the number of treated and non-treated individuals in each Mexican state. In Figure 4.4, the extent to which the distributions of the propensity scores in the treated and non-treated groups overlap is shown for 2002. As seen, there is more than sufficient overlap between the two samples and thus the common support assumption is confirmed.

State:	Small	Medium	Large
Baja California Sur	T: 2 N: 72	T: 23 N: 18	T: 4 N: 37
Coahuila	T: 82 N: 35	T: 0 N: 10	T: 15 N: 39
Durango	T: 273 N: 178	T: 167 N: 68	T: 125 N: 41
Guanajuato	T: 74 N: 180	T: 62 N: 45	T: 64 N: 104
Jalisco	T: 39 N: 45	T: 3 N: 6	T: 6 N: 69
Estado de Mexico	T: 70 N: 96	T: 9 N: 6	T: 149 N: 422
Michoacán	T: 137 N: 175	T: 23 N: 30	T: 112 N: 242
Morelas	T: 37 N: 51	T: 0 N: 22	T: 16 N: 82
Nuevo Leon	T: 6 N: 50	T: 15 N: 28	T: 11 N: 42
Oaxaca	T: 419 N: 218	T: 75 N: 18	T: 242 N: 189
Puebla	T: 88 N: 210	T: 24 N: 3	T: 78 N: 236
Sinaloa	T: 44 N: 95	T: 280 N: 98	T: 233 N: 179
Sonora	T: 1 N: 120	T: 0 N: 29	T: 17 N: 103
Veracruz	T: 58 N: 221	T: 2 N: 38	T: 55 N: 233
Yucatan	T: 55 N: 65	T: 87 N: 31	T: 48 N: 60

Table 4.3: Treated (T) and Non-Treated (N) by State
Source: Mexican Family Life Survey, 2002, 2005, and 2009

4.5 Theoretical Framework and Methodology

4.5.1 Theoretical Framework of the Evaluation Problem

This chapter is interested in evaluating the causal effect of *PROCAMPO* relative to non-treatment on the living standards of Mexican households in the agriculture sector. To evaluate the effects of *PROCAMPO* on Mexican households, it is necessary to determine which programme evaluation tool to use and to utilise a method that can estimate the impact of intervention in the presence of selection decisions by agents. The method needs to use correct empirical correlations to separate out the causal effect of the treatment from the confounding effect of other factors influencing the outcome. There are multiple methods available to determine this including randomised experiments, instrumental variables, OLS, matching, and difference in differences.

The Roy-Rubin model (1951,1974) is utilised here to determine the impact of a treatment on the outcome of an individual. To do this, inference about this involves speculation about how this individual would have performed had he not received the treatment. In evaluation analysis, this problem is addressed in the Roy-Rubin model, whereby the main pillars of the model are individuals, treatment, and potential outcomes. In this chapter, we have a binary treatment, and the treatment indicator is thus D_i, which equals 1 if the individual I receives treatment, and zero otherwise. The potential outcomes are $Y_i(D_i)$ for each individual i, where i=1…N and N denotes the total Mexican population. Therefore, the treatment effect for an individual i is written as:

$$\tau_i = Y_i(1) - Y_1(0). \quad (1)$$

However, the evaluation problem, as described above, is that we can only observe one potential outcome for each individual. We cannot observe the counterfactual. In other words, once an individual does or does not receive the treatment, we do not know what would have happened if the opposite had happened. Therefore, estimating the individual treatment effect is not possible, and one has to concentrate on the population average treatment effects. The parameter this chapter utilises is the ATT (average among those observed to take the treatment), expressed as the difference between the heterogeneous impact of treatment (β) on the outcome variable (Y) given the observed attributes of individual i (X).

$$\tau_{ATT} = E(\tau|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1] \quad (2)$$

Again, the counterfactual mean for those being treated $E[Y(0)|D = 1\ ]$ is not observed.

A significant part of the evaluation problem is dealing with selection bias (Sianesi 2004). As we attempt to measure the treatment effect, it is not possible to observe the participants' outcomes with and without the treatment. Taking the mean outcome of nonparticipants as an approximation is ill-advised, due to the differences between participants and nonparticipants. This problem is selection bias, whereby a participant entering the programme may have characteristics that will affect the outcome (Caliendo and Kopeinig 2008). An easy example is whether more productive individuals enter the *PROCAMPO* programme. This would affect their outcome on productivity and income. Matching involves finding a large group of nonparticipants whose individuals are similar to the participants in all relevant pre-treatment characteristics *X*. As well, another problem in this evaluation is that it is impossible to observe the outcome for the control group in the state of treatment. As well, it is impossible observe the outcome for the treatment group without treatment. Therefore, matching is used to estimate ATT. We take the expected value of the outcome (Y_i) for those who have the treatment ($Y_i(1)$) minus the treatment for those without the treatment ($Y_i(0)$), if the treatment is being implemented (D_i = 1). The results from this chapter are the ATT, or average among those observed to take the treatment, effect. Once the ATT for each outcome is estimated utilising propensity score matching, they will be compared to other outcomes and to each group of farmers.

In order to utilise matching, and thus solve the self-selection bias, studies invoke some identifying assumptions including the conditional independence assumption (CIA), common support, and an estimation strategy (which, in this context is propensity score matching). The conditional independence assumption assumes that given a set of observable covariates, X, potential outcomes are independent of treatment assignment. These covariates are not affected by treatment. This simply states that selection is solely based on observable characteristics and that the model will observe all variables that could influence the treatment assignment and potential outcomes. The common support requirement, also known as the overlap condition, ensures that people with the same X values have a positive probability of being participants and non-participants. Finally, the estimation strategy utilised is propensity score matching. If the CIA and overlap conditions hold, the propensity score matching estimator for ATT is:

$$\tau_{ATT}^{PSM} = E_{P(X)|D=1}\{E[Y(1)|D=1, P(x)] - E\{Y(0)|D=0, P(x)]\} \quad (3)$$

Propensity score matching is the mean difference in outcomes over the common support, weighted by the propensity score distribution of participants. To estimate the ATT, propensity score matching is estimated. It entails forming matched sets of treated and untreated subjects who share a similar value of the propensity score. The propensity score is defined by Rosenbaum and Rubin (1983a) to be the probability of treatment assignment conditional on observed baseline covariates. Essentially, the distribution of measure baseline covariates is similar between the treated and untreated subjects. One-to-one matching, where the pairs of the treated and untreated subjects are formed such that matched subjects have similar values of the propensity score, is estimated. After matching, the treatment effect is estimated by directly comparing the outcomes between the treated and untreated subjects, or households in this sample. In practice, the propensity score is estimated utilising a logit or probit model. It is the predicted probability of treatment derived from the regression model. The PSM estimator for ATT is utilised and further econometric considerations are discussed below.

4.5.2 Methodology and econometric specification

Outcome:	Description in Mexican Family Life Survey
First Product	"Total value 7 days: first product cultivated"
Second Product	"Total value 7 days: second product cultivated"

Third Product	"Total value 7 days: third product cultivated"
First Plot	"Total value 7 days: first plot cultivated"
Second Plot	"Total value 7 days: second plot cultivated"
Third Plot	"Total value 7 days: third plot cultivated"
Onions	"Total value 7 days: onions cultivated"
Potatoes	"Total value 7 days: potatoes cultivated"
Chiles	"Total value 7 days: chiles cultivated"
Other Vegetables	"Total value 7 days: other vegetables cultivated"
Maize	"Total value 7 days: maize cultivated"
Rice	"Total value 7 days: rice cultivated"
Value of Food	"Total value 7 days: value of food cultivated"
Beans	"Total value 7 days: beans cultivated"

Table 4.4 Production
All production variables are measured in kilograms. This table describes the question asked of the participants of the survey, to construct the outcome variable utilised in this analysis.

Outcome:	Description in Mexican Family Life Survey:
Health	"Expenditure 7 days: health"
Domestic	"Expenditure 7 days: domestic"
Furniture	"Expenditure 7 days: furniture"
Corn Tortilla	"Expenditure 7 days: corn tortilla"
Bread	"Expenditure 7 days: bread"
Chicken	"Expenditure 7 days: chicken"
Steak	"Expenditure 7 days: steak"
Beans	"Expenditure 7 days: beans"
Sodas	"Expenditure 7 days: sodas"
Personal Items	"Expenditure 7 days: personal items"
Cleaning	"Expenditure 7 days: cleaning"
Media	"Expenditure 7 days: media"
Gambling	"Expenditure 7 days: gambling"
Entertainment	"Expenditure 7 days: entertainment"

Table 4.5 Consumption
All consumption variables are measured in pesos. This table describes the question asked of the participants of the survey, to construct the outcome variable utilised in this analysis.

Outcome:	Description in Mexican Family Life Survey:
Debt Paid	"Money Payed Debts, pesos, 12 months"
Savings	"Total amount savings, pesos, 12 months"
Total Value of Debt	"Debts Value, pesos, 12 months"

Table 4.6: Assets/Credit
All assets/credit variables are measured in pesos. This table describes the question asked of the participants of the survey, to construct the outcome variable utilised in the analysis.

Outcome:	Description in Mexican Family Life Survey:
Individual Income	"Individual income"
Monthly Main Income	"Monthly Income Main Job"
Monthly Second Income	"Monthly Income Second Job"
Annual Main Income	"Annual Income Main Job"
Annual Second Income	"Annual Income Second Job"

Table 4.7: Income
All income variables are measured in pesos. This table describes the question asked of the participants of the survey, to construct the outcome variable utilised in the analysis.

Different outcomes, Y, are considered including amount cultivated of multiple different goods (specifically PROCAMPO goods), individual income, profits, and money earned from selling goods. The individuals are matched using criteria to ensure individuals in the same state, with a similar family size, utilising their plot for farming and saving as the 1st income source, and of the same education level were matched. This was to ensure that previous heterogeneous characteristics that would result in heterogeneous impacts of the treatment were controlled for, such as education level, size of plot, and regional differences. A higher education level could result in more knowledge on improving cultivation. A larger plot will result in more goods being cultivated. Regional differences were utilised as a proxy for type of products being cultivated. This is to confirm that the people being matched are similar in their ability to cultivate items of the same price. Essentially, they are facing similar market forces and prices for the similar goods they produce. For example, in the larger farm group, the majority of these farms are located in Oaxaca, which is located in the south of Mexico. The majority of crops produced in that state is corn, beans, sorghum, and grains. However, for the medium farms, they are mostly located in Durango, which is further to the North of Mexico. The majority of crops produced there is cotton, wheat, and alfalfa. The two regions produce slightly different crops, and it would be disingenuous to not account for this when conducting the analysis.

To assess whether the propensity score model has been sufficiently specified, this involves examining the distribution of baseline covariates. It is important that the distribution is similar between treated and untreated subjects with the same estimated propensity score. After conditioning on the propensity score, if there remain differences in the baseline covariates between the treated and untreated subjects, then this could be an indication that the propensity score model is not correctly specified. First, it is necessary to compare the means or medians of the continuous covariates and the distribution of their categorical counterparts between treated and untreated subjects. This includes comparing the distribution of the estimated propensity scores between the treated and untreated subjects. This is useful to determine the common area of support or degree of overlap between the treated and untreated subjects, essential for comparing the two samples. Another method for estimating the mean of the covariates is to utilise statistical significance testing. In this analysis, the distributions between treated and non-treated individuals are compared to determine whether these two groups can be matched.

The next step is to understand whether the covariates utilised in the model are sufficient and should be included. There is a lack of consensus in the literature on choosing which variables to include in the propensity score model. Many sets of variables could be included, such as baseline covariates, baseline covariates associated with treatment assignment, all covariates that affect the outcome, and all covariates that affect both the treatment assignment and the outcome. As the propensity score is defined to be the probability of treatment assignment, there are theoretical arguments in favour of inclusion of only the variables that affect treatment assignment. Heckman et al (1997a) and Dehejia and Wahba (1999) show that omitting important variables can increase bias in the resulting estimates. It’s very important to choose variables that are unaffected by participation (or anticipation of treatment), such as age, farm size, household assets, and major production. In the case of *PROCAMPO*, these four items affect treatment assignment. Older farmers were more likely to participate in PROCAMPO, as the major requirement was historical farming activity in certain crops (also explaining the major production). Farm size was also a factor, with higher subsidies to those with larger plot sizes. Finally, household assets are included because this programme was intended to target subsistence farmers to improve their assets.

After determining the covariates to be used in this analysis, next it is necessary to choose a matching algorithm. The options available are nearest neighbour, calliper and radius, interval matching, and kernel and local linear matching. Nearest neighbour matching (NN matching) is considered the most straightforward estimator. The individual from the comparison group is chosen as a partner for a treated individual that is closest in terms of the propensity score. There are two cases within NN matching, called with replacement or without replacement. An untreated individual can be used more than once as a match with replacement, without replacement does not allow this. According to Smith and Todd (2005) if replacement is allowed, the average quality of matching will increase and bias will decrease. NN matching has problems though, whereby there is the risk of bad matching if the closest neighbour is far away. To avoid this, it is possible to impose a "tolerance level" on the maximum propensity score distance (or calliper). This is another way to impose the common support condition (Caliendo and Kopeinig 2008). A problem with this approach is that it is difficult to understand what choice for the tolerance level is necessary (Dehejia and Wahba 2002). However, in this analysis NN matching with replacement and a calliper will be utilised. In addition, after matching, there should be no systematic differences in the distribution of covariates between both groups and therefore the R2 should be fairly low. However, an F-test on the joint significance of the regressors will also be completed to confirm the matching quality.

As mentioned previously, ATT is only defined in the region of common support. According to Heckman et al (1997a), a major source of evaluation bias is due to a violation of the common support condition. It is impossible to compare the incomparable, as such. Therefore, it is a very important step to check the overlap and the region of common support between the treatment and comparison group. Lechner (2001b) and other authors determine that the best and most straightforward way is to check the density distribution of both groups. This has been completed in the results section, with our results showing no violation of the overlap or common support condition. It is necessary to implement the common support condition because it ensures that any combination of characteristics observed in the treatment group is observed in the comparison group. It is sufficient to ensure that there are potential matches in the comparison group. There are multiple options to determine the region of common support (Caliendo and Kopeinig 2008). The easiest option is to delete all observations whose propensity score is smaller than the minimum and larger than the maximum in the opposite group. NN matching only matches those matches that are the closest neighbour. Therefore, given NN matching already handles the common support problem sufficiently, it is not necessary for our analysis to do any other step other than visually comparing the density distribution of both groups.

4.6 Results

4.6.1 Pooled Farms

First, the effects of the pooled farms are detailed in Table 4.8 to 4.11. It is important to understand that the estimated coefficients are the ATT, the average treatment effect of the treated. These are the result of multiple estimations, while the individual outcome variables are tabled by category, production outcomes, consumption outcomes, income outcomes, and assets/credit outcomes. These outcomes were not run in the same model, but each individual outcome was estimated using the propensity score matching. Production is in Table 4.8, showing higher outcomes for the value of the first product produced by the farm in all three years. This increases significantly in 2005 and declines slightly by 2009. The *PROCAMPO* recipients produce more maize and beans. However, the value of the food produced is lower than the non-recipients. Given the price reduction in maize and beans due to increasing competition from imports, these farmers possibly could see a lower value of their food due to a lower price of the items they produce.

Outcomes	(1) 2002	(2) 2005	(3) 2009
First Product	4,419***	8,019***	5,891***
			(1,555)
	(689.2)	(1,462)	
Second Product	2,804***	1,129	626.6
	(860.2)	(629.1)	(1,015)
Third Product	-3,057***	1,997*	
	(619.6)	(1,060)	
First Plot	-2.153	-2.895	1,663
	(53.61)	(33.44)	(1,348)
Second Plot	3.696	-20.84	-61.68
	(24.00)	(42.98)	(51.68)
Third Plot	95.18	-199.4	-462.1**
	(59.74)	(132.6)	(221.6)
Onions	-0.726***	-0.0558	
	(0.151)	(0.234)	
Potatoes	-0.789***	-2.120***	
	(0.178)	(0.771)	
Chiles		3.295***	
		(0.848)	
Other Vegetables		4.022***	
		(1.055)	
Maize	4.712***	-1.516	4.449**
	(1.159)	(1.317)	(1.926)
Rice	1.257***	1.008***	
	(0.218)	(0.211)	
Value of Food	18.27	-56.90***	-15.40**
	(24.68)	(18.21)	(6.557)
Beans	8.773***	2.397***	1.493
	(1.323)	(0.493)	(1.160)
Constant	6,903***	9,167***	31,322***
	(470.4)	(945.8)	(4,658)
Observations	6,357	3,751	1,411
R-squared	0.006	0.008	0.046

Table 4.8: Production, Pooled Farms

All produce is in kilograms, plots are in hectares, and value of food is estimated in pesos. These are the estimated treatment effects, using the propensity score matching method. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there’s a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

These are the result of multiple estimations, while the individual outcome variables are tabled by category, production outcomes, consumption outcomes, income outcomes, and assets/credit outcomes. These outcomes were not run in the same model, but each individual outcome was estimated using the propensity score matching. Consumption is in Table 4.9, there are very little differences in their consumption of a basket of goods compared to the non-recipients. The outcomes are in kilograms. According to the original guidance for *PROCAMPO,* the government was expecting that *PROCAMPO* would provide the recipients with additional income to increase consumption of all goods. If they are removed from poverty due to the subsidy, then they would increase their overall consumption of goods, including entertainment, health, and food. However, these results show that they did not see the intended effect on their overall consumption.

Outcomes	(1) 2002	(2) 2005	(2) 2009
Health	56.63**	94.55***	40.09
	(28.50)	(29.23)	(30.13)
Domestic	-341.2***	-86.16***	-269.8
	(125.5)	(30.16)	(208.6)
Furniture	450.1***	-226.6*	0.497**
	(143.0)	(121.4)	(0.236)
Corn Tortilla	0.322*	1.554***	0.511
	(0.187)	(0.297)	(0.533)
Bread	-0.182	1.017	
	(0.485)	(0.800)	
Chicken	0.366***	0.509***	-0.00228
	(0.109)	(0.112)	(0.0882)
Steak	-0.194	-3.077**	1.483***
	(0.149)	(1.257)	(0.557)
Beans	0.146**	-0.102	0.948**
	(0.0668)	(0.111)	(0.394)
Sodas	0.513***	1.287***	-0.266
	(0.175)	(0.274)	(0.186)
Personal Items	0.486	5.940	-14.40**
	(3.005)	(4.773)	(5.891)
Cleaning	-0.354	8.082**	6.772*
	(1.907)	(3.745)	(3.738)
Media	-0.623	64.56***	16.47**
	(4.166)	(7.252)	(6.785)
Gambling	-2.169***	-2.651***	0.475
	(0.433)	(0.962)	(0.354)
Entertainment	-16.03***	-10.61	-13.29***
	(4.313)	(10.40)	(3.064)
Constant	310.2***	290.3***	293.8***
	(18.52)	(18.31)	(18.41)
Observations	9,637	6,367	7,765
R-squared	0.000	0.000	0.000

Table 4.9: Consumption, Pooled Farms

All consumption of food, like chicken, bread, corn tortilla, etc. are in kilos. Health, domestic, furniture, media, etc. are in pesos. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

In Table 4.10, the recipients of PROCAMPO did pay more debt in 2002 (Column 1) and 2009 (Column (3) than the non-recipients. There is a slight treatment effect on savings in 2009 and they also had more debt in 2009. The government intended for the recipients to be able to use the *PROCAMPO* certificate as collateral for receiving credit to improve their farm production, such as improving technology. According to these outcomes, *PROCAMPO* has had an effect on their overall total debt. However, another possibility is that due to a lower value of overall food, compared to the non-recipients, they need to take more debt out in order to survive each year. It is possible they are more vulnerable. Given these are the pooled farmers, it will be important to check whether small, medium, or larger farms are seeing a similar treatment effect.

Outcomes	(1) 2002	(2) 2005	(2) 2009
Debt Paid	4,126**	-2,689	8,531***
	(1,616)	(2,148)	(1,805)
Savings	-4,440	-2,222	3,476*
	(3,754)	(7,011)	(1,932)
Value Total Debt	-235.9	475.3	3,956**
	(1,288)	(552.3)	(1,839)
Constant	9,986***	15,443***	12,167***
	(997.3)	(1,363)	(1,013)
Observations	2,345	1,129	1,527
R-squared	0.003	0.001	0.014

Table 4.10: Assets/Credit, Pooled Farms
All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

Outcomes	(1) 2002	(2) 2005	(3) 2009
Individual Income	-4.397e+06**	-10,060	10,931
	(2.105e+06)	(13,492)	(7,904)
Monthly Main Job	-363.3*	225.3	-1.715
	(201.2)	(227.7)	(205.2)
Monthly Second Job	-970.6***		1,298
	(297.9)		(808.1)
Annual Main Job	-3,735***	405.5	-128.8
	(1,333)	(3,746)	(1,997)
Annual Second Job	-3,679***	95.10	3,764
	(1,371)	(4,372)	(6,680)
Constant		34,794***	31,322***
		(8,016)	(4,658)
Observations	3,789	1,558	1,411
R-Squared	0.000	0.000	0.001

Table 4.11: Income, Pooled Farms

All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

Finally, in Table 4.11, the changes in income are available for comparison. There was very little treatment effect in their individual income for all three waves. The only year with an effect was 2002, in Column (1). For each outcome, the recipients of *PROCAMPO* have a negative treatment effect regarding income. Therefore, they have a lower individual income and annual income from their main job (which is defined as farming activities, on their farm).

4.6.2 Small Farms

Outcomes	(1) 2002	(2) 2005	(3) 2009
First Product	-4,101***	-4,347***	7,716
	(838.3)	(1,351)	(4,903)
Second Product	596.6*	-1,211	353.3
	(310.0)	(1,114)	(3,149)
Third Product	-2,049***	3,847**	8,539
	(762.8)	(1,878)	(6,685)
First Plot	-37.46	34.39	-111.6***
	(132.4)	(58.03)	(37.41)
Second Plot	116.1***	-125.6***	-95.02
	(26.07)	(29.43)	(74.18)
Third Plot	75.84	-23.60	36.76
	(102.7)	(38.58)	(50.33)
Onions	-1.076***	-0.285	2.870***
	(0.302)	(0.433)	(0.562)
Potatoes	-1.416***	-0.139	0.412**
	(0.334)	(0.264)	(0.167)
Chiles		2.326***	10.01**
		(0.805)	(4.875)
Other Vegetables		-1.424**	5.328***
		(0.661)	(1.496)
Maize	3.145**	4.099**	7.045***
	(1.507)	(1.992)	(1.259)
Rice	0.657*	1.582***	0.639
	(0.388)	(0.245)	(0.443)
Value of Food	27.15	-93.90**	
	(26.96)	(37.68)	
Beans	2.564**	3.131***	2.162
	(1.271)	(0.624)	(1.350)
Constant	7,867***	9,650***	25,547***
	(583.2)	(878.0)	(4,011)
Observations	2,114	1,767	638
R-squared	0.011	0.006	0.004

Table 4.12: Production, Small Farms

All produce is in kilograms, plots are in hectares, and value of food is estimated in pesos. These are the estimated treatment effects, using the propensity score matching method. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

These are the result of multiple estimations, while the individual outcome variables are tabled by category, production outcomes, consumption outcomes, income outcomes, and assets/credit outcomes. These outcomes were not run in the same model, but each individual outcome was estimated using the propensity score matching. In Table 4.12, Columns (1) and (2), looking at the difference in the amount cultivated from their first, second, and third product it's obvious that *PROCAMPO* recipients produce less of their first product, possibly the good that allows them eligibility for the subsidy. They continue to produce significantly less of their second and third product. However, their second plot is more profitable than their other plots of land. They produce more maize, rice, and beans than the non-participants. These goods are the qualifying goods for *PROCAMPO*. The value of their food is insignificant compared to the non-recipients in 2002, but is negative and significant in 2005. By 2005, the smaller farms are still producing less of their first product than non-recipients. They are producing more of their third product. Once again, it is possible that it is necessary for them to receive the subsidy, therefore they produce only what is necessary of the first product in order to receive the subsidy. They still produce more maize, rice, and beans in 2005. However, they are producing other goods as well, such as chilies. On the other hand, their value of food is less than the non-recipients. Finally, the effects on income are in Table (11). Once again, there is little effect on their overall income, compared to the non-recipients. They only effect is a slightly significant, yet negative effect on their annual income from their main job, which are their farming activities. There is a negative effect of farming activities, as seen in the negative treatment effect of the value of food they're producing in 2005.

The results for 2009 are very important for the *PROCAMPO* recipients, especially the smaller producers. They've been receiving the *PROCAMPO* subsidy for 15 years, and the 2007-2009 Great Recession is affecting the wider economy. Does *PROCAMPO* provide a barrier to other adverse effects of the global recession? First, they are still producing less of the first and second product, compared to their non-recipients. They cultivate significantly more maize, but fewer beans. Again, the total value of their cultivated food is less than the non-recipients. According to their trade data, the imports of maize have increased dramatically in the previous years of *PROCAMPO* and NAFTA (UN Comtrade).

As seen in Table 4.13, these smaller producers are consuming more beans than the non-recipients of *PROCAMPO*. Other than that, there are few significant differences between the non-recipients and recipients of *PROCAMPO*. This has been consistent over the entire period of *PROCAMPO* for these smaller producers. The recipients spend less on beans, steak, and bread than the recipients. This is possibly due to the fact that they produce more beans and maize than the non-recipients. Other than that, there is very little difference in their spending. They consume more tortillas and chicken, a contrast to their 2002 results where they consumed fewer items that they produced more of. The groups are matched based on household size; therefore, it is not possible that the recipients have a larger household size, and thus a higher consumption bill. An explanation of these results is that they are producing less, and thus need to purchase more goods to fulfil their consumption needs.

In Column (1) and (2) of Table 4.14, for smaller farms, the total value of debt is insignificant. The *PROCAMPO* subsidy did not have any significant effect on their ability to pay debt, save, or reduce/increase their total value of debt. This is a significant result. One of the main outcomes for this programme was to increase their ability to receive credit, pay off their debts, and expand their farms. The subsidy certificate would be used as collateral for debt from financial institutions. However, it is possible that these farmers are still unable to access these institutions due to other barriers. It has not had a consistent and constantly positive effect on their consumption, possibly detailing that the effect of the subsidy is not seen through their consumption choices, but elsewhere, if there is any effect on these smaller producers. In Table 4.15, Column (3), the effect of *PROCAMPO* on their assets/credit in 2009 is detailed. Once again, they are paying more debt in 2009, as an effect of *PROCAMPO*. However, that is the only effect of *PROCAMPO* on their assets/credit, compared to the non-recipients.

There has been very little change over the 7-year period of the analysis. Once again, the effect of *PROCAMPO* on their overall income is either insignificant or negative. This result has not changed in the entire period of the analysis. *PROCAMPO* has not provided a significant shift or increase in their income, compared to non-recipients. By 2005, the smaller farms have paid more debt, but the effect on their savings and value of total debt is still insignificant. The mean monthly income for the main job in 2009 was 3,682 Mexican pesos for *PROCAMPO* participants and 3,562 Mexican pesos for non-participants. However, for the matched pairs, therefore those who are most similar to the participants yet do not receive the subsidy, those with the subsidy earn less. This supports the method of using matching. If the naïve estimator had been used, we would conclude that the *PROCAMPO* recipients earned more than the non-recipients.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Health	4.258**	168.7***	212.0***
	(1.735)	(36.06)	(50.02)
Domestic	55.34	-69.77*	47.45
	(41.48)	(36.16)	(31.98)
Furniture	-260.2***	-148.9	161.1
	(39.23)	(154.0)	(176.8)
Corn Tortilla	-0.529	1.633***	0.165
	(0.371)	(0.402)	(0.364)
Bread	-1.939**	-1.933*	-0.585
	(0.879)	(1.121)	(0.706)
Chicken	-0.126	0.819***	-0.640***
	(0.240)	(0.230)	(0.119)
Steak	-0.469*	-2.547*	2.319**
	(0.205)	(1.393)	(1.102)
Beans	-0.343***	0.0652	1.695**
	(0.0870)	(0.119)	(0.788)
Sodas	0.619*	-0.789***	-0.0442
	(0.363)	(0.276)	(0.212)
Personal Items	5.014	9.124	-2.660
	(4.612)	(5.812)	(4.207)
Cleaning	-3.404	8.459**	5.533
	(3.522)	(4.048)	(5.277)
Media	-13.62*	65.99***	9.219
	(7.352)	(10.46)	(9.847)
Gambling	0.0625	-2.949	1.232**
	(0.291)	(1.992)	(0.500)
Entertainment	-14.07***	4.258**	-5.500*
	(2.141)	(1.735)	(3.138)
Observations	2,813	2,796	3,698

Table 4.13: Consumption, Small Farms

All consumption of food, like chicken, bread, corn tortilla, etc. are in kilos. Health, domestic, furniture, media, etc. are in pesos. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there’s a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

Outcomes	(1) 2002	(2) 2005	(3) 2009
Debt Paid	-5,435	5,780**	6,309***
	(3,433)	(2,481)	(2,271)
Savings	2,949	-1,791	-3,361
	(3,844)	(4,254)	(2,150)
Value of Total Debt	-65.24	1,025	3,880
	(401.9)	(957.6)	(2,693)
Constant	13,137***	15,950***	13,185***
	(1,983)	(1,700)	(1,479)
Observations	680	456	653
R-squared	0.004	0.012	0.012

Table 4.14: Assets, Small Farms
All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

Outcomes	(1) 2002	(2) 2005	(3) 2009
Individual Income	-4,108***	-1,960	-952.1
	(1,554)	(2,558)	(3,053)
Monthly Main Job	-279.2	149.1	-568.1*
	(317.8)	(356.5)	(340.1)
Monthly Second Job	-1,577***		
	(437.9)		
Annual Main Job	-5,806***	-9,960*	-6,430**
	(1,787)	(5,298)	(2,937)
Annual Second Job	1,639	-83.49	1,600
	(2,229)	(6,714)	(4,936)
Observations	666	666	667

Table 4.15: Income, Small Farms
All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing

the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match. This is done by running other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates (Ho, Imai, King, and Stuart, 2007).

When controlling for differences between the groups and matching them based on similarities, those participants earn less than those who are most similar to them yet do not receive the subsidy over multiple years. Other studies, such as Cord and Wodon (2001), did not complete an analysis that studied what type of increase in income these recipients would have received if they had not received the subsidy. In addition, most studies about the effect of a subsidy, including Wiggins and Brooks (2010), argue that there could be a problem with providing these subsidies to smaller farms, because they would not have the financial capability to fully exploit the subsidy. It is possible that the increase in income was not due to *PROCAMPO* but improving conditions for the entire rural population. Given income is lower than the non-treated farms; it could be a reason why they're unable to access credit. With a lower income, the certificate would not be sufficient to receive enough credit to expand their farm production.

Individual income for *PROCAMPO* farmers is significantly less than the non-participants. This effect is similar over all forms of income for the smaller farmers. An increase in income was also a main objective for the *PROCAMPO* programme. Again, their main job is described as working on their own farm. This is intriguing, as one of the main objectives of *PROCAMPO* was to increase production and the value of their food. This would provide a necessary surplus that they could sell, or consume. When looking at the rest of the results, this makes sense. The recipients are cultivating a significant amount of the product they need to receive the subsidy, and not diversifying their crops. Other cereals, rice, and beans are some of the *PROCAMPO* goods that receive the subsidy. They cultivate more cereals, rice, and beans than their counterparts. They also cultivate significantly less of other items, such as chilies, other vegetables, and onions. Furthermore, they buy more meat and corn tortillas, which are considered staples. However, they buy less bread and sodas. This confirms the literature, whereby a targeted subsidy would continue to distort the market, creating a surplus in only certain goods, and not allowing the farmers/producers to diversify their income with more profitable goods (OECD 2006).

The overall results detail a troubling trend for the small farmers who receive *PROCAMPO*. Compared to the non-recipients, over a seven-year period, they produce less, or have a lower value of food that they produce, spend less on other foods, pay off more of their debt, and have a negative effect on their income from farming activities. Is this a trend that is seen by the non-recipients, yet, for some reason, those who receive the subsidy exacerbate it? Given the non-recipients do not produce more of the *PROCAMPO* goods (beans, maize, etc.), yet have a higher income, it is possible they produce goods that are worth more, giving them a higher overall income and value of food produced. They are not bound by the rules of *PROCAMPO*, and can successfully diversify their production, and maximise their income opportunities.

4.6.3 Medium Farms

These are the result of multiple estimations, while the individual outcome variables are tabled by category, production outcomes, consumption outcomes, income outcomes, and assets/credit outcomes. These outcomes were not run in the same model, but each individual outcome was estimated using the propensity score matching. Once again, this sample includes farmers with 5 to 10 hectares in their farm. As seen in Column (1) of Table 4.16, in 2002, the medium sized farmers produce significantly more of their first product than the non-recipients of *PROCAMPO*. Comparing this to the small farms, there is a positive and significant effect. They produce more beans, but an insignificant effect on the production of maize. In addition, the value of the food they produce is higher. Comparing their results to 2005, there is an insignificant effect for most production. However, most importantly and in line with the results from the small producers, they are producing more chilies and maize than the non-recipients. However, they produce more of other vegetables than the non-recipients, and an insignificant number of beans and rice. There were not enough observations to estimate the effect on their value of food, compared to the non-recipients. In 2009, the effect of *PROCAMPO* on the amount of the first product the produce is significant, and higher than in 2002 and 2005. They cultivated more beans in 2009, but an insignificant effect on the cultivation of maize in 2009, in contrast to the smaller farms. It would be important to determine their consumption of beans and maize in 2009.

Outcomes	(1) 2002	(2) 2005	(3) 2009
First Product	16,820***	7,716	27,487***
	(2,858)	(4,903)	(6,029)
Second Product	4,842	353.3	3,605
	(3,145)	(3,149)	(3,431)
Third Product	99.18	8,539	8,517***
	(700.0)	(6,685)	(3,065)
First Plot	-478.9***	-111.6***	317.0**
	(80.05)	(37.41)	(159.3)
Second Plot	-8.488	-95.02	-190.4**
	(31.16)	(74.18)	(92.22)
Third Plot	-95.91	36.76	-73.78
	(216.2)	(50.33)	(55.15)
Onions	-0.730*	2.870***	
	(0.401)	(0.562)	
Potatoes	-2.443***	0.412**	
	(0.714)	(0.167)	
Chiles		10.01**	
		(4.875)	
Other Vegetables		5.328***	
		(1.496)	
Maize	3.430	7.045***	-0.352
	(2.203)	(1.259)	(0.647)
Rice	-0.877	0.639	
	(0.798)	(0.443)	
Value of Food	56.82**		
	(28.00)		
Beans	13.75**	2.162	10.60***
	(5.521)	(1.350)	(2.585)
Constant	9,984***	25,547***	22,259***
	(2,363)	(4,011)	(4,625)
Observations	727	638	622
R-squared	0.046	0.004	0.005

Table 4.16: Production, Medium Farms

All produce is in kilograms, plots are in hectares, and value of food is estimated in pesos. These are the estimated treatment effects, using the propensity score matching method. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there’s a balance on the covariates.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Health	79.03	129.1	469.3*
	(60.11)	(84.94)	(267.5)
Domestic	54.35	-309.8***	78.37
	(72.24)	(72.44)	(67.88)
Furniture	190.5	-1,863***	-3,171***
	(309.3)	(522.7)	(1,163)
Corn Tortilla	-0.572	1.434***	1.107**
	(0.500)	(0.424)	(0.437)
Bread	-1.076	-4.638**	2.620***
	(1.492)	(1.830)	(0.921)
Chicken	0.426	-0.106	-0.373*
	(0.344)	(0.114)	(0.192)
Steak	-0.366	-9.184*	0.652***
	(0.278)	(4.695)	(0.207)
Beans	-0.651***	-0.198	0.492
	(0.239)	(0.240)	(0.363)
Sodas	-0.546	1.633***	-0.0803
	(0.394)	(0.467)	(0.321)
Personal Items	-25.02***	34.07***	9.982
	(7.005)	(12.07)	(8.305)
Cleaning	-9.246	-23.42**	41.01***
	(6.353)	(9.673)	(7.646)
Media	10.63	130.8***	70.55***
	(14.79)	(20.71)	(20.35)
Gambling	-8.598***	-2.929***	1.414*
	(2.080)	(0.739)	(0.783)
Entertainment	6.633	28.57***	6.483*
	(4.263)	(10.18)	(3.435)
Observations	1,145	1,078	1,156

Table 4.17: Consumption, Medium Farms

All consumption of food, like chicken, bread, corn tortilla, etc. are in kilos. Health, domestic, furniture, media, etc. are in pesos. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

Consumption is similar to the small farms; it's quite possible for those of a lower income or farm size, the *PROCAMPO* subsidy has an insignificant effect on their consumption choices. However, as seen in Table 4.17, there is an insignificant effect of the consumption of beans for the medium farm recipients of *PROCAMPO*. For consumption, there aren't any significant answers in their consumption patterns in 2005. Other than corn tortillas, there is an insignificant treatment effect consume an insignificant number of beans and chicken in 2005, compared to the non-recipients.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Debt Paid	8,343***	-11,566	8,238
	(2,750)	(7,409)	(9,118)
Savings	12,987**	-9,455*	9,389
	(6,508)	(5,032)	(7,499)
Value Total Debt	-11,564	455.2	19,938***
	(10,876)	(2,118)	(5,522)
Constant	8,529***	26,201***	6,993*
	(2,236)	(5,274)	(4,235)
Observations	375	315	212
R-squared	0.024	0.000	0.004

Table 4.18: Credit/Assets, Medium Farms

All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

In Table 4.18, it's obvious that amongst the medium sized farmers, the *PROCAMPO* recipients have higher savings, and more debt paid than the non-recipients. Assets and income are insignificant for 2005 medium farms. Reviewing the changes in assets/credit and income, these producers have higher debt in 2009 than the non-recipients of *PROCAMPO*, and higher monthly income for their main job (farming) than the non-recipients of *PROCAMPO*. Finally, in Table 4.19, the effect of individual income for the medium sized farm producers receiving *PROCAMPO* is also negative, as was for the smaller farmers. Reviewing the medium producers, there isn't a significant gain in their income, assets, consumption, or production over the seven-year period. As there was a mixed result for the smaller producers, it is possible that the larger producers feel the majority of the gains or treatment effects.

Outcomes	(1) 2002	(3) 2005	(4) 2009
Individual Income	-10,104***	4,950	8,214
	(3,038)	(3,966)	(5,121)
Monthly Main Job	-662.0	388.7	953.7**
	(490.2)	(240.8)	(427.3)
Monthly Second Job			
Annual Main Job	-5,841		5,865
	(4,990)		(5,474)
Annual Second Job	345.5		4,767
	(3,486)		(8,017)
Observations	322	271	204
R-squared	0.007	0.006	0.013

Table 4.19: Income, Medium Farms

All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

4.6.4: Large Farms

Outcomes	(1) 2002	(2) 2005	(3) 2009
First Product	10,284***	17,780***	13,439***
			(3,095
	(1,325)	(2,681)	
Second Product	8,238***	1,563***	3,016
	(2,206)	(320.4)	(1,904)
Third Product	-2,391**	-822**	-5,175*
	(947.0)	(363.2)	(2,981)
First Plot	-201.5**	-13.39	-135.2
	(90.75)	(41.63)	(98.44)
Second Plot	-140.6*	225.3*	-846.5
	(64.57)	(112.1)	(529.2)
Third Plot	23.48	-259.7	-1,693
	(44.42)	(306.6)	(1,407)
Onions	-0.522**	-0.506***	
	(0.239)	(0.142)	
Potatoes	-0.349	-4.096**	
	(0.256)	(1.754)	
Chiles		2.154***	
		(0.612)	
Other Vegetables		12.36***	
		(2.214)	
Maize	11.88***	-8.873***	-7.753***
	(2.899)	(2.064)	(2.509)
Rice	1.153***	1.146***	
	(0.211)	(0.371)	
Value of Food	51.27	-11.13	-3.898
	(49.33)	(16.79)	(13.31)
Beans	15.60***	3.838***	7.741***
	(2.880)	(0.902)	(1.255)
Constant	4,851***	7,691***	11,827***
	(830.2)	(1,634)	(1,778)
Observations	2,185	1,707	1,740
R-squared	0.027	0.025	0.06

Table 4.20: Production, Large Farms

All produce is in kilograms, plots are in hectares, and value of food is estimated in pesos. These are the estimated treatment effects, using the propensity score matching method. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

These are the result of multiple estimations, while the individual outcome variables are tabled by category, production outcomes, consumption outcomes, income outcomes, and assets/credit outcomes. These outcomes were not run in the same model, but each individual outcome was estimated using the propensity score matching. The larger farm recipients, who received most of the *PROCAMPO* subsidy (just 10% of recipients, who received over 57% of the benefits[20]), exhibited a positive effect on their first and second product due to *PROCAMPO*, compared to the non-recipients. They produce a significant more amount of maize, rice, and beans than the non-recipients. Their treatment effect is significantly higher than the small or medium farms in 2002. There are vast differences between the large farms and the small farms. First, they have better and more technology, more workers (on average at least 30 non-household member workers), easier access to credit, more assets, and a higher amount of the money received from *PROCAMPO*. The effect of *PROCAMPO* on their consumption is relatively insignificant or very low. This is not surprising. These farms are very large, with a significant surplus sold on the international market. These farms are not below the poverty line, and are comparatively much wealthier than the other farms. Each added income into the household would have a smaller effect on consumption in a larger farm than a smaller farm. Therefore, it stands that comparing large farms between each other would not see a huge increase in their consumption. Instead, most of the effects would be in their production and overall credit and income. Compared to the non-recipients, they paid off more debt, yet had a higher value of total debt. However, there was an insignificant effect on their income. The results form 2005, in Column (4), Table 4.11 show that the larger farms have a higher treatment effect than the smaller or medium farms. They produce more of their first

[20] Cejudo (2012)

product and second product. However, they produce far less in maize, but more beans, rice, other vegetables, and chilies. However, the results in Tables 4.21, 4.22, and 4.23 show that the effect on their consumption, assets, and income are insignificant in 2005.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Health	33.38	13.22	-129.6*
	(65.37)	(43.99)	(73.88)
Domestic	-527.1*	-14.98	123.7**
	(313.4)	(53.13)	(58.00)
Furniture	441.1**	203.2**	-921.3**
	(189.4)	(94.83)	(444.5)
Corn Tortilla	0.665*	1.900***	1.096***
	(0.348)	(0.513)	(0.367)
Bread	1.459	5.439***	2.557***
	(0.923)	(1.234)	(0.900)
Chicken	0.195	0.285***	0.948***
	(0.119)	(0.0897)	(0.150)
Steak	-0.284	-1.323	0.697
	(0.191)	(0.886)	(0.523)
Beans	0.290***	-0.163	-0.286**
	(0.0939)	(0.194)	(0.112)
Sodas	0.671**	3.492***	-0.0794
	(0.304)	(0.506)	(0.357)
Personal Items	12.97**	-3.464	-31.10**
	(6.047)	(8.128)	(12.92)
Cleaning	3.632	12.31*	-0.331
	(3.251)	(6.980)	(6.125)
Media	15.45**	58.07***	9.397
	(6.984)	(11.33)	(10.84)
Gambling	-2.749***	-2.684***	-1.126**
	(0.895)	(0.765)	(0.539)
Entertainment	-15.31*	-26.92	-21.74***
	(9.275)	(22.40)	(6.227)
Observations	3,007	3,069	3,501
R-squared	0.002	0.003	0.001

Table 4.21: Consumption, Large Farms

All consumption of food, like chicken, bread, corn tortilla, etc. are in kilos. Health, domestic, furniture, media, etc. are in pesos. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there’s a balance on the covariates.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Debt Paid	7,260***	-1,429	2,403
	(2,731)	(3,783)	(2,369)
Savings	-7,931	1,513	9,254***
	(7,091)	(13,253)	(3,527)
Total Debt	1,627***	-250.4	4,266
	(573.9)	(738.9)	(2,966)
Constant	1,533***	15,473***	11,885***
	(343.8)	(2,199)	(1,036)
Observations	870	571	758
R-squared	0.008	0.000	0.001

Table 4.22: Assets/Credit, Large Farms

All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

Outcomes	(1) 2002	(2) 2005	(3) 2009
Individual Income, Annual	-5.564e+06	-17,546	39,314**
	(4.459e+06)	(28,386)	(18,739)
Main Job, Month	-566.2	396.8	402.1
		(350.3)	(280.3)
Second Job, Month	621.7		2,156***
	(593.4)		(464.2)
Main Job, Annual	-586.2	9,938	5,524*
	(2,731)	(6,034)	(2,977)
Second Job, Annual	-8,832***	-2,690	19,806
	(2,487)	(6,200)	(17,185)
Observations	818	772	649
R-squared	0.001	0.000	0.007

Table 4.23: Income, Large Farms

All of the above outcomes are in pesos. These are the estimated treatment effects of *PROCAMPO*, utilising propensity score matching. The estimated R^2 should not be utilised for the goodness of fit test, as in other models. In propensity score matching, the R^2 are irrelevant, and are considered a poor method of assessing the effectiveness of the propensity score at achieving balance. The most important diagnostics from propensity score matching is to determine a good match is to run other sensitivity analysis, confirm common support, and make sure there's a balance on the covariates.

Finally, the outcomes for 2009 detail a large and significant effect on their production and cultivation in beans and bananas. However, there is a negative and significant treatment effect of their maize cultivated. This matches a trend of a lower amount of maize being cultivated by the large farms, and an increase in production of all of the other goods available, such as beans, rice, and vegetables. Their consumption has stayed consistently insignificant for 2009, not varying widely from 2002 or 2005. They have a higher savings in 2009, compared to the non-recipients of *PROCAMPO*. It is possible they utilised the subsidy to save money during the Global Recession, during a low period of demand. However, their income in 2009 is significantly higher in 2009, showing that it is possible they recovered significantly quicker than the non-recipients or even the other farmers. The standard errors estimated here at bootstrapped errors, as the standard errors relies on sampling from the analysis sample with replacement, and replicate the analysis multiple times. However, bootstrapped errors can be asymptotically unbiased if the sample is too large. Therefore, the standard errors estimated in the entire analysis, given the small samples, can be determined to be unbiased. The most important statistics from propensity score matching is the robustness checks of the matching algorithm.

4.6.5: Summary

Again, the estimated relationships are the estimated outcomes from the *PROCAMPO* subsidy on multiple outcomes. These treatment effects are estimated using propensity score matching, with an estimated propensity score algorithm in order to match the two groups of individuals, treated and non-treated. The treatment effect is estimated by taking the difference between the treated and non-treated individuals, after matching them based on X covariates to produce a probability score (propensity score) and then matching the individuals with similar scores. The treatment effects are the most important statistics from the estimated results. The most important diagnostic test is to test the algorithm utilised to match the two groups. As evidenced above, larger farms seem to have benefitted more than the smaller and medium farms. They exhibit the largest treatment effects than the other farms, such as changes in production and, in 2009, higher income. They have higher savings, and produce a more variety of vegetables, beans, rice, and chilies. It is possible that they benefit from multiple other factors that allow for them to benefit significantly from the subsidy. For example, they have more technology on their farms, irrigation systems, access to credit, and the ability to sell their surplus on the international market. As a percentage of their income, they receive a higher amount of the actual subsidy than the small and medium farms. This confirms criticism of the *PROCAMPO* programme, by Cejudo (2012), who determine that the *PROCAMPO* programme only provides benefits to large farms, and completely defeats the purpose of the programme. These results confirm that a different approach may be necessary for improving the production and living standards in the small farms.

Farm Size	% change 2002 to 2005	% change 2005 to 2009	% change 2002 to 2009
Small	43.28%	10.5%	58.36%
Medium	55.12%	3.05%	59.87%
Large	-3.68%	18.5%	14.16%

Table 4.24: Individual income for non-participants
Source: Mexican Family Life Survey

Farm Size	% change 2002 to 2005	% change 2005 to 2009	% change 2002 to 2009
Small	43.7%	10.06%	58.18%
Medium	55.81%	5.78%	64.82%
Large	2.36%	18.95%	21.76%

Table 4.25: Individual income change for participants
Source: Mexican Family Life Survey

Table 4.24 and Table 4.25 show the difference in income increases between the non-participants and participants respectively. It's clear that both the non-participants and participants of *PROCAMPO* have a similar percentage change in income between each year in the wave. Therefore, the increase in income is not related to *PROCAMPO*, and would have happened without *PROCAMPO*. The natural increase in income without *PROCAMPO* is exhibited in the non-participants' income. This can help explain the insignificant results for the smaller farms. The largest difference in the rate of change is seen for the medium and larger farms. This confirms the above results, detailing that the medium and larger farms received a larger treatment effect of the *PROCAMPO* subsidy than the smaller farms.

4.6.6: Robustness and Diagnostic Checks

Outcomes	(1) Nearest Neighbour (1)	(2) Caliper (0.001)	(3) Caliper (0.005)	(4) Nearest Neighbour (5)
Value of Food	22.06	22.06	22.06	22.06
	(25.14)	(25.14)	(25.14)	(25.14)
Consumption of Beans	0.120***	0.120***	0.120***	0.120***
	(0.0607)	(0.0607)	(0.0607)	(0.0607)
Savings	-857.8	-857.8	-857.8	-857.8
	(4,134)	(4,134)	(4,134)	(4,134)
Annual Main Job	-4,371***	-4,371***	-4,371***	-4,371***
	(1,554)	(1,554)	(1,554)	(1,554)

Table 4.26: Sensitivity Analysis Pooled Farms, 2002

Again, the matching algorithm utilised in the previous analysis could possibly change/alter the treatment effects estimated. To conduct sensitivity and diagnostics tests on the algorithms utilised, Table 4.26 includes the sensitivity analysis for certain outcomes, as a test for the entire method. This is conducted to make sure that these findings are not driven by the selection of particular strategy. The sensitivity analysis utilises the pooled panel, in 2002 reported in Table 4.26. Columns (1) and (4) utilises NN matching with two different settings. It shows how many nearest neighbours could be used for comparison or matching. Therefore, there will be low bias, but the variance could be high in that measurement. Columns (2) and (3) utilises a caliper of 0.001, utilised to avoid the risk of poor matches. It provides the maximum distance a propensity score match could be made. Comparing these results to Table 4.8, there is very little difference in which of the above options is utilised. In Column (1) of Table (4), the treatment effect of the value of food was insignificant and positive, as is in all of the options. In Column (1) of Table 4.9, the consumption of beans is highly positive and significant, and this is very similar to the result in Table (22). In addition, savings and individual income have very close results in Column (1) of Table (22), when compared to Tables 4.10 and 4.11 respectively. The treatment effect found in the above analysis does not appear to depend on the algorithm used, as the coefficients and the significance are very similar, even when utilising different alternatives. Figure 4.4 confirms common support of the treated and untreated samples. This provides the density distributions for both samples. As is evidenced below, there is sufficient common support available in this analysis. If there would be a failure of common support, the estimated effect on the individuals may not be representative.

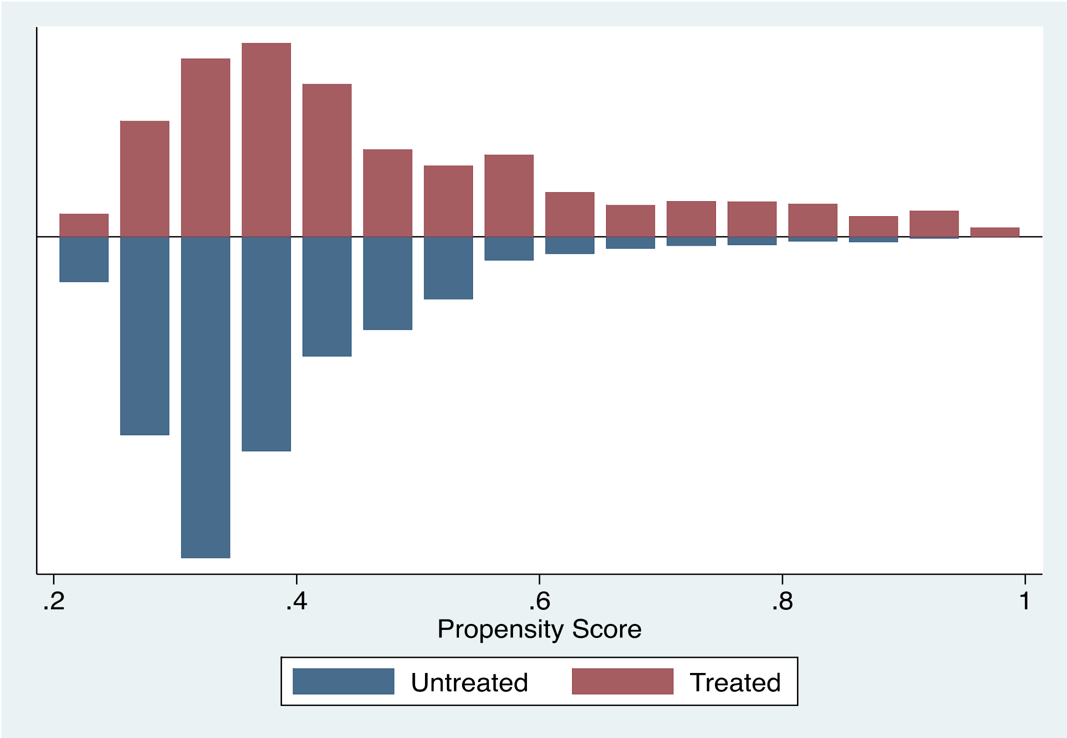


Figure 4.4: Distributions for Treated and Non-treated, common support

4.7 Summary and Conclusions

Utilising a robust propensity score matching method, this chapter estimated the treatment effects of *PROCAMPO* on farmers in Mexico in 2002, 2005, and 2009. When I separated the farms by farm size, I find mixed results from the *PROCAMPO* programme on all of the farmers. Small farms see very little positive treatment effects from the subsidy. However, the large farms see a significantly higher treatment effect. These farms have more production in key goods and overall income effects than the small farms. While other papers (Cord and Wodon (2001), and Sadoulet et al (2001)) saw a positive effect, such as a multiplier effect, this chapter proved a distributional difference in the treatment effect of *PROCAMPO*. These results confirm Davis et al (2002), who confirmed there was little effect on consumption. The treatment effect related to consumption variables were either negligible or insignificant for most of the farmers in all three years analysed.

These results partially confirm criticism about the *PROCAMPO* programme by multiple organisations and researchers, such as Karnik and Lalvani (1996), who asserted that the intention of the agricultural subsidies to improve poverty could be overpowered by well-connected and politically powerful groups. These groups can use these subsidies as an easy source for rents, which would exacerbate the unequal or negative distributional effects. As well, other authors assert that the subsidies may not be effective in their lacks the necessary conditions and technological investment to make them work (Wiggins and Brooks, 2010; Kilic et al, 2013; Pauw and Thurlow, 2014). These results also confirm the need for a new approach by the Mexican government to fully compensate the farmers for the effects of NAFTA.

Given the intention to utilise these policies to reform and improve the opportunities available to everyone within the economy, it is clear the *PROCAMPO* subsidy did not go far enough to solve the lower income and lack of production opportunities for these farms. Chapter 2 and 3 provided evidence that those within manufacturing have seen other benefits of these policies. However, within the agriculture sector, the smaller farms have not been provided with the opportunities to improve their income. As stated in Chapter 4, there is a propensity of developing countries to reform their manufacturing sector, with the intention of using trade-led growth to improve their economy. On the other hand, in multiple developing countries, 50-90% of income is dependent on agricultural activities (Kwa, 2001). Therefore, for countries attempting to utilise subsidies to improve conditions, while reforming the manufacturing sector, given the large proportion of those reliant on agricultural income, it would important to understand these results when forming policies targeted to these economies.

Other countries are attempting to solve this problem. For example, Brazil instituted Bolsa Familia in 2003, with the intention to go beyond just providing cash transfers, but also provide the necessary tools of social and economic transformation. There has been significant work on the Bolsa Familia programme by Kabeer et al (2012) and Lindert et al (2007) detailing the positive impact of these subsidies on poverty alleviation in Brazil. In addition, Mexico does provide other conditional cash transfers to improve rural communities, such as *PROSPERA*. The literature confirms that *PROSPERA* has had a positive impact on poverty alleviation, with Ruiz-Arranz et al (2006) showing that *PROSPERA* has had a higher effect on poverty alleviation than *PROCAMPO*. These farms are still affected by the effects of NAFTA and other distortions in the agricultural market and further policies, such as expanding *PROSPERA*, would need to be implemented by the government to continue to compensate these communities.

Chapter 5: Conclusion

This thesis analyses a fundamental research question; how can multiple trade policy changes impact a developing country over a long period of time? Utilising multiple policy evaluation tools, this thesis finds, in the long term, trade policy changes enacted in the 1980s resulted in a severe unequal distribution of effects within the country, which is not being addressed by domestic policies. For example, the effect of crises was very different for those in the manufacturing sector and those within agriculture. Smaller farms were not adequately compensated for the loss of competition after NAFTA, with large farms absorbing most of the treatment effects. As well, this fits into the overall discussion in the literature on the long-term effects of globalisation policies in developing countries, in light of the success stories in the East Asian countries. The thesis is unique, as it contributes to different subjects within economics, such as development, policy, and applied econometrics.

This thesis provides a necessary analysis of the implications for trade policies in Mexico with relation to trade changes and how they affect income and agriculture. Chapter 1 provided an introduction to the research question. Chapter 2 built a gravity model to examine the differences in the impact of trade agreements over time, providing a contribution to the literature with relation to the results on NAFTA and EUTA. The gravity model is built by relating the amount of trade between two countries to their economic size, as measured by their national incomes, and the cost of transport between them. In the original model, the distance between their economic centres, or capital cities measured the cost of transport. More theoretical developments arise from new trade theory, whereby the critical factor in determining international patterns of trade are the substantial economies of scale and network effects. The economies of scale can outweigh the more traditional theory of comparative advantage, but if one country specialises in a particular industry then it may gain economies of scale and other network benefits from its specialisation (Krugman 2008). The amount of trade between the two countries increase in their economic size and decrease as the cost of transport increases between them. The chapter includes analysis of their crisis years (1982 and 1994, among others), to fully understand the effect of these years on their total trade flows. Previous work by Martinez-Zarzoso (2003) utilises a gravity model on Mexico's trade flows, however without any discussion of their crisis years. Before this thesis, there has not been a discussion of Mexico's trade agreements over a long period of time, with the implications of the crises included (Martinez-Zarzoso, 2003 is a notable mention). Furthermore, Chapter 2 contributes to the overall research question because it provides the evidence needed to question whether the trade changes have an effect on their income. There is also the contribution of the database, an original database of over 21,000 observations.

Chapter 3 analysed income inequality, and proved the distributional differences in income inequality in Mexico after trade liberalisation. This provided evidence of a distributional difference in the effects of the trade policies in relation to income. This work confirmed the literature in relation to the effect of development status and natural and economic geography (Hall and Jones, 1999; Redding and Venables, 2004; and Acemoglu, 2001). The theoretical framework follows a trade and geography model, as outlined in Fujita et al (1999) in Chapter 14.

The theoretical framework is based on standard new trade theory, but is extended to have transport frictions in trade and intermediate goods in production. The model defines a gravity-like relationship for bilateral trade flows between countries. This is an original contribution to the literature, as this type of analysis does not exist in the literature for Mexico, and the distinction between GDP per capita and manufacturing wages provides a necessary understanding of the distributional effect of these policies on income within Mexico. It is also a contribution to the literature for multiple reasons. First, this chapter uses an augmented foreign market access measure to capture the effects of trade determinants, specifically their propensity to trade with those nearest. Second, this chapter analyses multiple theories to analyse the change in trade determinants. Finally, this chapter finds that the foreign market access is only a positive determinant for manufacturing wages. This would imply those within the manufacturing sector benefit from the trade determinants, and the wider economy does not.

Chapter 4 provides further evidence of the distributional difference in the *PROCAMPO* subsidy within Mexico. Using data from the Mexican Family Life Survey (2002, 2005, 2009), Chapter 4 implements propensity score matching to examine the effects of this subsidy on production, consumption, income, and assets of farmers throughout Mexico. The Roy-Rubin model (1951,1974) is utilised here to determine the impact of a treatment on the outcome of an individual. To do this, inference about this involves speculation about how this individual would have performed had he not received the treatment. In evaluation analysis, this problem is addressed in the Roy-Rubin model, whereby the main pillars of the model are individuals, treatment, and potential outcomes. Another contribution to the literature, by scrutinising the effects of this subsidy on total farmers, and then dividing the farmers into groups by farm size (small, medium, and large), this thesis provides further evidence of the distributional impact of the subsidy within the agriculture sector. The results provide an original contribution to the literature because of the implications for future development, trade, and economic policy related to developing countries. Given the Mexican experience was unequal throughout the entire economy, this could provide a cautionary tale to other developing countries whom attempt to follow a similar route. Chapter 4 is an essential analysis, due to the increase in developing countries utilising subsidies to improve the living standard of those in the non-manufacturing sector, while implementing globalisation policies.

This thesis applies a gravity model, fixed effects with geographic indicators, and propensity score matching. Given the necessity to analyse the change in trade flows over a long period of time, a gravity model is the obvious choice. Its status as a workhorse of trade policy analysis means that the thesis would have been remiss without such an analysis. In addition, the method of combining the geographic results to form a new measure, called market access, to analyse income inequality between other countries is a novel contribution to the literature. This thesis combines market access, or economic geography, with natural geography, development, social infrastructure, and other variables to explain income within Mexico and between other countries. Other than Hering and Poncet (2007, 2008), there has not been this type of work completed just to evaluate a developing country. Finally, the final chapter employs propensity score matching, over three waves, and between three separate groups in order to understand the effect of the subsidy over a long period of time. The combination of multiple econometric and policy evaluation tools and an extensive database are strength of this thesis, providing wide-ranging analysis of the research question. Although these tools were able to provide some answers for the research question, there are some limitations.

One of the limitations of this thesis is it could not study the impact of TPP. TPP, or the Trans-Pacific Partnership, is a trade agreement signed in 2005, yet will be extended to include Mexico, the United States, Japan, Vietnam, Japan, Australia, Canada, Malaysia, and Peru. The original signatories are Brunei, Chile, New Zealand, and Singapore. It is important to conduct analysis of the effect this new trade agreement could have on the manufacturing sector. Given the previous results of the gravity model in Chapter 2, this is an interesting trade agreement for Mexico. Specifically, the NAFTA coefficient has declined, and the distance coefficient is still negative, but this has changed over time. Given the change in their trade determinants, TPP could provide an opportunity for Mexico to continue to diversify their exports. It would also be important to conduct future work to include the intended effects of TPP with regards to welfare analysis. This analysis could use the welfare analysis method pioneered by Eaton and Kortum (2002), which allows the researcher to conduct counterfactuals based on future policy changes. This also relates economic geography to trade and welfare changes with respect to trade. This could highlight a further change in their trade, welfare, and income determinants.

Furthermore, the Mexican Family Life Survey provides the opportunity to analyse the treatment effect of multiple treatments, especially those in *PROCAMPO* and *PROSPERA*. This would complement Cardenas-Rodriquez (2004), but would extend the analysis, as there are more years available for analysis than in Cardenas-Rodriquez (2004). Given the literature states that *PROSPERA* has been more successful, this could aid researchers in how to further this programme, or expand it to capture *PROCAMPO* recipients who cannot receive *PROSPERA*. In addition, this thesis does not analyse more fully the macroeconomic changes within the Mexican economy, in relation to the economic crises. Although the literature addresses this, specifically in Kehoe and Cole (2004), Ros et al (2011), Lustig (1990, 1999), and Mishkin (1999), a long term analysis is missing, especially in light of the 2007-2009 crisis. In addition, the combination of the Tequila Crisis, plus an increase in migration needs to be highlighted, especially in light of these results. Given the unequal distribution of the effects of these policies, this provides further evidence of possible changing patterns in migration. Finally, all further research mentioned above should provide a clear understanding of the further policy options available to developing countries. It should also include more implications for the long-term. Other papers mentioned previously are attempting to address these issues in developing countries such as Nigeria, China, Vietnam, and Brazil (Tang, Wang, Zhao, 2015; Kaur et al, 2010; Del Granado, Coady, and Gillingham, 2012; Soetan and Yinusa, 2009). However, significant work should be completed to provide more opportunities for policy changes that could aid in reducing the possible negative effect of these policies. Research that provides an understanding of the types of alternative policies available to developing countries, would also be exceedingly helpful.

This thesis complements and extends the literature, especially in relation to those questioning the benefits of globalisation and trade policies. This analysis provide further evidence of how economic policies can provide unequal effects on the population, and may not provide the intended effects. The Mexico case provides a cautionary tale for other developing countries that may attempt to increase growth through liberalisation. If countries like Mexico continue to attempt to employ trade liberalisation policies for rapid growth opportunities, it is imperative that these countries provide a way to complement these policies with excellent domestic policies, to improve the standard of living of all within the country. Given the work completed in this thesis, it is clear that further research into the effects of these policies is warranted, to possibly understand how to implement a more equitable policy.

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