Trade, Migration, Poverty and Inequality:

A Global Perspective

A thesis

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Abstract

Trade and migration have been extensively studied in a variety of disciplines but their inter-relationship is still arguable. It is crucial to understand how trade and migration are linked, since they are important elements in a modern, globalized economy. This thesis presents three interconnected studies on trade and migration that make use of newly estimated international migration flows data, to understand these relationships and the potential contributions of trade and migration to global poverty and inequality reduction.

The first study examines the bi-directional relationship between trade and migration using international bilateral trade and migration flows data within a seemingly-unrelated regression gravity model framework. The study finds that trade and migration are complements, which means that larger migration flows are associated with higher trade flows, and vice versa. Although these results do not definitively demonstrate causality, they suggest that, if world trade decreases due to countries implementation on current protectionist policies, migration flows might also be likely to decline.

The second study extends the investigation by examining the causal relationship between trade and migration. The study uses a novel instrumental variables strategy, utilising World Trade Organisation (WTO) affiliation and average tariff rates as instruments within a gravity model framework, to overcome endogeneity in the regression model. The results suggest that trade is a causal driver of migration. This means that migration flows would increase following an increase in trade flows.

The third study investigates whether international trade or migration has a larger effect on global extreme poverty and inequality. Again, an instrumental variables approach is used to address any endogeneity problems. The results suggest that trade has a larger potential impact on reducing extreme poverty and inequality.

Overall, the outcomes of this thesis are important to policy makers in countries where growing migration is a political issue, and to origin countries that want to restrict the mobility of migrants and reduce the brain drain from their countries. It suggests that how countries treat their borders influences poverty and income inequality outcomes. This thesis suggests that trade provides a greater impact than migration on extreme poverty as well as inequality. Therefore, a country might want to allow freer trade by reducing their national border barriers, in order to reduce extreme poverty and inequality.

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Rosmaiza Binti Abdul Ghani

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Abbreviation

CC	Common Colonial
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
CPTPP	Comprehensive and Progressive Trans Pacific Partnership
DIST	Distance
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effects
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GDPPC	Gross Domestic Product Per Capita
GMM-SYS	System Generalized Method of Moments
ILOSTAT	International Labour Organization Statistics
IRRs	Incident Rate Ratios
IV	Instrumental Variables
LNCS	Landlockness
MDGs	Millennium Development Goals
MIG	Migration Flows
MR	Multilateral Resistance
OECD	Organisation for Economic Co-operation and Development
OFFLANG	Official Language
OLS	Ordinary Least Squares
POP	Population

PPML	Pseudo-Maximum Likelihood Estimator
RCEP	Regional Comprehensive Economic Partnership
RQ	Research Question
RTA	Regional Trade Agreement
SDGs	Sustainable Development Goals
SUR	Seemingly Unrelated Regression
TRDE	Trade Flows
TSLS	Two Stage Least Squares
U.S	United States
UK	United Kingdom
UN	United Nation
UNESCO	United Nations Educational, Scientific and Cultural Organization
WIID	World Income Inequality Database
WTO	World Trade Organization

Chapter 1 : Introduction

1.1 Overview

Interactions between economies have expanded over time and this has had a significant impact on the world's economic development. Macroeconomic conditions such as growth, trade openness, borders openness, global poverty, welfare and global income inequality issues are widely discussed by economists. All of these have a connection with globalization. So, what is globalization?

According to McGrew (1992), globalization creates a multiplicity of links and interconnections that go beyond the nation states and by implication the societies that build up the modern world system. It defines a practice through which events, selections and actions in one part of the world can come to have significant consequences for individuals and societies in other parts of the world. As Gill (1995) points out, economic globalization affects society at the group, national, and transnational levels. There are connections between the processes of economic globalization, and the way the outlook, expectations, and social choices of individuals and groups are being reformed. Fischer (2003) notes that globalization, the ongoing process of greater interdependence among countries and their citizens, is complex and complicated. He added that, as far as economics is concerned, the big challenge is poverty and the unquestionable route to sustained poverty reduction is economic growth. As globalization is expanding over time, economies become freer especially in terms of international trading. Globalization brings

a lot of benefits to people, but some economists believe that the benefits from globalization are more concentrated among the rich[1].

Openness of borders has reduced transaction costs and migration costs (Genç, 2014). But some countries only favor lowering their borders for trade but not for migration (Mayda, 2007; Genç, 2014) . Why are governments willing to open borders for trade, but are unwilling to do the same for migration? Will open borders for trade will provide more gains than opening the borders for migration? Doesn't migration stimulate trade? These questions help to motivate this thesis.

Free trade brings a lot of opportunities to help countries to develop. Since the 1970s, open borders have attracted a lot of financial flows, foreign direct investment, trade and migration flows. Historically, trade became more liberal when an agreement called the General Agreement on Tariffs and Trade (GATT) was introduced in 1947, which became World Trade Organization (WTO) in 1995. The main purpose of these agreements was to increase international trade by reducing trade protectionism. Since the WTO has so many members, its impacts will be global in scale.

[1]https://www.bloomberg.com//articles/globalization-still-favors-the-rich

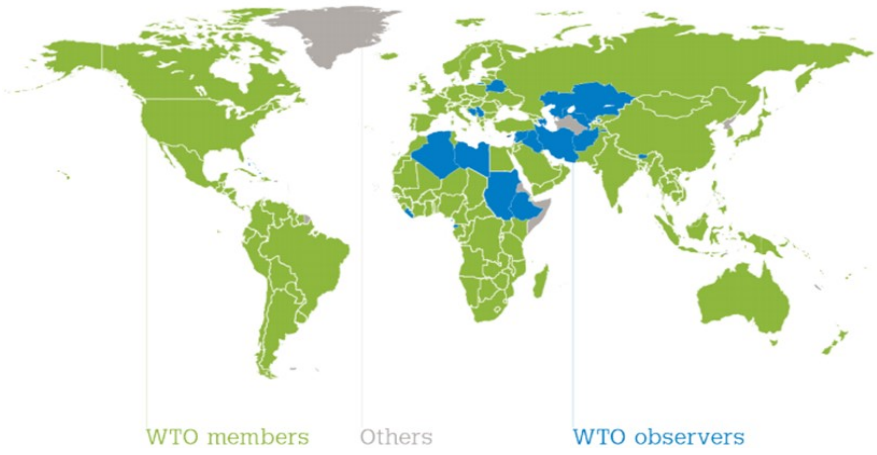

Figure 1: WTO members and observers (Source: WTO statistics 2015)

Based on Figure 1, nearly every country in the world is a member of the WTO (164 members; see Appendix 1). There are a lot of benefits gained by joining the WTO. The main benefit is that all members must have lower trade barriers towards all members without any preferential trade benefits. But what happens to people who live in very poor countries, rural areas or in a very remote places who are commonly live in extreme poverty? They are less likely to be able to benefit from trade opportunities (Cororaton and Cockburn, 2006; Le Goff and Singh, 2014) because trade helps to induce opportunities for certain country and certain regions.

Globalization has been an important contributor to freer trade (Nooruddin and Simmons, 2009; Chase-Dunn, Kawano, and Brewer, 2000). But not only does globalisation enhance trade, it encourages more movement of people too. Migration is the movement of a person or a group of people, either across an international border, or within a state. Every year, millions of people are willing to leave their home countries and cross-national borders in order to find better opportunities and livelihoods for themselves and their families. In general, international migration is said to have enormous implications for the economy in the both the home and host

countries. Based on (Russell, 1992), international migration can be separated into five subclasses:

1. *Temporary contract labour*: Includes low skilled and low paid workers. This is only to fill gaps in the labour market temporarily.

2. *Settler migrants*: Includes people who move across borders, whether legally or illegally. Sometimes, the permanence of the move was not projected at first, but the migrant's preference for remaining in the new location increases with time.

3. *Student migrants*: The admission of foreign students for educational purposes for limited time periods.

4. *Skilled labour migrants*: Includes short term and long-term movements of skilled workers, technical personnel, and staffs of multinational companies and governmental agencies.

5. *Refugees and asylum seekers*: Include people who move across borders to escape civil wars, violence, environmental crises, and starvation. Their immediate objective is to try to find protection.

It has been forecasted that in the coming decades, globalization, climate change and demographic forces will increase the level of migration both within and across borders (The World Bank, 2015). Migration affects poverty and inequality in the origin as well as the destination country in several ways (as will be discussed in Chapter 4). One of the main reasons that international migration happens is because individuals want to increase their personal welfare by moving to a wealthier country (Harris and Todaro, 1970; Black, Natali, and Skinner, 2005). However, people migrate for a variety of reasons and influence on how and why they

choose a particular country to migrate. This issue made Wegge (1998) came out with a classic theory of migration mixture of push and pull. The push-pull framework was originated by (Lee, 1966), who saw the model as a conceptualization of migration in which a set of causes in the home and host countries are involved. Push factors are the reasons why people leave their home countries, for example due to famine or drought, poor economic activity or lack of job opportunities. Pull factors are factors that attract people to a certain location. Examples include availability of employment, the promise of better living conditions, education and better medical care.

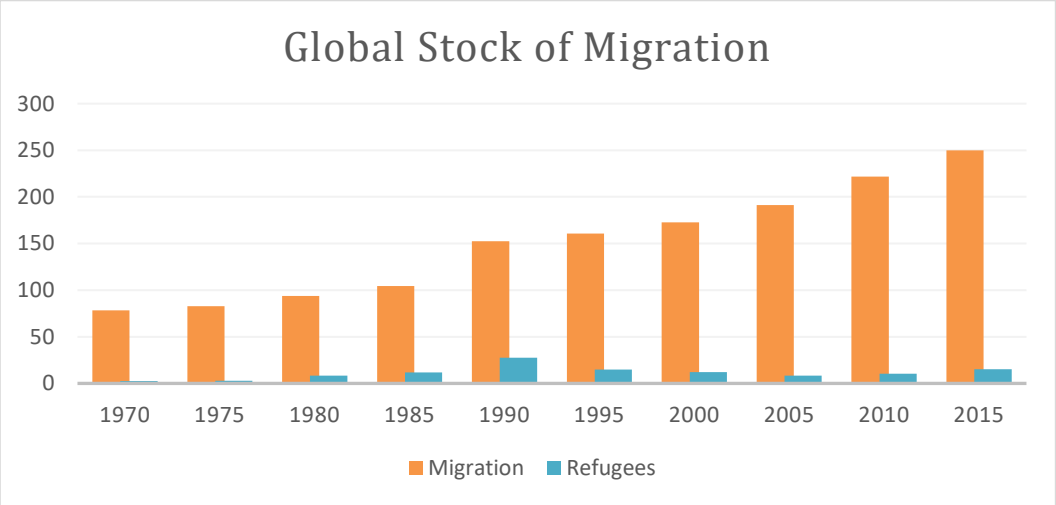

Figure 2: Global stock of refugees and International Migrants[2].

(Source: World Bank 2015)

Based on Figure 2, international migration stocks have been increasing globally since at least the 1970s. In 1970, there were 78.4 million people living outside of their country of birth but in 2015, the total migrant stock had increased by 171.5 million to 250 million. The

[2] Excludes Palestinian refugees numbering 5.1 million

proportion of South–South migrants (migration between developing countries) is approximately 38 percent of the total migrant stock, greater than South–North migration (migration from less developed or developing countries to developed countries). Mexico–United States is the largest migration passageway in the world, followed by Russia–Ukraine, and Bangladesh–India. The most chosen migrant-destination country is the United States, followed by Saudi Arabia, Germany, and Russia (World Bank, 2016). The number of migrant workers as a proportion of population in the host country is the highest in the smaller nations of Qatar, the United Arab Emirates and Kuwait with 91 percent, 88 percent and 72 percent respectively (World Bank, 2016).

The links between migration and trade have been debated in terms of how they are related in terms of whether they are complements or substitutes. The majority of previous empirical studies focus on the relationship between trade and migration in a single country or a single region. A lot of previous studies have aimed to look at how migration influences trade but surprisingly, they are not many previous studies that examine the relationship the other way around, about the causality from trade to migration. This thesis re-examines the correlation and causal relationships between trade and migration.

This thesis concerns extreme poverty. According to (Betson and Warlick, 1998), poverty is a condition in which a person (or family) lacks goods and services considered necessary to human well-being. Poverty is not only about lack of money but a wide range of problems, including being unable to afford necessities (food, shelter), health care, education, clean water, and specific needs depending on where people live. According to Our World in Data,[3] in the

[3] https://ourworldindata.org/extreme-poverty

year 1820, 94 percent of the world population lived in extreme poverty, reduced to 85 percent in 1890 and kept on reducing to 60 percent in 1970. After 1980 the percentage of the population who lived in extreme poverty was reduced from 44 percent to 9.6 percent in 2015, which means that at the global level more than 800 million people are living in extreme poverty in 2015. Adding to the bitterness, according to Angang, Linlin, and Zhixiao (2005), China is the only country which has biggest poverty reduction in the last couple of decades.

Trade and migration are two important elements in the growth of an economy. But their contributions to poverty and inequality reduction are still ambiguous. When some countries are only willing to open their borders for trade but not for people, this situation made economists curious, doesn't migration help with the process of reducing poverty as well? According to World Bank President Jim Yong Kim,[4] there is almost no model that can be implemented to help to end extreme poverty easily.

Some countries may have reduced extreme poverty but inequality has continued to grow (Liyanaarachchi Naranpanawa and Bandara (2016). Increases in income inequality have caused a lot of impacts on people's lives in terms of education (Mayer, 2001), health (Lynch et al., 2004; Moore, 2006), crime (Kennedy, Kawachi, Prothrow-Stith, Lochner, and Gupta, 1998; Western, 2006) and social relationships (Schwartz and Mare, 2005). People move out of the country searching for good opportunities and increases in the standard of living. But, if a poor person isn't able to migrate since they lack resources, they won't be giving any impact on poverty reduction. Furthermore, if only people who have resources are able to move and enjoy the benefit of globalization, migration won't serve the justice to alleviating poverty but instead,

[4] At the launch of the joint WTO-World Bank report: 'The Role of Trade in Ending Poverty', Geneva, 2015.

will increase income inequality gap. It is significant to consider the best methods to reduce poverty and inequality. Thus, this thesis studies whether international trade or migration flows has the potential to make a larger contribution to reducing poverty and inequality.

1.2 Theoretical Framework and Research Questions

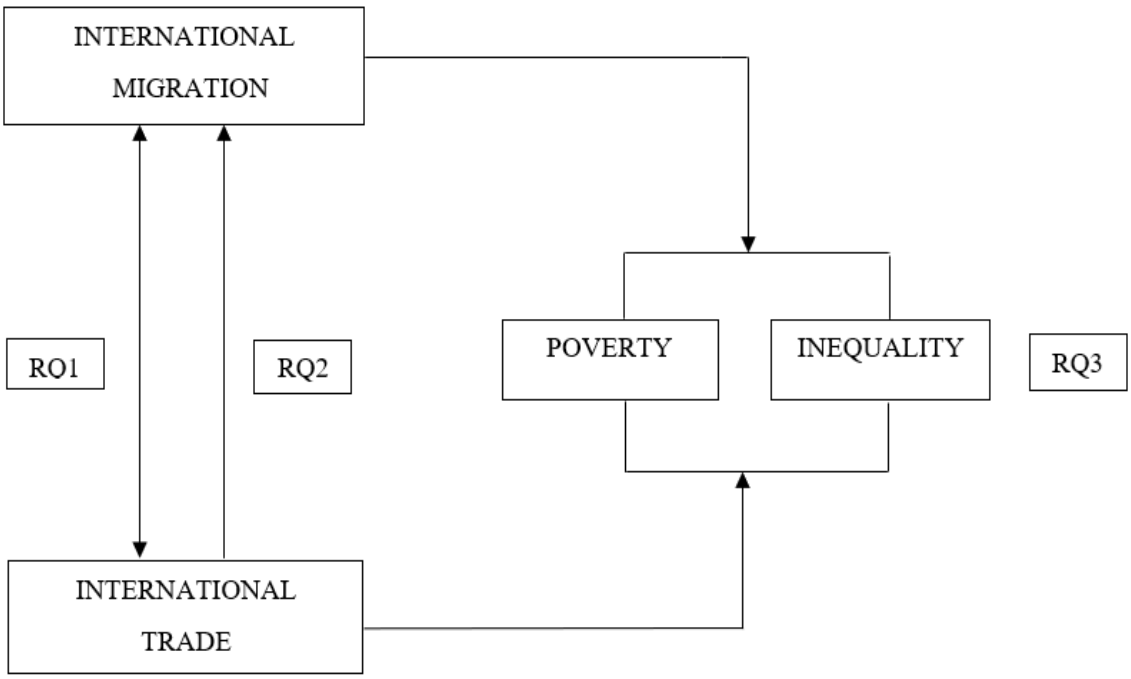

Figure 3: Theoretical Framework

(Source: Author)

The theoretical framework in Figure 3 is used to limit the scope of the relevant data by focusing on specific variables that will be used in analysing, interpreting and answering the research questions.

Based on the above framework, the research question of the first paper of this thesis is, are trade flows associated with migration flows and vice versa (RQ1)? To answer this research

question, bilaterally structured panel data for 248 countries is used, with each observation referring to a specific flow from origin *i* to destination *j* in a given five-year period, from 1990 to 2010. The average distances among all other trading partners is taken as a measure of multilateral resistance (Anderson and van Wincoop, 2003). There are two model equations, with trade and migration respectively as the dependent variables. There is a likely connection between trade and migration and so we expect that the errors in both regression models will be correlated. Therefore, a seemingly unrelated regression (SUR) gravity model framework was employed as the preferred specification. Since the data contain many missing values, a Poisson-Pseudo-Maximum Likelihood estimator (PPML) was used. As a result, SUR and PPML were combined to answer the research question.

Second, this thesis investigates the causal relationship between trade and migration flows. The research question of the second paper is, will increase in trade cause migration to increase (RQ2)? To answer this research question, bilateral panel data is used with each observation referring to a specific flow from origin *i* to destination *j* in a given five-year period, from 1990 to 2010. Given that there is likely an endogeneity issue between trade and migration, GATT/WTO accessions and average tariff rate are used as instruments for trade. The instruments were chosen because they are directly related to trade flows, but plausibly have no direct effect on migration flows. Gross domestic product, population, and distances between capital cities are included in the gravity regression model as control variables. In this paper, Two Stage Least Squares (TSLS) is combined with PPML to implement the regression.

The research question of the third paper of this thesis is whether international trade or migration flows will be more effective in reducing global extreme poverty and inequality(RQ3)? To answer this research question, unbalanced panel data for 217 countries in a given five-year

period, from 1990 to 2010 is used. Poverty headcount ratio at $1.90 a day data and Gini index are used as the dependent variables. Trade and migration flows as the included variables. Given that there is endogeneity for both trade and migration, three instrumental variables are used, two instrumental variables for trade and one instrument for migration. GATT/WTO accessions and average tariff rate are used as instruments for trade. Meanwhile, international migrant stocks are taken to be the instrument for migration. TSLS is employed as the preferred model specification for both dependent variables.

1.3 Significance of the Thesis

The relationship between trade flows and migration flows is still unclear from the literature, primarily because there are findings of both positive and negative relationships. If trade and migration are complements, migration will increase in host, home or both countries as trade increases, but if trade and migration are substitutes then migration will decrease with increases in trade. It can be examined from two directions: first, the impact of the flows of trade on the flows of migration, and second, the impact of the flows of migration on the flows of trade.

This thesis makes use of the exogeneity of GATT/WTO accession and average tariff rate as instruments in order to establish the causal effect of trade on migration. To my knowledge, there are no studies that have used GATT/WTO accession as an instrument for trade, so this thesis provides a new approach with potentially wide application. In contrast, many previous studies have only concentrated on the effect that migration has on trade, which does not require instrumenting for trade. This thesis therefore also contributes to a better understanding of the relationship between trade and migration and a new evaluation of the causal impact of trade on migration flows.

The question of whether trade or migration has a bigger effect on poverty and inequality remains an open question. This thesis assesses the causal effects of trade and migration on poverty and inequality and evaluates which of trade or migration will be a more effective avenue for reducing poverty and inequality. Previous studies have either limited the geographical scope of their analysis to two neighbouring countries, or within particular regions or members of a particular trade agreement. Therefore, this thesis provides important new analyses of these questions.

Finally, the thesis aims to come out with helpful findings for policy makers to make good decisions about trade and migration policies, since the results will demonstrate whether more trade protection is associated with a decrease in migration flows. The outcomes will also provide some evidence on whether freer trade, or freer movement of people, is the best help to reduce poverty and inequality. These will affect how a country should treat their national border barriers for trade and migration.

1.4 Thesis outline

The rest of this thesis is structured as follows. Chapter 2 examines the bilateral relationship between trade and migration flows. The chapter starts with a brief review on the previous literature of the relationship between trade and migration. The findings suggest that trade and migration are complements - larger migration flows are associated with larger trade flows, and vice versa.

Chapter 3 extends the investigation in Chapter 2, by alleviating the endogeneity issue between trade and migration, and investigating the *causal* relationship from trade to migration. This chapter begins with a review of the contradictory findings in the extant literature. Based

on the results in this chapter, migration flows from country *i* to country *j* would increase by 1.13 percent if the corresponding trade flows increase by one percent.

Chapter 4 identifies the relationship between trade and migration, and each of poverty and income inequality. This chapter begins with a review on how complex the relationship between trade, migration, poverty and inequality due to the complex causation between trade and migration. The findings suggest that trade provides a greater impact than migration on extreme poverty as well as inequality.

Chapter 5 concludes the thesis by summarising main findings of all research articles and includes a discussion on the implications for policy makers, as well as potential extensions for future research.

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Chapter 2: A Gravity Model Estimation of the Bi-Directional Relationship Between International Trade and Migration.

2.1 Introduction

The relationships between international migration and trade are a continuing source of debate in the academic literature. Many studies on these relationships have been conducted (e.g. Steingress, 2015; Serrano-Domingo and Requena-Silvente, 2013; G. Felbermayr, Grossmann, and Kohler, 2015). If migration flows increase with increases in trade (or vice versa) that would demonstrate that they are complements, whereas if they are negatively correlated, they will be substitutes. The question of whether trade and migration are complements or substitutes has been the source of much academic research.

The question of the relationship between trade and migration has increased in importance. International trade and migration flows have increased in recent years due to globalization. Economic research on globalization suggests that it has occurred in three waves (Robertson, 2003) and we are now currently in the midst of the third wave of globalization (Rodrik, 1998; Holton, 2000). A general definition of globalization is the growing flows through national borders of trade, capital, investment, community, information, way of life, and even diseases, or in other words, more economic interdependence among countries (Scholte, 2005), include the exchanging of cultures, attitudes, and people (Bergstrand, 2013).

After the inter-war years where trade barriers rose substantially, trade became more liberal after 1947, when 23 countries signed the first worldwide multilateral free trade agreement, the General Agreement on Tariffs and Trade (GATT). This evolved into the World Trade Organization (WTO) on 1st January 1995. The main purpose of GATT and the WTO has been

to increase international trade by eliminating and reducing trade protectionism, i.e. various types of tariffs and quotas, as well as non-tariff trade barriers. Since the 1970s, open borders have lured huge amounts of foreign direct investment, financial flows, and increased international migration flows, as well as increased the trade of services and goods (Poot, 2013).

The world has become more interconnected and besides trade, this has also affected the magnitude of migration flows across national boundaries. Every year, millions of people are willing to leave their home countries and cross-national borders in search of greater opportunities and better livelihoods for themselves and their families. The world population in 1990 was 5.3 billion and the number of international migrants was 152 million (2.8% of the global population). By 2010, the world population had increased to 6.9 billion[5] with 221 million international migrants globally (3.2%).[6]

The growing magnitude of international migration flows has attracted a lot of researchers to study whether it is associated with increases in trade. The majority of previous empirical studies have focused on the relationship between trade and migration in a single country, a single region, or between countries within a single trade agreement. Many of these previous studies have found that trade and migration have a positive relationship (e.g. Mundra, 2005; Wong, 1983; Genç, 2014; Akkoyunlu and Siliverstovs, 2009; White, 2007). Other studies have found that there is no relationship between trade and migration (Hatzigeorgiou and Lodefalk, 2015) or that trade and migration are substitutes (e.g. Wickramasekera, 2002; Markusen,1983).

[5] https://data.worldbank.org/
[6] https://www.oecd.org/World-Migration-in-Figures

Countries openness to cross-border flows has reduced both transaction costs and migration costs (Genç, 2014). However, some studies have found that governments only favor opening their borders for trade but not for migration (Mayda, 2007; Genç, 2014). Why are governments willing to open borders for trade, but less willing to do so for migration? Will open boarders for trade be more beneficial than open boarders for migration? Doesn't migration stimulate trade? These questions help to motivate this research.

The main motivation is to unpack the contradictions surrounding trade and migration by empirically examining whether international trade flows are positively related to international migration flows, and vice versa. The hypothesis for the study is that an increase in international trade flows is associated with an increase in international migration flows. The novelty of the research comes from the use of an extensive dataset of bilateral migration and trade flows, in particular a newly available international bilateral migration flows dataset that has yet to be fully exploited in this area of study.

The remainder of the paper is structured as follows. Section 2 reviews relevant literature on the relationship between trade and migration, focusing on studies that have evaluated whether they are substitutes or complements. In Section 3, we describe the data and methodology. Section 4 presents and discusses our empirical results, and Section 5 the conclusions and implications. Most of the literature to date has examined the relationship between trade flows and either immigration flows or emigration flows separately, instead of studying both types of migration flows simultaneously or considering migration flows in the same direction as trade flows.

In one of the first studies of this type, Mundell (1957) used the Heckscher-Ohlin-Samuelson Model to describe theoretically whether international trade and factor mobility are substitutes or complements. Mundell determined that trade and factor movements are expected to be substitutes. Markusen (1983), by relaxing some of the underlying assumptions of the standard Heckscher–Ohlin model, noted that there is theoretical support for both relationships (substitutes *and* complements). One of their explanations was that, if trade increases alongside international factor mobility, then factor mobility and trade are theoretically complements. Razin and Sadka (1992) expanded the study of Markusen (1983) by using the Hecksher-Ohlin Proposition Model.[7] They concluded that if the only difference between countries was in their relative abundance of labour, then commodity trade and labour are substitutes.

Morrison (1982) studied how U.S. foreign assistance, international trade and foreign direct investment influence migration flows for countries that send large numbers of migrants to the U.S., especially countries in the Caribbean, Central and South America, and Mexico. They found that trade and immigration are complementary. Collins, O'Rourke, and Williamson (1997) analyzed trade and factor (labour and capital) movements between several countries for the years 1870 to 1940. Using panel data, they found that trade and capital flows were rarely substitutes and most of the time were complements, and between trade and migration flows they found that there is a strong complementary link.

Bruder (2004) studied whether trade and factor movements (migration) were substitutes or complements between Germany and each of Spain, Portugal, Greece, Italy, and Turkey, the

[7] This is a "type of model relating the inter economy factor movement to inter economy factor price differentials" (Smith, 1975, p.165), which means that labour-abundant countries will specialize in labour intensive merchandise and capital-abundant countries will specialize in capital intensive merchandise for export.

five biggest foreign worker sources for Germany. They found that there is no significant impact of labor migration on trade, but on the other hand increasing trade volume has significant negative effects on labour migration. Panagariya and Panagariya (1992) proposed a North-South (richer to poorer countries) model driven by scale economies in the modern sector. They divided migration into two subgroups – skilled and unskilled labour. They found that the movement of factors of production, like capital and skilled labour in particular, leads to an expansion of trade, while the movement of unskilled labour may or may not lead to any effect on trade. They concluded that trade and unskilled factor mobility are substitutes, while trade and both skilled labour and capital are complements. Likewise, López and Schiff (1998) and Felbermayr and Jung (2009) used skilled and unskilled labour, international labour mobility, migration costs, and financial constraints in their studies. In contrast with Panagariya and Panagariya (1992), both studies found that trade flows and migration of unskilled workers were complements, while the migration of skilled workers was unrelated to trade flows.

The most widely used method to analyze international trade and migration individually is the gravity model approach, initiated by Ravenstein (1885). Inspired by Newton's Law of Universal Gravitation, Tinbergen (1962) described the patterns of bilateral aggregate trade flows between two countries as being directly proportionate to the level of GDP for both countries, but inversely related to the distance between them. Studies using panel data gravity models have shown that migration is positively associated with trade flows in terms of imports and exports between the host and home countries. For example, Gould (1994) studied about forty-seven U.S. trading partners. They analyzed producer goods and consumers goods separately and found that both imports and exports were strongly positively influenced by immigration. Head and Ries (1998) studied Canadian trade with one hundred and thirty-six trading partners from 1980 to

1992. They found that immigration (which they divided into three primary categories: *family*; *refugee*; and *independent*) positively affects both imports and exports. They added that independent immigrants tend to be more skilled, with more knowledge, and lead to greater impacts on trade flows than other immigrant groups. Hong and Santhapparaj (2006) studied the impact on Malaysia's bilateral trade flows of ASEAN and non-ASEAN skilled immigration. They found that skilled immigration positively affects both Malaysian imports and exports, but that the link is stronger between Malaysia and ASEAN countries than between Malaysia and non-ASEAN countries. Combes, Lafourcade, and Mayer (2005) investigated how migrants influence trade between French regions, considering the network effects of migrants. They found that migrants were able to increase trade but with the presence of network effects, migration will increase trade more that without network effects. One natural experiment about migrant networks and trade on Vietnamese boat people in the U.S., by Parsons and Vézina (2018), showed that U.S. exports to Vietnam grew larger in 1995 to 2010 and mostly in those states with greater Vietnamese populations.

The study that most closely resembles ours, using comprehensive international trade and migration data, is Fagiolo and Mastrorillo (2014). Using migrant stock data, they applied a complex-network approach for 226 countries, and found evidence that international migration network size and merchandise trade are strongly positively related, with pooled OLS as their estimator. Our study differs in our use of the Poisson-Pseudo-Maximum Likelihood (PPML) estimator combined with Seemingly Unrelated Regression (SUR). We discuss the advantages of our approach in the following section.

Recent research has suggested that immigration has a positive relationship with trade only until the migrant stock reaches a certain threshold, and then migration–trade links become

exhausted (Egger, Von Ehrlich, and Nelson, 2012). According to Serrano-Domingo and Requena-Silvente (2013), potential bilateral export value reaches its maximum point when the array of immigrants of a certain nationality or ethnicity living in the same zone reaches a specific level (70 immigrants from the same nationality for Italy, and 100 for Spain). Similarly, Gould (1994) estimated the impact of immigrant links to their home countries to U.S. bilateral trade. They found that the influence is exhausted at a considerably higher level of immigrants for imports (370,879 immigrants) than for exports (12,016 immigrants).

To summarize, some studies have suggested that migration and trade are complements, but there are arguments that migration and trade have no direct relationship, while other studies have found that they are substitutes. Some studies have found that migration only affects exports and not imports, and some have found that the relationship differs between skilled and unskilled migrants. We contribute this literature by providing a study of the relationship between trade and migration using flows between all countries (where data are available), an approach that has been mostly lacking in the extant research.

2.3 Data and Methods

2.3.1 Data

We use data for 248 countries over four five-yearly periods (1990-2010). A list of the included countries is in the Appendix, Table A2. The data are bilaterally structured, with each observation referring to a specific flow from origin *i* to destination *j* in a given five-year period.

Bilateral trade flows (in nominal US$1000s) were obtained from the Center for International Data at the University of California – Davis (Baxter and Kouparitsas, 2006;

Feenstra, Lipsey, Deng, Ma, and Mo, 2005).[8] To ensure data quality, this dataset uses source data reported by the importer as much as possible, because importers have more incentive to properly record all transactions than exporters, due to duties and tariffs (Fouquin and Hugot, 2016).

Bilateral migration flows data were obtained from a newly assembled global dataset developed by Abel and Sander (2014). The dataset consists of estimated bilateral migration flows at country level for each five-year period from 1990-2010. It was developed from the changes in stock migration from mid-year to mid-year, based on place-of-birth answers to census questions, information obtained from population registers, and refugee statistics[9] (Abel and Sander, 2014). This dataset effectively captures the estimated total number of people who change their country of residence during each five-year period.

Our analysis also controls for relevant covariates. Gross domestic product (GDP) is a common variable employed in gravity models (Vicente, 2003). We obtained data on gross domestic product (GDP) in international dollars using purchasing power parity from the World Bank database.[10] Population data were obtained from the United Nations Population Division,[11] being mid-year estimates of the total population (headcount) counting all residents of each country regardless of legal status or citizenship. Population is another variable that previous researchers have found to positively affect trade and migration (Bove and Elia, 2017). This is

[8] http://cid.econ.ucdavis.edu. Constructed from United Nation Trade data by Robert Fenestra and Robert Lipsey. The data could be either in c.i.f. (receiving countries) or f.o.b. or f.a.s. (sending countries), depending on data availability (Feenstra, personal communication).
[9] Refugees are included in the measure of migration flows.
[10] This is the total gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current international dollars. For most economies, PPP figures are extrapolated from the 2011 International Comparison Program (ICP) benchmark estimates, or imputed using a statistical model based on the 2011 ICP (http://databank.worldbank.org/data/reports.aspx).
[11]https://esa.un.org/unpd/wpp/

theorized to be due to an increased pool of potential migrants as the origin country population increases, while destination countries with larger populations offer more amenities and opportunities to attract migrants (Lee, 1966).

Data on common official language (as a dummy variable) was obtained from French Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (Mayer and Zignago, 2011).[12] Common language is expected to be positively related to both bilateral trade flows and bilateral migration flows (Ball, 1967;di Giovanni, 2005). If the majority of the residents in a country are able to speak the language of its trading partners, it is hypothesized that the trade volume will be higher among these countries due to lower trading, transaction and information costs, as previous research has consistently shown (Gould,1994; Wagner, Head, and Ries, 2002; Egger and Lassmann, 2018). Distance between countries was calculated as the geographical distance between their respective capital cities in kilometers. Trade and migration are expected to be negatively affected by geographical distance. Distance is one of the defining variables of the gravity model (Montanari, 2005; Blomqvist, 2004; White, 2007; McCallum, 1995).

Additional dummy variables were created for adjacency, landlockedness, and common colonial heritage. Data for these variables were obtained from CEPII database. Adjacency denotes whether countries *i* and *j* share a common border and has also been used by Baier and Bergstrand (2009). Neighboring countries have easier trade and migration due to lower transportation costs (Wong and Wong, 2008). Landlocked countries face constraints accessing world markets (Faye et al. 2004), so landlocked countries might have poor international trade performance (Paudel and Burke, 2015), since the means to transport goods and services are

[12]http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp

limited. Common colonial heritage is also often used by economists (Mayer, Head, and Ries, 2008; Ekkayokkaya, Foojinphan, and Wolff, 2017) to represent similarities in cultural, political or legal institutions. Previous research has shown that countries that share a common culture are more likely feel comfortable trading among each other since common culture will develops trust between people in those countries (Guiso, Sapienza, and Zingales, 2009).

Trade between two countries will likely increase if both countries are part of a Regional Trade Agreement (RTA) due to lower costs of trade (Baier and Bergstrand, 2009). Hence, it is essential to include an indicator of RTAs in the model. It is expected that countries that belong to the same trade block will have greater trade volumes (Bendjilali, 2000; Ball, 1967). Data on RTAs were obtained from the World Trade Organization (WTO).[13] Of all the explanatory variables, RTAs are the only variable that is used in the trade model but not in the migration model. This is because RTAs do not typically include agreement on migration flows between countries.

Instead of only depending on bilateral cost, trading between two countries will also need to take into account the relative cost with other countries besides the pairing country. Multilateral resistance is an important consideration in the gravity model. Anderson and van Wincoop (2003) introduced the concept of multilateral resistance (MR) as a measure of the transaction costs of trade flows between countries *i* and *j*, relative to those between country *i* *and* other countries. It is important to include MR in gravity model estimations. To see why, consider a simple example. If country *i* and *j* are trade partners and the trade resistance between countries *i* and *k* reduces, the trade flow between *i* and *j* might reduce, as trade is diverted instead

[13]http://rtais.wto.org/UI/PublicAllRTAList.aspx

to country *k*. This may happen regardless of any of the other characteristics of countries *i* and *j*, leading to an omitted variable bias (Adam and Cobham, 2007). According to Alberto and Nelson (2012), bilateral trade costs are important but MR gives enormous impact to trade between paired countries since trade flows will definitely respond to a change in trade resistance among other trading partners. The same MR arguments apply equally to the gravity model of migration flows as well as that of trade flows. According to Bertoli and Fernández-Huertas Moraga (2013), the decision to migrate between two countries does not simply rely on the relative attractiveness of the origin and destination countries, but also relies on the relative attractiveness of other possible destinations. In this paper, we use the average distances among all *other* trading partners, as the multilateral resistance for both the gravity model of trade and the gravity model of migration.

Table 1: Descriptive summary of variables

Variable	Observations	Mean	Std. Dev.	Min	Max
Trade (Trde)	123,313	359,008	3,948,634	0.001	3.83E+08
Migration (Mig)	47,367	3314	32,578	1	2,677,763
Distance (Dist)	179,445	7839	4556	1.881	19,951
GDP (GDP)	169,870	4.39E+11	1.35E+12	2.13E+07	1.53E+13
Population (Pop)	184,900	3.62E+07	1.32E+08	9004	1.34E+09
Official language (Offlang)	205,180	0.109	0.311	0	1
Common colonizer (Cc)	205,180	0.188	0.390	0	1
Adjacency (Adjcc)	205,180	0.052	0.222	0	1
Regional Trade Agreement (RTA)	205,180	0.137	0.344	0	1
Landlocked country (Lcns)	205,180	0.180	0.384	0	1

Notes: The unit of the variables used. Trade (US$1000s), Migration (total number of people). Distance (kilometers between cities). GDP (current international $). Population (total headcount). All others are dummies variables (yes=1, otherwise=0).

2.3.2 Methods

The main objective of this paper is to investigate the relationships between inter-country trade flows and migration flows. For this, we apply a classical gravity model approach. The equation below describes the basic gravity model of trade:

$$T_{ij} = A\frac{GDP_i\, GDP_j}{D_{ij}} \quad (1)$$

where T_{ij} is the trade flow from country i to country j, A is the gravitational constant, GDP_i represents the economic mass of country i and GDP_j represent the economic mass of country j. D_{ij} is the distance between country i and country j. Re-specified in natural logarithms and with the addition of regression coefficients, the regression equation becomes:

$$lnT_{ij} = A + \beta_1 ln\left(GDP_i . GDP_j\right) + \beta_2 ln\left(D_{ij}\right) + \varepsilon_{ij} \quad (2)$$

where the betas are the coefficients of interest, and ε_{ij} is an idiosyncratic error. We estimate two main gravity model equations, for: (1) bilateral trade flows; and (2) bilateral migration flows:

$$ln(\text{Trde}_{ijt}) = \beta_0 + \beta_1 ln(\text{Mig}_{ijt}) + \beta_2\, \text{RTA}_{ijt} + \beta\, Z_{ijt} + \varepsilon_{ijt} \quad (3)$$

$$ln(\text{Mig}_{ijt}) = \delta_0 + \delta_1 ln(\text{Trde}_{ijt}) + \delta\, Z_{ijt} + u_{ijt} \quad (4)$$

where o and d are representing origin and destination respectively, i and j indicates countries, and t indicates years. Trde_{ijt} is nominal trade value. Mig_{ijt} is the total of people who change their country of residence. $Zijt$ represent the rest of control variables and u_{ijt} , ε_{ijt} represent

idiosyncratic error terms. β_1 and δ_1 capture the impacts of migration flows on trade flows and trade flows on migration flows respectively.

Our data is an unbalanced panel. Since panel data are used, there are three models that can be chosen (pooled OLS, fixed effects and random effects). We begin with the simplest (pooled OLS) model. According to Hong and Santhapparaj (2006), even if some independent variables are correlated with the dependent variable, pooled OLS outcomes may still be valid. We used the average distances among all other countries, besides the pairing country as mentioned in data section above, as our multilateral resistance in this estimator. Though, the result of pooled OLS will be biased because the error term across countries is correlated and heteroscedastic due to omitted (and unobserved) time-invariant differences between countries. Therefore, we next move to panel data models, with robust standard errors to account for both heteroscedasticity and autocorrelation. A Hausman test (p<0.001) indicated that the fixed effects model was more appropriate (Hsiao, 2014). The regression equation become;

$$ln(\text{Trde}_{ijt}) = \beta_0 + \beta_1 ln(\text{Mig}_{ijt}) + \beta_2 \text{RTA}_{ijt} + \beta Z_{ijt} + \mu_{ij} + \gamma_t + \varepsilon_{ijt} \quad (5)$$

$$ln(\text{Mig}_{ijt}) = \delta_0 + \delta_1 ln(\text{Trde}_{ijt}) + \delta Z_{ijt} + \mu_{ij} + \gamma_t + u_{ijt} \quad (6)$$

where μ_{ij} denoted the unobservable origin-destination countries fixed effect and γ_t denotes the unobservable time fixed effect.

However, both fixed effects and pooled OLS ignore the system interrelationships between the two equations (trade and migration). In our third specification, we use a seemingly unrelated regression (SUR) gravity model framework, building on the approach proposed by Zellner (1962). Observably, there is a link between trade and migration and so we expect that

the errors in Equations 3 and 4 will be correlated. Both variables (migration and trade) appear as an explanatory variable in the equation for the other variable. SUR captures the efficiency due to the correlation of the disturbances across equations (Moon and Perron, 2006). In the simplest SUR application, each equation is estimated twice, with the residuals from the estimated equations in the first stage used as explanatory variables in the other equation in the second stage in order to account for the cross-equation correlations. That is, the error in Equation 3.1 becomes an explanatory variable in Equation 3.2, and the error in Equation 3.2 becomes an explanatory variable in Equation 3.1. Rather than the simple two-stage approach, we estimate the system iteratively until convergence is achieved. Concerning the error terms, in the basic SUR model, it is assumed that there is homoscedasticity within individuals (standard deviation not indexed by *t*) and heteroscedasticity across individuals (standard deviation indexed by *i*). For multilateral resistance, the same variable is used as in pooled OLS estimator.

Bilateral trade and migration data often have zero values, particularly for pairs of small and distant countries. Unfortunately, in a logarithmic regression specification these data points are undefined. Adding one before computing the logarithm solves the technical issue, but potentially biases the results. Therefore, we move to the Poisson-Pseudo-Maximum Likelihood (PPML) estimator, since it accommodates observations of zero. Silva and Tenreyro (2005) and Santos and Tenreyro (2011) also note that all estimators of log-linear models that overlook heteroscedasticity are generally not consistent, and non-linear estimators such as PPML should be use instead. Moreover, since PPML doesn't require the condition of constant variance, it is able to handle inefficiencies caused by heteroscedasticity (Silva and Tenreyro, 2005). We obtain incidence rate ratios by exponentiating the Poisson regression coefficients. In the PPML model, the MR terms are omitted as their inclusion would re-introduce problems of heteroscedasticity

(Silva and Tenreyro, 2005). Therefore, following Silva and Tenreyro (2005) and Anderson and van Wincoop (2003), we used origin and destination country fixed effects in all our PPML specifications to deal with multilateral resistance.

Finally, since we still need to consider the interrelationships between the two equations, we combine SUR and PPML together. To achieve this, we adopt the original two-stage SUR procedure. That is, we obtain the residuals from first-stage PPML models and add each residual as an additional variable in the opposite PPML model in the second stage. This is our preferred model because it captures the advantages of both the PPML model and the SUR specification.

2.3.3 Limitations

There are two main limitations to our approach. First, there is likely to be some endogeneity between trade and migration flows. We estimate reduced form models, as the focus of the research is to illustrate the correlation between those two flows, and not to analyse the potential causality, which we leave for future research. The second limitation is that the dataset has a number of missing values. Since we are using global datasets with fourteen variables, it is difficult to get complete data, especially for small countries like Kiribati, Latvia, Marshall Islands, Tuvalu or recently-independent countries like Montenegro or South Sudan. The trade and migration flows for small countries are likely to themselves be small, so we believe that any resulting bias in our estimates is likely to be small, and our results to be representative of the relationship between trade and migration flows between larger countries.

2.4 Results and Discussions

Table 2 presents the results in terms of coefficients for pooled OLS (columns 1 and 2), fixed effects (columns 3 and 4), SUR (column 5 and 6), and in terms of incident rate ratios (IRRs) for the PPML (columns 7 and 8), and PPML-SUR (columns 9 and 10) models. In each pair of columns, the first column has trade as the dependent variable, and the second column has migration as the dependent variable.

Table 2: The Gravity Model Regression Results

Variables	(Pooled OLS) Trade	(Pooled OLS) Migration	(Fixed Effect) Trade	(Fixed Effect) Migration	(SUR) Trade	(SUR) Migration	(PPML)IRR Trade	(PPML)IRR Migration	(PPML-SUR) IRR Trade	(PPML-SUR) IRR Migration
Migration	0.158***		-0.006		0.780***		1.017***		1.011***	
	(0.007)		(0.006)		(0.002)		(20.68)		(13.52)	
Trade		0.194***		-0.011		0.802***		1.064***		1.254***
		(0.008)		(0.010)		(0.002)		(41.11)		(5.87)
GDP Origin	1.086***	-0.074***	1.582***	0.047	0.578***	-0.483***	1.125***	0.954***	1.106***	0.334***
	(0.014)	(0.018)	(0.072)	(0.096)	(0.009)	(0.01)	(73.02)	(-16.17)	(60.64)	(-13.63)
GDP	1.309***	0.573***	1.062***	-0.681***	0.645***	0.321***	1.151***	1.122***	1.039***	0.599***
Destination	(0.017)	(0.021)	(0.068)	(0.091)	(0.004)	(0.004)	(73.97)	(35.60)	(12.75)	(-3.95)
Distance	-0.333***	-0.256***			-1.693***	0.675***	0.909***	0.863***	0.997	1.198
	(0.049)	(0.055)			(0.015)	(0.015)	(-32.48)	(-35.54)	(-0.49)	(1.20)
Population	-0.340***	0.506***	0.054*	0.067*	0.611***	0.716***	0.964***	1.149***	0.909***	2.405***
Origin	(0.017)	(0.017)	(0.028)	(0.037)	(0.013)	(0.013)	(-20.23)	(51.92)	(-43.13)	(19.15)
Population	-0.338***	-0.232***	0.105***	-0.025	0.055***	-0.002	0.966***	0.954***	1.000	1.210**
Destination	(0.018)	(0.018)	(0.018)	(0.024)	(0.004)	(0.004)	(-18.15)	(-16.84)	(-0.19)	(2.60)
Common	0.420***	0.931***			0.739***	1.121***	1.082***	1.272***	0.932***	1.011
Language	(0.066)	(0.076)			(0.017)	(0.017)	(12.19)	(27.36)	(-9.73)	(0.05)
Common	0.341***	0.443***			0.206***	0.009	1.020***	1.080***	0.949***	0.650*
Colonizer	(0.048)	(0.058)			(0.014)	(0.013)	(3.84)	(10.57)	(-9.75)	(-2.39)
Adjacency	-0.159**	0.600***			0.684***	0.861***	0.988	1.083***	0.895***	2.028***
	(0.062)	(0.079)			(0.018)	(0.018)	(-1.72)	(8.27)	(-15.10)	(3.95)
RTA	0.783***				0.261***		1.083***		1.049***	
	(0.042)				(0.014)		(16.01)		(9.43)	
Multilateral	-0.816***	-0.587***			1.253***	-0.663***				
Resistance	(0.06)	(0.067)			(0.016)	(0.016)				
Landlocked	-0.279***	0.116**			-0.933***	0.549***	0.962***	1.047***	0.961***	1.430*
Origin	(0.046)	(0.054)			(0.043)	(0.044)	(-6.53)	(5.60)	(-6.80)	(2.15)
Landlocked	-0.118***	0.111**			-0.596***	0.272***	0.981***	1.028***	0.977***	0.882
Destination	(0.046)	(0.046)			(0.012	(0.012)	(-3.32)	(3.38)	(-4.06)	(-0.83)
N	30,359	30,359	30,359	30,359	30,359	30,359	30,359	30,359	30,359	30,359
R-squared (or Pseudo R-squared)	0.679	0.397	0.216	0.010			0.167	0.1505		

Notes: Result for data without zero added in the dependent variable. Column 1 to 6 have clustered standard errors by countries of origin and destination in parentheses. Column 7 to 10 consists the exponentiated coefficients; t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The pooled OLS results show that one percent higher bilateral migration flows are associated with 0.158 percent higher bilateral trade flows, while one percent higher bilateral trade flows are associated with 0.194 percent higher bilateral migration flows. In other words, the pooled OLS results demonstrate that migration and trade are complements.

Interestingly, the fixed effects model results show no statistically significant relationship between trade and migration (in either direction). However, according to Cameron and Poot, (2019), the coefficients obtained with OLS and Fixed Effects gravity models can't be compared directly due to differences in the way the variables should be interpreted. Moreover, like pooled OLS, the fixed effects models ignores the system interrelationships between the two equations. The SUR results show that one percent higher bilateral migration flows are associated with 0.780 percent higher bilateral trade flows, while one percent higher bilateral trade flows are associated with a 0.802 bilateral migration flows. Again, the relationships between trade and migration are complementary.

The coefficients on the control variables in the first six columns are mostly as expected. However, the SUR model shows some odd results, such as positive distance and landlockness elasticities in the migration equation. For the contradicted coefficient sign of landlockness, Grigoriou and Carrere (2008) note that a dummy variable alone is insufficient to capture how landlockedness affects trade because overland transportation costs, bargaining power with transit countries, and the infrastructure of the transit countries are important matters influencing trade in landlocked countries. However, in the first three models a larger concern is the treatment of observations of zero.

As noted in the previous section, the PPML model does a better job of dealing with zeroes in the dependent variable. The results in column 7 show that each additional one percent migration per year from country *i* to country *j* is associated with an increase in trade flows from country *i* to country *j* of 1.017 percent, ceteris paribus. In column 8, the results show that an increase of one percent in trade flows from country *i* to country *j* is associated with a 1.064 percent increase in migration flows from country *i* to country *j*. Finally, the PPML-SUR results show that each additional one percent migration from country *i* to country *j* is associated with a 1.011 percent increase in trade flows from country *i* to country *j*, while an increase in trade flows from country *i* to country *j* of one percent is associated with a 1.254 percent increase in migration flows from country *i* to country *j*. In other words, the positive relationships in the PPML+SUR results demonstrate that migration and trade are complements.

The models presented in Table 2 may suffer from missing data. Data on inter-country trade or migration flows may be missing because the data or unknown, or because the flow is genuinely zero. A careful examination of the dataset reveals that most missing values are for pairs of countries that are small and/or distant from each other, which suggests that the missing values are really zero flows (e.g. consider the migration flows between Kiribati and Latvia). However, that is not always the case. As a robustness check, we ran another set of regressions models by replacing missing values with zero. These results are reported in the Appendix, Table A1. The signs and significance of most coefficients remain the same as for the results in Table 1, although the coefficients are smaller for our preferred PPML-SUR model. The coefficients on trade and migration being larger for the smaller sample (excluding missing data) is likely due to those results omitting consideration of the extensive margin.

2.5 Conclusions

In this paper, we analysed the relationship between global bilateral trade flows and migration flows. There has been a lot of inconsistency in the results in previous studies and not many before have made use of large global datasets of trade and migration flows. Thus, our paper contributes to this literature by using a more expansive set of data than previous studies, as well as exploiting the system structure of the relationships between migration and trade through seemingly unrelated regression.

We found that trade and migration have positive coefficients in all of the specifications except for the fixed effects model (where, as noted above, the interpretation of the coefficients is challenging). That is, trade and migration are complements. In our preferred PPML-SUR specification, additional one percent migration from country *i* to country *j* is associated with a 1.011 percent increase in trade flows from country *i* to country *j*, while an increase in trade flows from country *i* to country *j* of one percent is associated with a 1.254 percent increase in migration flows from country *i* to country *j*.

These results have important implications based on current events. For instance, the United States is currently engaged in a period of economic nationalism by imposing new trade barriers, such as on aluminum and steel imports.[14] Moreover, the United States has also proposed to increase barriers to the movement of people through their borders, by limiting the granting of guest-worker visas and green cards, restrictions on H-1B visas and family-based immigration, and imposing travel bans.[15]. Similarly, the 'Brexit' deal suggests a period of

[14] https://www.bbc.com/news/business-44765760
[15] https://www.migrationpolicy.org/programs/us-immigration-policy-program

economic nationalism in the U.K. as well. Meanwhile, the EU mini-summit on migration which was held in Brussels in 2018, recommended stronger protections on external borders, and management of migration flows.[16]

Although our results are not causal, our findings could be interpreted as implying that more trade protection should be associated with a decrease in migration flows. Similarly, the reverse is true – countries that restrict migration flows should expect lower trade flows. Given that international trade and migration are sources of wealth and wellbeing for countries, our results argue against such migration and trade restrictions. However, these policy implications could be strengthened in future work, which extends our analysis and further examines the causal relationships between international trade and migration.

[16] https://www.theguardian.com/world/2018/jun/20

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Chapter Appendix

Table A1: The Gravity Model Regression Results (with added zeroes in dependent variables)

	(Pooled OLS)	(Pooled OLS)	(Fixed Effect)	(Fixed Effect)	(SUR)	(SUR)	(PPML)IRR	(PPML)IRR	(PPML-SUR)	(PPML-SUR)
Variables	Trade	Migration	Trade	Migration	Trade	Migration	Trade	Migration	Trade	Migration
Migration	0.113***		-0.006		0.745***		1.129***		1.347***	
	(0.004)		(0.004)		(0.002)		(26.72)		(20.12)	
Trade		0.056***		-0.003		0.781***		1.165***		1.078***
		(0.002)		(0.002)		(0.002)		(25.81)		(58.20)
GDP Origin	1.082***	0.009*	0.189***	0.201***	0.591***	-0.463***	1.002*	0.979***	0.926*	0.975**
	(0.007)	(0.005)	(0.032)	(0.024)	(0.009)	(0.010)	(2.29)	(-9.07)	(-2.23)	(-2.80)
GDP	1.341***	0.410***	0.034	-0.613***	0.660***	-0.314***	1.002	1.001	0.930*	0.979*
Destination	(0.007)	(0.005)	(0.032)	(0.022)	(0.004)	(0.004)	(1.61)	(0.52)	(-1.19)	(-2.08)
Distance	-0.212***	-0.027			-1.665***	0.805***	1.010***	1.042***	1.046*	1.028*
	(0.025)	(0.016)			(0.014)	(0.015)	(4.88)	(9.53)	(0.40)	(2.30)
Population	-0.232***	0.212***	0.140***	0.034***	-0.591***	0.679***	1.014***	1.039***	1.092*	1.027***
Origin	(0.008)	(0.005)	(0.016)	(0.013)	(0.012)	(0.013)	(12.01)	(14.96)	(1.65)	(4.41)
Population	-0.278***	-0.245***	0.115***	-0.113***	-0.063***	0.001	1.002	0.996	1.100*	1.002
Destination	(0.008)	(0.005)	(0.016)	(0.013)	(0.004)	(0.004)	(1.60)	(-1.46)	(2.06)	(0.32)
Common	0.721***	0.338***			-0.686***	1.031***	1.034***	0.968**	1.395**	0.980
Language	(0.031)	(0.021)			(0.017)	(0.017)	(7.03)	(-3.05)	(1.93)	(-0.88)
Common	0.481***	0.181***			0.211***	-0.001	1.006	1.023**	0.920	0.993
Colonizer	(0.025)	(0.017)			(0.013)	(0.013)	(1.64)	(2.74)	(-0.71)	(-0.40)
Adjacency	-0.522***	0.809***			0.654***	0.853***	1.011	1.001	0.985	0.994
	(0.041)	(0.027)			(0.018)	(0.018)	(1.68)	(0.04)	(-0.06)	(-0.24)
RTA	1.507***				0.147***		1.019***		1.387*	
	(0.028)				(0.012)		(4.32)		(2.31)	
Multilateral	-1.395***	-0.503***			-1.160***	-0.726***				
Resistance	(0.029)	(0.019)			(0.016)	(0.016)				
Landlocked	-0.681***	-0.056***			-0.909***	0.561***	0.928***	1.052***	0.601**	1.040*
Origin	(0.022)	(0.015)			(0.042)	(0.043)	(-21.23)	(6.76)	(-3.12)	(2.37)
Landlocked	-0.578***	0.098***			-0.596***	0.300***	0.989**	1.010	0.925	1.009
Destination	(0.023)	(0.015)			(0.012)	(0.012)	(-3.27)	(1.36)	(-0.61)	(0.56)
N	132,474	132,474	132,474	132,474	132,474	132,474	132,474	132,474	132,474	132,474
R-squared pseudo R-squared	0.572	0.219	0.249	0.152			0.058	0.146		

Notes: Result for data with zero added in dependent variable. Column 1 to 6 have clustered standard errors by countries of origin and destination in parentheses. Column 7 to 10 consists the exponentiated coefficients; t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A2: List of Countries used in the data

	Countries		Countries		Countries
1	Aruba	84	Ghana	167	New Zealand
2	Afghanistan	85	Gibraltar	168	Oman
3	Angola	86	Guinea	169	Pakistan
4	Anguila	87	Guadeloupe	170	Panama
5	Albania	88	Gambia	171	Fmr Pacific Isds
6	Andorra	89	Guinea-Bissau	172	Pitcairn
7	Netherlands Antilles	90	Equatorial Guinea	173	Peru
8	United Arab Emirates	91	Greece	174	Philippines
9	Argentina	92	Grenada	175	Palau
10	Armenia	93	Greenland	176	Papua New Guinea
11	American Samoa	94	Guatemala	177	Poland
12	Antarctica	95	French Guiana	178	Puerto Rico
13	Fr. So. Ant. Tr	96	Guam	179	Korea, Dem. Rep.
14	Antigua and Barbuda	97	Guyana	180	Portugal
15	Australia	98	Hong Kong, China	181	Paraguay
16	Austria	99	Heard Island and McDonald Islands	182	Occ. Palestinian Terr.
17	Azerbaijan	100	Honduras	183	French Polynesia
18	Burundi	101	Croatia	184	Qatar
19	Belgium	102	Haiti	185	Reunion
20	Benin	103	Hungary	186	Romania
21	Burkina Faso	104	Indonesia	187	Russian Federation
22	Bangladesh	105	India	188	Rwanda
23	Bulgaria	106	British Indian Ocean Ter.	189	Saudi Arabia
24	Bahrain	107	Ireland	190	Serbia and Montenegro
25	Bahamas	108	Iran, Islamic Rep.	191	Sudan
26	Bosnia and Herzegovina	109	Iraq	192	Senegal
27	Belarus	110	Iceland	193	Singapore
28	Belgium-Luxembourg	111	Israel	194	South Georgia and the South Sandwich Islands
29	Belize	112	Italy	195	Saint Helena
30	Bermuda	113	Jamaica	196	Solomon Islands
31	Bolivia	114	Jordan	197	Sierra Leone
32	Brazil	115	Japan	198	El Salvador
33	Barbados	116	Kazakhstan	199	San Marino
34	Brunei	117	Kenya	200	Somalia
35	Br. Antarctic Terr.	118	Kyrgyz Republic	201	Saint Pierre and Miquelon
36	Bhutan	119	Cambodia	202	Serbia
37	Bouvet Island	120	Kiribati	203	South Sudan
38	Botswana	121	St. Kitts and Nevis	204	Sao Tome and Principe

39	Central African Republic	122	Korea, Rep.	205	Suriname
40	Canada	123	Kuwait	206	Slovak Republic
41	Cocos (Keeling) Islands	124	Lao PDR	207	Slovenia
42	Switzerland	125	Lebanon	208	Soviet Union
43	Channel Islands	126	Liberia	209	Sweden
44	Chile	127	Libya	210	Swaziland
45	China	128	St. Lucia	211	Seychelles
46	Cote d'Ivoire	129	Sri Lanka	212	Syrian Arab Republic
47	Cameroon	130	Lesotho	213	Turks and Caicos Isl.
48	DR Congo	131	Lithuania	214	Chad
49	Congo, Rep.	132	Luxembourg	215	Togo
50	Cook Islands	133	Latvia	216	Thailand
51	Colombia	134	Macao	217	Tajikistan
52	Comoros	135	Morocco	218	Tokelau
53	Cape Verde	136	Moldova	219	Turkmenistan
54	Costa Rica	137	Madagascar	220	Timor-Leste
55	Czechoslovakia	138	Maldives	221	Tonga
56	Cuba	139	Mexico	222	Trinidad and Tobago
57	Christmas Island	140	Marshall Islands	223	Tunisia
58	Cayman Islands	141	Macedonia, FYR	224	Turkey
59	Cyprus	142	Mali	225	Tuvalu
60	Czech Republic	143	Malta	226	Taiwan
61	German Democratic Republic	144	Myanmar	227	Tanzania
62	Germany	145	Montenegro	228	Uganda
63	Djibouti	146	Mongolia	229	Ukraine
64	Dominica	147	Northern Mariana Islands	230	United States Minor Outlying Islands
65	Denmark	148	Mozambique	231	Uruguay
66	Dominican Republic	149	Mauritania	232	United States
67	Algeria	150	Montserrat	233	Uzbekistan
68	Ecuador	151	Martinique	234	Holy See
69	Egypt, Arab Rep.	152	Mauritius	235	St. Vincent and the Grenadines
70	Eritrea	153	Malawi	236	Venezuela
71	Western Sahara	154	Malaysia	237	British Virgin Islands
72	Spain	155	Mayotte	238	Virgin Islands (U.S.)
73	Estonia	156	Namibia	239	Vietnam
74	Ethiopia	157	New Caledonia	240	Vanuatu
75	Finland	158	Niger	241	Wallis and Futura Isl.
76	Fiji	159	Norfolk Island	242	Samoa
77	Falkland Island	160	Nigeria	243	Yemen Democratic
78	France	161	Nicaragua	244	Yemen, Rep.
79	Faeroe Islands	162	Niue	245	Yugoslavia, FR (Serbia/Montene

80	Micronesia, Fed. Sts.	163	Netherlands	246	South Africa
81	Gabon	164	Norway	247	Zambia
82	United Kingdom	165	Nepal	248	Zimbabwe
83	Georgia	166	Nauru		

Chapter 3: The Causal Impact of Trade on Migration -A Gravity Model Estimation

3.1 Introduction

International trade flows and migration flows have been the subject of many studies. Many researchers and policymakers believe that trade and migration are important elements in the growth of an economy. However, their complex inter-relationships are still the subject of debate. Even though many studies have been conducted into the relationship between international trade and migration, studies on the causal effect of trade on migration are somewhat scarce. Most previous studies have instead looked at the impact of migration on trade or have narrowed their focus to flows between neighbouring countries, within geographical regions, or within the members of a single trade agreement. Therefore, there is a lack of evidence on the relationship between trade and migration using a global perspective.

Investigating this topic is important and timely. Trade flows have been expanding in response to globalization and the growth of developing countries. Migration flows are also affected by globalization. Both elements are important factors in providing opportunities, raising living standards and allowing society access to a greater variety of goods. However, recent political pressures have called into question the continuing desirability of both migration and trade flows, particularly originating in certain parts of the world (Greenhill, 2016) . In 1990, the percentage of people who migrate was 2.9 percent over total world population and the percentage increase to 3.1 in 2010[17]. Meanwhile, world merchandise exports grew annually by 7 percent on average from 1990 to 2005. Given the increases in both trade and migration flows

[17] United Nations Department of Economic and Social Affairs/Population Division 1 International Migration Report 2011

internationally, it is important to re-examine whether when trade increases, it will cause migration to increase as well.

Historically, the first wave of globalization (which occurred before 1870) benefitted rich countries more than poor countries (Federico et al., 2016). To liberalize trade conditions and harmonize trade-related regulations within national borders and in other countries via negotiations, trade agreements started to be negotiated. The first free trade agreement was signed by Britain and France (the Anglo-French Treaty of Commerce) in 1860 and within six years, France had signed commercial treaties with eleven other countries (Kirby, 2001).

Following the protectionism of the inter-war period, in 1947 trade became more liberal when 23 countries agreed to be part of the first worldwide multilateral free trade agreement, the General Agreement on Tariffs and Trade (GATT), which transformed into the World Trade Organization (WTO) in 1995. The aim of this agreement was to increase international trade among members by removing or at least reducing any kind of trade protectionism. The WTO established a set of standards to guide member countries to participate in international trade. Nearly every country in the world is now a member of the WTO (164 members; see Appendix 1), and it has global impact. There are many benefits gained by a country joining the WTO. In general, all members must treat each other the same without any preferential trade benefits. The principal areas of activity of the WTO all focus on trade (WTO, 2011), including: trade negotiations; implementation and monitoring; dispute settlement; and building trade capacity. WTO is not directly involved in migration issues.

Globalization has started caused by the act of lowering national border barriers and since then, world becoming more globalized and lead to a declining in the costs of cross-border trade

and to more trade openness (Nooruddin and Simmons, 2009; Chase-Dunn, Kawano, and Brewer, 2000). For example, globalization enables multinational firms such as Apple to access international sources of cheap raw materials and be more cost competitive (global sourcing). Even though the product lines are designed in the United States, Apple outsources a lot of their production to factories all over the globe, including in Germany, Taiwan and China. Some of their newest manufacturing operations began operating in India in 2016. If we look at this one particular case (from among a great many multinational firms), these transnational activities should increase demand for skilled as well as unskilled workers in manufacturing countries, resulting directly in improved economic opportunities and higher household income (Meschi, Taymaz, and Vivarelli, 2016). This situation suggests that migration flows may decrease due to greater opportunity in manufacturing countries, but the impact on migration might be ambiguous. Globalization might reduce migration from the newly-industrializing manufacturing countries to more developed countries but increase migration from even lesser-developed countries to the newly-industrializing countries. Similarly, Fernández-Kelly et al. (2007) concluded that free trade agreements may not be a remedy for a country's migration problems, but such agreements can be a base from which to stimulate further bilateral and regional cooperation in terms of migration.

Many previous researchers have examined the *correlation* between trade and migration flows and the results are inconsistent (Gould, 1994; Head and Ries, 1998; Hong and Santhapparaj, 2006; Serrano-Domingo and Requena-Silvente, 2013; Fagiolo and Mastrorillo, 2014; Mundell, 1957; (Razin and Sadka, 1992). Our paper adds to this literature by focusing on the *causal* impact of trade on migration.

Hanson (2010) notes that it is complicated to engage in causal inference using data on international trade and migration movements, because migration may be correlated with omitted variables that can also affect trade, e.g. economic policies. If Country A faces a positive productivity shock, trade might increase since trading partners will face lower import prices from Country A, while emigration from Country A might decrease because of better job opportunities at home. Similarly, Massey et al. (1993) note that, if migration is driven by differences in earnings, then there will be less reason for migration to take place if trade increases. These potential confounding mechanisms make identifying the causal relationship between trade and migration difficult.

To identify the causal relationship, we employ an instrumental variables analysis, which can be used when standard regression estimates of the relation of interest are biased due to reverse causality (Stock, 2015). The challenge is to identify an instrument that plausibly affects the explanatory variable, without having a direct effect on the dependent variable. We employ World Trade Organisation (WTO) membership and average tariff rates as instruments (as we explain further below). They are directly related to trade flows, but plausibly have no direct effect on migration flows.

The remainder of this paper is structured as follows. Section 2 reviews relevant literature on trade and migration. Section 3 describes the data and methodology used in this paper. In Section 4, we present and discuss the empirical findings, and Section 5 concludes.

3.2 Literature Review

Many studies have focused on the correlation between both trade and migration and identifying whether they are complements (when the signs of both estimated coefficients are in

the same direction) (e.g. Ghani, Cameron, Cochrane, and Roskruge, 2019; White, 2007; Genç, 2014), or substitutes (when the signs of both estimated coefficients are contradicted to each other) (e.g. Wickramasekera, 2002).

Fewer studies have attempted to identify the causal effect of trade on migration. Campaniello (2014) estimated the causal effect of trade on migration for countries of the Euro-Mediterranean partnership over the period from 1970 to 2000. Average trade tariffs and exchange rate volatility were used as instruments for exports. They found that an increase in trade is likely to increase migration from the southern Mediterranean to the European Union. Similarly, Peri and Requena-Silvente (2010) found that the more trade creation rises, the newer immigrants there were into Spanish provinces.

The closest study to our paper is Aguiar et al. (2007). Their study is based on the data of legal permanent resident flows to and from the U.S., using import trade costs as an instrument. They found that trade flows have a positive but insignificant impact on migration flows.

Other studies have focused on the causal effect of migration on trade, rather than the effect of trade on migration. Steingress (2015) found that there were causal relationship between immigration and imports, with a 10 percent increase in immigrants to the U.S. increasing intermediate imports from the immigrants' origin country by 1.5 percent. They used the allocation of refugee immigration spaces by the government as an instrument.

Mundra (2005) studied the effect of immigration on US imports and exports of finished and intermediate goods and employed the immigrant stock as an instrument. They found immigration has a positive effect on the import of both finished and intermediate goods, but for exports, immigration only has a positive effect on finished goods.

Collins, O'Rourke, and Williamson (1997) studied the economy of the Atlantic (the UK, the US, Canada, Denmark, France, Germany, Italy, Norway and Sweden) plus Australia using data from 1870 until 1940, and they found that migration has positive impacts on trade. Similarly, Hatzigeorgiou and Lodefalk (2015) found similar results for Sweden. Steingress (2015) found, using the allocation of refugees in the US as their instrument, that an increase in the number of immigrants will increase imports.

To summarize, even though some previous studies have investigated the causal effect of trade on migration, those studies have either focused on a single pair of countries, or a single region, or countries that are members of the same trade agreement. In addition, these previous studies have tended to focus on big economies, and there has been little work on the effects based on a global sample of countries that includes small and developing countries. Our study is the first to address these important gaps in the literature.

3.3 Data and Methods

3.3.1 Data

We use bilateral panel data for 248 pairs of countries over four five-yearly periods (1990-2010). Each single observation of our migration and trade variables is a dyadic flow from origin *i* to destination *j* in the given time period.

Data on bilateral trade flows were attained from the Center for International Data at the University of California – Davis.[18] The value of bilateral nominal trade flows are in US$1million (Baxter and Kouparitsas, 2006; Feenstra, Lipsey, Deng, Ma, and Mo, 2005) The

[18] http://cid.econ.ucdavis.edu. Constructed from United Nation Trade data by Robert Fenestra and Robert Lipsey. The data could be either in c.i.f. (receiving countries) or f.o.b. or f.a.s. (sending countries), depending on data availability (Feenstra, personal communication).

source of these bilateral trade flows data is importer countries' reports. Importers are believed to have more incentive to accurately record all transactions than exporters due to their liability for tariffs and duties (Fouquin and Hugot, 2016).

Abel and Sander (2014) have produced a newly assembled global dataset on bilateral migration flows that has yet to be fully exploited in this area of study. The dataset consists of country–level data for each five-year period from 1990 to 2010, constructed from the changes in migrant stocks. These data effectively represent the total absolute number of people who change their country of residence within each five-year period and were mainly developed based on place-of-birth answers to census questions, information obtained from population registers, and refugee statistics.[19]

In our regression models, use gross domestic product (GDP) and population data from the United Nations Population Division,[20] being mid-year estimates of the total population (headcount) counting all residents of each country irrespective of legal status or nationality, as control variables. Other variables were obtained from the CEPII database, including bilateral distances and colonial heritage. Distance was measured as the geographical distance between capital cities in kilometres. The distances can be taken as an indicator of the cost of a trade flow or migration event because the greater the distance, the higher the cost will be (Marimoutou, Peguin, and Peguin-Feissolle, 2009). Common colonial heritage is also often used by economists (Mayer, Head, and Ries, 2008; Ekkayokkaya, Foojinphan, and Wolff, 2017) to represent similarities in cultural, political or legal institutions. Additional dummy variables were created for adjacency and landlockedness. Adjacency means whether countries *i* and country *j*

[19] UNPD, Trends in International Migrant Stock: Migrants by Destination and Origin, The 2013 Revision
[20] https://esa.un.org/unpd/wpp/

share a common border and has also been used by Baier and Bergstrand (2009). Meanwhile, landlocked countries face constraints to accessing world markets, which may affect trade or migration flows (Faye et al., 2004).

In gravity models (as described in the following section), it is important to recognise the effect of multilateral resistance (MR) (Adam and Cobham, 2007). That is, bilateral trade flows or bilateral migration flows depend not only on differences between the given pair of countries but also the rest of the world (Anderson and van Wincoop, 2003). Consider this simple example. If Country *i* and Country *j* are trading partners, when the trade resistance between Country *i* and a third Country, *k*, decreases, this may cause the trade between Country *i* and Country *j* to decrease. In our paper, we create a variable to control multilateral resistance in our equations, being the average distance to all other trading partners.

We use World Trade Organization Agreement (WTO) membership (since 1995) and General Agreement on Tariffs and Trade (GATT) membership (prior to 1990) as one instrument for trade (see Table A1 for the lists of members of World Trade Organization (WTO) and their accession dates). Since our data is bilateral, we code a dummy variable equal to one only if both countries are members in the respective year, and zero if only one country or neither country in the dyad is a member. We also use a second instrument, being the average tariff rate, which consists of the unweighted[21] average of applied rates for all products subject to tariffs calculated for all traded goods. This data is classified using the Harmonized System of trade at the six- or eight-digit level obtained from the World Bank database.

[21] An alternative would be to use trade-weighted tariffs. However, using a trade-weighted variable as an instrument for trade would generate endogeneity in our instrument, making it invalid.

3.3.2 Methods

We employ a gravity model specification in our analysis, which was introduced by Tinbergen (1962), and recently reviewed by Poot, Alimi, Cameron, and Maré (2016). Following Ortega and Peri (2011), our regression model in the log-linear form is:

$$ln\ (\mathrm{Mig}_{ijt}) = \delta_0 + \delta_1\, ln(\mathrm{Trde}_{ijt}) + \delta\ (\mathrm{X}_{ijt}) + u_{ijt} \qquad (1)$$

Where all variables except dummy variables are in log form, *i* and *j* indicate origin and destination countries respectively, and *t* indicates years. Trde_{ijt} is bilateral trade, Mig_{ijt} is bilateral migration, and X_{ijt} is a vector of control variables, while u_{ijt} is an idiosyncratic error term. The coefficient δ_1 captures the impact of trade flows on migration flows and is a causal impact in the case of our preferred IV model specification.

First, we use pooled ordinary least squares (OLS) with cluster-robust standard errors (Cameron and Miller, 2015), that account for heteroskedasticity across paired countries. Our main variables, migration and trade, have many zero values, especially when dyads involve smaller or more-distant countries. This poses a problem for a model where the dependent variables are specified as natural logs and adding a small number before the log is calculated can introduce substantial bias into the estimations. A better approach is to adopt the Poisson-Pseudo-Maximum Likelihood (PPML) estimator, which can accommodate observations with zero values (Silva and Tenreyro, 2005). In this method, the dependent variable is not in natural log form. MR terms are omitted from the PPML model, as including them would re-instate problems of heteroscedasticity (Silva and Tenreyro, 2005). Country pair fixed effects are instead used in the PPML model to deal with multilateral resistance, following Silva and Tenreyro (2005).

One of the most important ordinary least squares (OLS) assumptions, which also applies to PPML, is that the errors are uncorrelated with the dependent variables. This assumption is violated in the presence of endogeneity, in which case OLS produces biased and inconsistent parameter estimates. Unlike the OLS assumptions, we expect that $E_{[uij,t|TRDEi]} \neq 0$. Then the OLS estimate of δ_1 will be biased and inconsistent since trade and the error term are correlated, i.e. trade is endogenous.

To deal with the potential endogeneity of bilateral trade flows in our model, we use GATT/WTO membership and average tariff rates as instruments for trade. Our preferred model is a combination of two-stage least squares (TSLS) and PPML model.

Two-Stage least squares is frequently used to identify causal effects and/or to address endogeneity (Zelekha and Bar-Efrat, 2011; Campaniello, 2014; Romer and Frankel, 1999; De Vita, Trachanas, and Luo, 2018; Yu, de Jong, and Lee, 2012). The reason this method is used is that variation in the estimated values of the endogenous variable is limited to that occurring because of changes in the exogenous instruments. Instruments will only be correlated with *x* but cannot be correlated with *y* or the error term in the equation model.

In our preferred specification, we combine the PPML estimator with TSLS. We implement this by running the first stage and then using the predicted values of trade in the second stage of our model (in million). To avoid issues with the standard errors in the second stage arising from running the two stages separately (Angrist, Pischke, and Pischke, 2008), we obtain coefficients in both stages of the estimation by bootstrapping, with 100 replications in each stage. This means that in the second stage, the standard errors are obtained from 10,000 replications (from 100 replications of each of the 100 first stage results). The coefficient of

interest is δ_1 from Equation (1).This procedure does not allow for the estimation of t-statistics for the second stage, so instead we report 95 percent confidence intervals, based on the central 95 percent of estimates from the bootstrapped results. As for the PPML model, MR terms are omitted from this specification. All models were estimated using Stata v15.1.

3.3.3 Weakness test and overidentifying test

To test the validity of the instrumental variables, a weak instrument test (Staiger and Stock1997) was used to confirm that our instruments were not weak (F test = 137.45). Since we have only endogenous variable but two instrumental variables, our model is over-identified. We used the Sargan test for the overall relevance of the instruments (Baum et al., 2007). Under the null hypothesis that all instrumental variables are uncorrelated with the error terms, we failed to reject null hyphothesis (Sargan statistic=47.04, p= 0.6). Therefore, it is safe to conclude that all excluded instruments are relevant.

3.3.4 Limitation

There are some primary limitations to our study. First, to prove that an instrument is valid, we must test the correlation between the instruments and the error term. Since the error term is unknown, this test is impossible to conduct. However, we argue that our instruments are nevertheless valid because they are plausibly exogenous. Since WTO membership does not entail any special access between countries for migration purposes, WTO membership should not exert a direct impact on migration flows. Similarly, tariff rates are plausibly unrelated to migration flows, and indeed have been used as an instrument in prior research (Aguiar et al., 2007). The second limitation is that our dataset has a number of missing values. Since we are using global dataset with eleven variables, it is difficult to get complete data, especially for small countries like Tuvalu, Marshall Islands, or Montenegro, which just recently gained

independence. However, we use the most complete data currently available, including a dataset on migration that is new and the most complete exploration of international migration flows (Abel and Sander, 2014).

3.3.5 Robustness Tests

According to our trade flows data, the United States and China made up almost 29 percent of the world economy in 1990 and 35 percent in 2010. Since these two giant economies are potentially outsized influencers on world trade, we test the robustness of our results by dropping both countries from the dataset. We also test the robustness of our results to our choice of two instruments, by also estimating the models using each instrument alone.

Table A2 below, column 2 reports first stage coefficients and column 3 reports second stage incidence rate ratio for regression model with only WTO as the instrumental variable for trade. Column 4 reports first stage coefficients and column 5 reports second stage incidence rate ratio for regression model with only tariff rate as the instrumental variable for trade. Column 6 reports first stage coefficients and column 7 reports second stage incidence rate ratio for regression model with excluded trade data from China and the United States. We were worried that the US and China might have an outsized effect on the results given their contributions to world trade. Interestingly, when we dropped China and the United States from our dataset, our desired coefficients were showing completely similar with findings in Table 1. The fact that the U.S is the largest economy in the world and China had an average 9.7 percent economic growth annually and before 2010, it became the global second biggest economy (Sheng and Ma, 2011), were not giving the difference on the causal relationship between trade and migration flows with or without the influenced of two biggest world economy drivers.

For the robustness test model, weakness and overidentifying test were run to make sure that both excluded variables were relevant and valid to each model. Since the F-test for both instrumental variables exceeded 10 – the rule of thumb (Staiger and Stock, 1997) and the Sargan test shows that the null hypothesis is accepted, it is safe to conclude that both of our instrumental variables are valid. See Table A2.

3.4 Results and Discussions

Table 1 shows the results of each model. The second column shows the pooled OLS results, the third column shows results PPML model without IVs and in the fourth column shows the regression results using instrumental variable in TSLS combined with PPML model.

Table 1: The Regression Results with All countries

Variables	(Pooled OLS) (logMigration	PPML without IV (Migration) irr	Trade (1st stage)	PPML-TSLS Migration(2nd stage)
Trade	0.203***	1.344		1.130
	(0.006)	(1.227-1.472)		(1.130-1.142)
GDP Origin	-0.101***	0.627	0.999***	1.031
	(0.013)	(0.567 - 0.700)	(0.006)	(1.022-1.032)
GDP	0.540***	1.546	1.322***	1.164
Destination	(0.015)	(1.274 - 1.877)	(0.007)	(1.154-1.657)
Distance	-0.125***	0.919	-1.230***	0.740
	(0.036)	(0.896 - 0.942)	(0.011)	(0.733-0.741)
Population	0.508***	1.147	-0.197***	1.105
Origin	(0.012)	(1.137 - 1.156)	(0.007)	(1.095-1.106)
Population	-0.226***	0.950	-0.304***	0.973
Destination	(0.013)	(0.942 - 0.958)	(0.007)	(0.964-0.974)
Common	0.737***	0.781	0.719***	1.269
Colonizer	(0.034)	(0.541- 1.127)	(0.020)	(1.257-1.270)
Adjacency	0.636***	2.035	0.488***	1.168
	(0.051)	(1.313 - 3.153)	(0.034)	(1.157-1.170)
Landlocked	0.091**	1.197	-0.599***	1.024
Origin	(0.038)	(0.877- 1.633)	(0.021)	(1.015-1.025)
Landlocked	0.084	0.911	-0.451***	0.952
Destination	(0.037)	(0.658 - 1.276)	(0.021)	(0.943-0.953)
WTO			0.692***	
			(0.016)	
Average Tariff			-0.025***	
			(0.002)	
Multilateral	-0.731***	0.628		
Resistance	(0.042)	(0.434- 0.907)		
Observations	30,359	30,359		37,916
R-squared	0.38			
Pseudo R2		0.14		
F-test			137	
Sargan test			0.642	

Notes:. Column 2 and 4 reports coefficients, with standard errors clustered by paired countries of origin and destination in parentheses. Column 3 and 5 reports the exponentiated coefficients, with 95% confidence interval in parentheses.

In the pooled OLS model, the coefficient for the trade is positive and significant. The coefficient is an elasticity – it shows that an increase in trade by 1 percent is associated with an increase in migration of by 0.203 percent. Other variables in the first column all have coefficients of the expected signs, with the exception for population in the destination country (negative) and landlockedness of the origin country (positive). All coefficients are statistically significant at conventional levels. However, the OLS model is subject to endogeneity, and this might bias the results.

PPML without taking into account any instrumental variable in the model, was also added in the regression table mainly for comparison to our preferred model. The focused result shows that trade and migration have positive causal impact, but the ratio is slightly bigger which shows that if trade flows from country *i* to country *j* increase by one percent, this causes migration to increase by 1.34 percent. This model might also be bias subject to endogeneity without applying potential excluded instruments.

For the PPML-TSLS model, in the first stage, significant coefficients for both instrumental variables were obtained and proved that both are relevant and correlated with the endogenous variable. The sign of WTO and average tariff are as expected. For WTO, as a country become a member of WTO, their trade will increase and for tariff, the more tariff is implemented, trade between countries will be reduced. In the second stage, the main outcome shows that if trade flows from country *i* to country *j* increase by one percent, this causes migration to increase by 1.13[22] percent.

[22] Given that the explanatory variable is specified in natural logs, and the raw (non-exponentiated) coefficient is on a log-scale (because it is a Poisson model), then the raw coefficient is the elasticity. Therefore, in our case, a 1 percent increase in trade causes a 0.12 (=ln(1.13)) percent increase in migration

3.5 Conclusions

Previous studies have found that migration is positively correlated with trade. Fewer studies have established causality between them, and those studies have mostly focused on only a small subset of countries. In our paper, we established the causal impact of trade on migration using a large global dataset of bilateral trade and migration flows. We controlled for the endogeneity problem by using WTO memberships and average tariff rate as instruments for trade flows. We found that trade has a positive causal impact on migration, with one percent increase in trade, migration will increase by 1.13 percent. Our results are robust to the exclusion of China and the U.S. from the dataset, and robust to the use of each instrument separately, or together.

The findings of this paper have important policy implications, in addition to being of theoretical and practical interest. Countries that implement trade barriers, through tariffs or non-tariff trade barriers, can expect inward migration from those countries that are affected by the trade barriers to decrease. For country which favor of both reducing trade and reducing migration, will probably find the outcome of this research, helpful.

On the other hand, if a country becomes more liberal in their trading activities, they can expect greater immigration. Thus, would affect the policies making in the receiving countries. Not only trade policies but also all kind of policy that help a government to administer their country. Take New Zealand current issues for instance, they have various types of visa application requirements especially for residence and partnership visa . Their policy makers are facing such huge conflicts in visa processing since they need to look deep into the complications of diversified cultures as well as ethnicity and because of this, it is difficult for the government to be able to implement the ‘one size fits all’ rules and regulations.

Exporting countries are also affected. If a country increases exports, then it can expect increased emigration of people to other countries. This situation has two probabilities. The first one is, the origin country will suffer from shortage of labor (Docquier, 2014) especially the talented and educated labor forces which will contribute more to the economy of other countries. On the other hand, the second possibility is, labors might come back to their origin countries with new skills, knowledge and experiences. Thus, this will contribute more to their country development. Therefore, the findings of this research are crucial in order to provide more understanding about the causal impact of trade on migration since the effects are wider than we thought for an economy and in helping policy makers.

If a country, for some reason, is not favoring people crossing their border to work in the country, they might need to tighten up their border for trade, or for people if they want to keep the openness of their trade borders. This research suggests that trade policy might be a tool for reducing migration flows.

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Chapter Appendix

Table A1: Lists of members of World Trade Organization (WTO) and their accession dates.

Members of WTO	• Afghanistan — 29 July 2016 • Albania — 8 September 2000 • Angola — 23 November 1996 • Antigua and Barbuda — 1 January 1995 • Argentina — 1 January 1995 • Armenia — 5 February 2003 • Australia — 1 January 1995 • Austria — 1 January 1995 • Bahrain, Kingdom of — 1 January 1995 • Bangladesh — 1 January 1995 • Barbados — 1 January 1995 • Belgium — 1 January 1995 • Belize — 1 January 1995 • Benin — 22 February 1996 • Bolivia, Plurinational State of — 12 September 1995 • Botswana — 31 May 1995 • Brazil — 1 January 1995 • Brunei Darussalam — 1 January 1995 • Bulgaria — 1 December 1996 • Burkina Faso — 3 June 1995 • Burundi — 23 July 1995 • Cabo Verde — 23 July 2008 • Cambodia — 13 October 2004 • Cameroon — 13 December 1995 • Canada — 1 January 1995 • Central African Republic — 31 May 1995 • Chad — 19 October 1996 • Chile — 1 January 1995 • China — 11 December 2001 • Colombia — 30 April 1995 • Congo — 27 March 1997 • Costa Rica — 1 January 1995 • Côte d'Ivoire — 1 January 1995 • Croatia — 30 November 2000 • Cuba — 20 April 1995 • Cyprus — 30 July 1995 • Czech Republic — 1 January 1995 • Democratic Republic of the Congo — 1 January 1997 • Denmark — 1 January 1995 • Djibouti — 31 May 1995	• Indonesia — 1 January 1995 • Ireland — 1 January 1995 • Israel — 21 April 1995 • Italy — 1 January 1995 • Jamaica — 9 March 1995 • Japan — 1 January 1995 • Jordan — 11 April 2000 • Kazakhstan — 30 November 2015 • Kenya — 1 January 1995 • Korea, Republic of — 1 January 1995 • Kuwait, the State of — 1 January 1995 • Kyrgyz Republic — 20 December 1998 • Lao People's Democratic Republic — 2 February 2013 • Latvia — 10 February 1999 • Lesotho — 31 May 1995 • Liberia — 14 July 2016 • Liechtenstein — 1 September 1995 • Lithuania — 31 May 2001 • Luxembourg — 1 January 1995 • Macao, China — 1 January 1995 • Madagascar — 17 November 1995 • Malawi — 31 May 1995 • Malaysia — 1 January 1995 • Maldives — 31 May 1995 • Mali — 31 May 1995 • Malta — 1 January 1995 • Mauritania — 31 May 1995 • Mauritius — 1 January 1995 • Mexico — 1 January 1995 • Moldova, Republic of — 26 July 2001 • Mongolia — 29 January 1997 • Montenegro — 29 April 2012 • Morocco — 1 January 1995 • Mozambique — 26 August 1995 • Myanmar — 1 January 1995 • Namibia — 1 January 1995 • Nepal — 23 April 2004 • Oman — 9 November 2000 • Pakistan — 1 January 1995 • Panama — 6 September 1997 • Papua New Guinea — 9 June 1996

	• Dominica — 1 January 1995 • Dominican Republic — 9 March 1995 • Ecuador — 21 January 1996 • Egypt — 30 June 1995 • El Salvador — 7 May 1995 • Estonia — 13 November 1999 • European Union (formerly EC) — 1 January 1995 • Fiji — 14 January 1996 • Finland — 1 January 1995 • France — 1 January 1995 • Gabon — 1 January 1995 • Gambia — 23 October 1996 • Georgia — 14 June 2000 • Germany — 1 January 1995 • Ghana — 1 January 1995 • Greece — 1 January 1995 • Grenada — 22 February 1996 • Guatemala — 21 July 1995 • Guinea — 25 October 1995 • Guinea-Bissau — 31 May 1995 • Guyana — 1 January 1995 • Haiti — 30 January 1996 • Honduras — 1 January 1995 • Hong Kong, China — 1 January 1995 • Hungary — 1 January 1995 • Iceland — 1 January 1995 • India — 1 January 1995 • Netherlands — 1 January 1995 • New Zealand — 1 January 1995 • Nicaragua — 3 September 1995 • Niger — 13 December 1996 • Nigeria — 1 January 1995 • Norway — 1 January 1995 • The former Yugoslav Republic of Macedonia — 4 April 2003 • Togo — 31 May 1995 • Tonga — 27 July 2007 • Trinidad and Tobago — 1 March 1995 • Tunisia — 29 March 1995 • Turkey — 26 March 1995 • Uganda — 1 January 1995 • Ukraine — 16 May 2008 • United Arab Emirates — 10 April 1996	• Paraguay — 1 January 1995 • Peru — 1 January 1995 • Philippines — 1 January 1995 • Poland — 1 July 1995 • Portugal — 1 January 1995 • Qatar — 13 January 1996 • Romania — 1 January 1995 • Russian Federation — 22 August 2012 • Rwanda — 22 May 1996 • Saint Kitts and Nevis — 21 February 1996 • Saint Lucia — 1 January 1995 • Saint Vincent and the Grenadines — 1 January 1995 • Samoa — 10 May 2012 • Saudi Arabia, Kingdom of — 11 December 2005 • Senegal — 1 January 1995 • Seychelles — 26 April 2015 • Sierra Leone — 23 July 1995 • Singapore — 1 January 1995 • Slovak Republic — 1 January 1995 • Slovenia — 30 July 1995 • Solomon Islands — 26 July 1996 • South Africa — 1 January 1995 • Spain — 1 January 1995 • Sri Lanka — 1 January 1995 • Suriname — 1 January 1995 • Swaziland — 1 January 1995 • Sweden — 1 January 1995 • Switzerland — 1 July 1995 • Chinese Taipei — 1 January 2002 • Tajikistan — 2 March 2013 • Tanzania — 1 January 1995 • Thailand — 1 January 1995 • United Kingdom — 1 January 1995 • United States — 1 January 1995 • Uruguay — 1 January 1995 • Vanuatu — 24 August 2012 • Venezuela, Bolivarian Republic of — 1 January 1995 • Viet Nam — 11 January 2007 • Yemen — 26 June 2014 • Zambia — 1 January 1995 • Zimbabwe — 5 March 1995

Observer countries	• Algeria • Andorra • Azerbaijan • Bahamas • Belarus • Bhutan • Bosnia and Herzegovina • Comoros • Equatorial Guinea • Ethiopia	• Iran • Iraq • Lebanese Republic • Libya • Sao Tomé and Principe • Serbia • Somalia • Sudan • Syrian Arab Republic • Timor-Leste • Uzbekistan
Not Applying	• Eritre • Kiribati • Marshall Islands • Micronesia • Monaco • Nauru	• Palau • San Marino • Turkmenistan • Tuvalu • North Korea

Table A2: The Regression Results of robustness tests

Variables	Trade(1st	PPML-TSLS Migration(2nd stage)	Trade (1st stage)	PPML-TSLS Migration(2nd stage)	Trade (1st stage)	PPML-TSLS Migration(2nd stage)
Trade		1.014		1.052		1.410
		(1.008-1.020)		(1.020-1.085)		(1.376-1.460)
GDP Origin	1.002***	1.003	1.034***	0.991	0.976***	1.045
	(0.006)	(1.002-1.004)	(0.006)	(0.954-1.029)	(0.007)	(1.035-1.046)
GDP	1.348***	1.016	1.364***	1.124	1.311***	1.174
Destination	(0.006)	(1.015-1.017)	(0.007)	(1.083-1.167)	(0.007)	(1.164-1.176)
Distance	-1.236***	0.969	-1.190***	0.775	-1.293***	0.777
	(0.011)	(0.968-0.970	(0.010)	(0.753-0.798)	(0.011)	(0.760-0.778)
Population	-0.198***	1.011	-0.220***	1.105	-0.196***	1.092
Origin	(0.007)	(1.009-1.013)	(0.007)	(1.095-1.114)	(0.007)	(1.082-1.093)
Population	-0.347***	0.997	-0.340***	0.970	-0.315***	0.972
Destination	(0.007)	(0.996-0.998)	(0.008)	(0.963-0.977)	(0.008)	(0.963-0.973)
Common	0.709***	1.025	0.819***	1.175	0.670***	1.226
Colonizer	(0.020)	(1.024-1.027)	(0.020)	(1.112-1.242)	(0.021)	(1.215-1.227)
Adjacency	0.488***	1.016	0.489***	1.211	0.455***	1.184
	(0.034)	(1.014-1.018)	(0.035)	(1.161.263)	(0.036)	(1.173-1.186)
Landlocked	-0.599***	1.002	-0.635***	1.103	-0.591***	1.015
Origin	(0.021)	(1.001-1.004)	(0.021)	(1.044-1.165)	(0.021)	(1.006-1.016)
Landlocked	-0.420***	0.995	-0.474***	1.026	-0.417***	0.961
Destination	(0.021)	(0.993-0.997)	-0.635***	(0.976-1.079)	(0.021)	(0.952-0.962)
WTO	0.664***				0.752***	
	(0.016)				(0.016)	
Average			-0.018***		-0.026***	
			(0.002)		(0.002)	
Observations		37,916		37,916		35,874

F-Test IV	17.44	124.81	
Sargan test			0.3348

Notes: Column 2 reports first stage coefficients and column 3 reports second stage incidence rate ratio for regression model with only WTO as the instrumental variable for trade. Column 4 reports first stage coefficients and column 5 reports second stage incidence rate ratio for regression model with only tariff rate as the instrumental variable for trade. Column 6 reports first stage coefficients and column 7 reports second stage incidence rate ratio for regression model with excluded trade data from China and the United States. Standard errors clustered by paired countries of origin and destination in parentheses for coefficients, and for the exponentiated coefficients, with 95% confidence interval in parentheses

Chapter 4: International Trade or Migration: Which has the Biggest Impact on Poverty and Inequality?

4.1 Introduction

In 2000, at the United Nation (UN) Millennium Summit, leaders from 189 countries agreed on the Millennium Development Goals (MDGs). The first goal was to reduce extreme poverty and hunger by half in the fifteen years to 2015. This focus on poverty reduction has been claimed as a success, as the number of individuals living in extreme poverty around the world fell from 1.9 billion in 2000 to 836 million in 2015 (United Nations, 2015). Despite these successes, the number of global poor remains overwhelming (Kumar, Kumar, and Vivekadhish, 2016). As an extension of MDGs, the Sustainable Development Goals (SDGs) took effect in 2015. These goals include the eradication of poverty (SDG #1), and reduction of inequality (SDG #10). This reflects the view that inequality and poverty are among the biggest issues globally (Alvaredo and Gasparini, 2013).

According to Chen and Ravallion (2008), even though the overall extreme poverty rate has been falling since at least 1981, something important is still absent from previous research. In the poorest countries poverty has remained stubbornly high (Sala-i-Martin, 2002). Moreover, global poverty reduction over the last couple of decades has almost entirely occurred within China. Since China started its opening and modernization in 1978, the country has lifted some 200 to 300 million people out of extreme poverty (Angang, Linlin and Zhixiao, 2005). China is therefore responsible for nearly three-quarters of the world's reduction in poverty (World Bank, 2016). If we exclude China in the global extreme poverty reduction calculation, global poverty only declined by around ten percent, leaving the goal of ending poverty by 2030 in doubt.

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One possible explanation for the success of poverty reduction in China is globalization. Globalization is associated with more trade openness (e.g. Nooruddin and Simmons, 2009; Chase-Dunn, Kawano, and Brewer, 2000; Rodrik, 1998), and a global labour market that has enhanced the movement of people (Lee, 1966; Ramos and Suriñach, 2017). The simplest way to explain globalization in trade and migration terms is that consumers from any part of the world now have greater choice over which goods to purchase, and that many people can take advantage of job opportunities across the globe. This openness to new opportunities suggests that trade and migration may both have a role to play in reducing poverty and/or inequality (Freeman, 2006; Sawada and Estudillo, 2008; Liyanaarachchi, Naranpanawa, and Bandara, 2016; Onakoya, Johnson, and Ogundajo, 2019). This paper therefore focuses on the impact that country-level trade and migration intensity have had on country-level poverty and inequality.

Trade has ambiguous effects on both poverty and inequality at the country level. In terms of the effect of trade on poverty, Bhagwati and Srinivasan (2002) note that the trade promotes economic growth and economic growth reduces poverty (see also Anderson, 1964). Increases in international trade increases job opportunities and incomes in exporting countries. In turn, these mechanisms should reduce poverty. However, this argument relies crucially on an assumption that economic growth is to some extent pro-poor (Kakwani and Pernia, 2000; Ravallion and Chen, 2003). There is a lack of consensus on the appropriate policies to achieve pro-poor growth. For instance, Kraay (2006) identifies three potential sources of pro-poor growth: (1) a high rate of growth of average incomes; (2) a high sensitivity of poverty to growth in average incomes; and (3) a poverty-reducing pattern of growth in relative incomes. They then show that only the first and third sources are

empirically relevant, based on a broad set of cross-country data. However, that economic growth is pro-poor is not automatic. For instance, Gasparini et al. (2007) find that unambiguously pro-poor growth was rare in Latin America from the 1990s to the 200s.

Economic growth would not be the only source of trade's potential effect on poverty, if the effects of trade are heterogeneous. Le Goff and Singh (2014) argue that, if the poor are mostly unskilled workers, and trade causes demand for (non-poor) semi-skilled and skilled workers to increase, this will result at best in no reduction in poverty, and in some cases poverty may increase. They note the case of sub-Saharan Africa, which remains the poorest continent globally in spite of increasing trade volumes and trade liberalization. On the other hand, increased trade can reduce poverty if governments of countries experiencing greater trade flows and economic growth have a greater ability to finance programs for the poor and provide a social safety net.

In contrast, job opportunities and incomes in importing countries may be reduced by openness to trade, if (particularly manufacturing) jobs are relocated to other countries as multinational corporations take advantage of advances in global supply chain logistics to lower their production costs (Slabbert and Ukpere, 2009). However, job losses and lower incomes in importing countries will be offset by lower prices of imported goods. Overall the impact on poverty in importing countries is therefore ambiguous. Thus, it is unclear whether we should expect greater trade flows to be associated with decreases or increases in poverty at the country level, for both exporting and importing countries.

The effect of trade on inequality is, if anything, more ambiguous than its effect on poverty. Income gains resulting from increased employment in exporting countries are not shared equally among all workers. As Winters, McCulloch, and McKay (2004) note, trade benefits skilled workers more than unskilled workers. An increase in the incomes of skilled

workers, alongside no increase in income for unskilled workers, will exacerbate inequality. Moreover, people who live in very poor countries, or in rural or very remote areas and who live in extreme poverty, may be less able to benefit from increased trade opportunities (Cororaton and Cockburn, 2006). Thus, increased trade might be associated with greater inequality in exporting countries. For instance, when trade barriers were reduced in Mexico, this led to an increase in income inequality (Hanson and Harrison, 1999). If importing countries face increased poverty (as noted above), this is likely to be associated with increased inequality as well. However, if trade is pro-poor and/or governments can leverage trade and economic growth to provide a social safety net, this might lead to a reduction in income inequality. Overall, the effect of trade on country-level income inequality is ambiguous. Moreover, poverty and inequality do not necessary change in the same direction (Beteille, 2003). While the impact of increased trade on average incomes might be positive, it may simultaneously not reduce the poverty rate and increase inequality.

The effects of migration on country-level poverty and inequality are similarly ambiguous. Freeman (2006) argued that international migration, by raising world output along with other policies associated with globalisation, represents an important key to improving living conditions of the poor. However, population movements from a low-income developing country to high-income developed countries may perversely increase measured the poverty *rate* in the low-income country. This is because it is typically the relatively non-poor who have the resources necessary to migrate internationally, or the poor are limited in terms of the destinations available to them, so their returns to migration are lower (Du, Park, and Wang, 2005). So while the number of poor in the low-income country remains unchanged, the *proportion* of people in poverty might increase. Moreover, migration of skilled workers (sometimes referred to as a 'brain drain'), has a negative effect on the income distribution since it lessens the economic growth rate and affects the people

who stay, through static income-distributional effects (Wong and Yip, 1999). However, international diaspora send billions of dollars in remittances to low-income countries every year (Gammeltoft, 2002), and to the extent that those remittances are received by the poor in the receiving country, they will act to reduce poverty. Large migrant diasporas, and greater migration flows, are therefore associated with ambiguous effects on poverty for typical migrant origin countries.

For migrant destination countries, migrants may have lower income than natives but, depending on the country, this might either increase poverty or have little effect. For instance, South-South migration (from one low-income country to another) might serve to simply redistribute poverty from one country to another, while South-North migration (from a low-income country to a high-income country) may have no or only a small effect on poverty in the high-income destination country. However, relatively high-skilled migrants benefit receiving countries where they contribute their skills (Basri and Box, 2010; Ping Xu, 2016; Borjas, 1994) and pay taxes (Clemens, 2011). Overall, because countries are typically both senders and receivers of migrants, the effect of migration on country-level poverty is ambiguous.

The effect of migration on country-level inequality is also ambiguous. If migrants are positively selected (Docquier, 2006; Liebig and Sousa-Poza, 2004; ; Quaked, 2002) – that is, they tend to be higher skilled than non-migrants – this might have the effect of *reducing* income inequality among those that remain in a migrant-sending country. However, if migrants have lower average incomes than natives, which may be the case for a high-income destination country, then income inequality may increase in migrant-receiving countries. Again, the overall effect of migration on inequality for countries that are both senders and receivers of migrants is ambiguous.

Both trade and migration are proffered as potential solutions to global poverty and inequality. For instance, Clemens (2011) argues that a lack of open borders amounts to 'trillion-dollar bills being left on the sidewalk'. However, empirical studies have to date failed to establish a strong evidence base for positive net impacts of either trade or migration (e.g. Dollar and Kraay, 2004; Jaumotte, Lall, and Papageorgiou, 2013; Meschi, Taymaz, and Vivarelli, 2016; Ping Xu, 2016). The key issue is that most extant studies rely on correlations and do not estimate causal relationships, and that most studies look at the relationship of poverty and/or inequality to trade or migration, but not both simultaneously.

In this paper, we provide new evidence on the *causal* relationships between trade and migration. Specifically, we address the research question: How do international trade and migration affect poverty and inequality, and which has the largest effect? Our results contribute to the literatures on the positive or other effects of international trade and international migration, as well as the literature on poverty and inequality.

In investigating these relationships, we need to account for potential endogeneity resulting from the complexity of the inter-relationship between trade and migration (Abdul Ghani et al., 2019a; 2019b). For instance, if trade increases in Country *N*, this will create more job opportunities in Country *N* and therefore will reduce emigration from Country *N* to other countries (e.g. Massey et al., 1993). Immigration to Country *N* from other countries may also increase. Therefore, migration may be correlated with omitted variables (e.g. country-level determinants of economic development or amenities) that can also affect trade (Hanson, 2010). To reduce this endogeneity issue, we apply an instrumental variables approach, using instruments for both the intensity of international trade and the intensity of international migration, using country-level panel data for 1990-2010. We find that international trade intensity causally lowers both country-level poverty and country-level

inequality. In contrast, international migration intensity does not have a statistically significant causal effect on either poverty or inequality.

The remainder of the paper is structured as follows. Section 2 reviews relevant literature on the causal relationships between poverty and inequality, and international trade and migration. In Section 3, we describe the data and methods that we employ. Section 4 presents the empirical results and discussion, and Section 5 concludes.

4.2 Literature review

Many studies have investigated the relationship between international trade and either poverty or inequality, or both. For example, Porto (2003) studied the relationship between trade liberalization and poverty in Argentina, using general equilibrium analysis, and found that trade liberalization was associated with poverty reduction. Dollar and Kraay (2004) found similar results for a panel of developing countries. On the other hand, Onakoya et al., (2019) studied the relationship between trade and poverty in African countries. Using a pooled OLS model, they concluded that trade openness was *negatively* related to poverty.

Sala-i-Martin (2002) argued that the best strategy to reduce poverty is to induce aggregate economic growth, especially in poor countries. Using data from the G20 countries, they concluded that welcoming more trade and foreign direct investment was associated with lower poverty and income inequality. Castilho et al., (2012) also found that trade liberalization contributed to a decrease in poverty and income inequality in Brazil.

However, Hanson and Harrison (1999) found a positive relationship between freer trade and the income gap between skilled and unskilled workers in Mexico during the 1980s. Meschi, Taymaz, and Vivarelli (2016) found similar results for Turkey over the period 1980 to 1999. In contrast, Jaumotte, Lall, and Papageorgiou, (2013) studied the relationship between an increase in trade and financial globalization and the rise in income inequality for

a panel of 51 advanced and developing countries for the period 1981 to 2003. Using a fixed effects model, they found that increased trade was associated with lower income inequality.

More recently, studies have focused on the *causal* impact of international trade on poverty and income inequality. Liyanaarachchi, Naranpanawa, and Bandara (2016) found a 100 percent reduction in tariffs (provided no interference from any fiscal policy) would lead to increased trade and a reduction in poverty both in the short and long run in Sri Lanka. Mahadevan, Nugroho, and Amir (2017), using a dynamic computable general equilibrium model, estimated the effect on poverty and inequality in Indonesia if international trade was tightened by trade protectionism. They found that protectionism would cause lower GDP growth, and lead to a higher poverty rate but with little effect on income inequality. However, Rosyadi and Widodo (2018) found that trade tariff increases against China by the United States led to an increase in unemployment and income inequality, especially among unskilled workers, for 140 regions of the U.S. However, although these studies investigated the causal effects on trade on poverty and/or inequality, none accounted for the simultaneous effect of migration.

The relationship between international migration and either poverty or inequality, or both, has also been widely considered in the extant literature. There is an abundance of studies on the effect of remittances by migrant diasporas on poverty and inequality (e.g. Gubert et al., 2010; Stark, Taylor, and Yitzhaki, 1986a; Taylor, 1992). However, there are fewer empirical studies on the overall effect of international migration flows on poverty and inequality, not limited to the effect of remittances (which are difficult to accurately measure).

Extant studies have generally found that migration helps to decrease income inequality and poverty (e.g. Ranabahu, 2004; Karemera, Oguledo, and Davis, 2000; Stark et al., 1986; Stark and Taylor, 1991; Adams Jr. and Page, 2005; Mckenzie and Rapoport, 2007).

For example, Clemens and Postel (2017) studied the impact of temporary international migration among Haitians. They found that even a short period of time (several weeks) working in the USA would cause household income in Haiti to more than double, which would reduce poverty in Haiti. Siddique, Shehzadi, Manzoor, and Majeed (2016) and Adams Jr. and Page (2005) explored the relationship between international migration, remittances, and poverty reduction, using random effects models in South Asian countries and in 74 low and middle-income developing countries respectively. Both studies concluded that international migration and remittances play important roles in poverty reduction. However, in a study of internal migration, Du et al. (2005) found that the overall impact of migration on the poverty headcount in Chinese's poor regions has been uncertain, due to most poor households not having migrants in them and remaining poor.

Ping Xu (2016) examined the impact of immigration on income inequality in destination countries using static and dynamic models. They found that in American states from 1996 to 2008, immigration and state income inequality are positively related. Ottaviano and Peri (2006) used a general equilibrium approach to estimate the impact of immigration on income inequality of United States-born workers between 1990 and 2004. They found an uncertain impact of immigration, since the relationship between immigration and the wage gap of native workers was also dependent on workers' education and experience.

There are many causal studies that investigate the relationship between remittances and poverty (e.g Möllers and Meyer, 2014; Gaaliche and Gaaliche, 2014). However, studies on the causal relationship between migration flows, poverty and inequality are somewhat scarce. Sabates-Wheeler, Sabates, and Castaldo (2008) (for Ghana and Egypt) and Adams (1991) (for developing countries) both found that migration and remittances reduced poverty significantly. However, these studies both take no account of trade, and the scope of their studies was geographically limited.

To summarise, the relationships between international trade and international migration, and country-level poverty and inequality, are open to question. Extant studies have tended to focus only on a single country or region and most studies are correlational, and therefore fail to establish a causal link between the variables of interest. We contribute to this literature by presenting a causal study of the impacts of international trade and international migration on poverty and inequality, using panel data at a global scale.

4.3 Data and methods

4.3.1 Data

We use panel data based on five-yearly periods (1990-2010). Panel data allows us to control for unobserved time invariant country specific effects, reducing omitted variable biases (Ravallion, 1995).

The definition of poverty, according to Betson and Warlick (1998) is a condition in which a person (or family) lacks goods and services considered necessary to human well-being. Poverty is not only about lack of money but a wide range of problems, including being unable to afford necessities (food, shelter), health care, education, clean water, and specific needs depending on where people live. Countries have different definitions of poverty, and different ways of determining their national poverty lines. For our first dependent variable (poverty), we use the headcount poverty rate at $1.90 a day for 217 countries from the World Bank.[23]

Income inequality refers to the extent to which income is distributed in an uneven manner within a population (OECD, 2015). For the second dependent variable (inequality), we use the Gini index for 187 countries, from the World Income Inequality Database. The Gini index measures the extent to which the distribution of income (or, in some cases,

[23] https://databank.worldbank.org/data/reports.aspx?source=2&series=SI.POV.DDAY&country=WLD.

consumption expenditure) among individuals or households within a country deviates from a perfectly equal distribution. The Gini coefficient is equal to zero for a country that has a perfectly equal distribution of income, and the higher the values of the Gini coefficient, the more unequal the distribution of income in the country.

Since both dependent variables have a lot of missing values, we fill with potential values as much as possible, by interpolating the data. We do this by computing a predicted value based on known values before and after the missing value[24].

For trade flows, we use data from the Center for International Data of the University of California – Davis.[25] The value of nominal trade flows are in US$1,000s[26] (Baxter and Kouparitsas, 2006; Feenstra, Lipsey, Deng, Ma, and Mo, 2005). The source for the data was a set of bilateral trade flows, which was obtained from importer countries' reports, to avoid double-counting since importers and exporters report the same trade flows in their records. The use of importer data is because importers are believed to have more incentive to accurately record all transactions than exporters, due to duties and tariffs (Fouquin and Hugot, 2016). To obtain a measure of country-level trade intensity, or exposure to trade, we summed all import and export values for a country to obtain a measure of its total trade flows over each five-year period from 1990 to 2010.

Abel and Sander (2014) produced a new bilateral global migration dataset that has yet to be fully exploited in this area of study. The dataset consists of bilateral migration flows at country level for each five-year period from 1990 to 2010, which are estimated from the

[24] The interpolate formula used ; $y = y_1 + (x - x_1)\frac{(y2-y1)}{(x2-x1)}$. y represents year and x represents the known values.

[25] http://cid.econ.ucdavis.edu. Constructed from United Nation Trade data by Robert Fenestra and Robert Lipsey. The data could be either in c.i.f. (receiving countries) or f.o.b. or f.a.s. (sending countries), depending on data availability (Feenstra, personal communication).

[26] Not adjusted for inflation.

changes in stock migration. This dataset effectively estimates the total absolute number of people who change their country of residence over each five-year period and is mainly based on place-of-birth answers to census questions, information obtained from population registers, and refugee statistics.[27] Similar with trade flows data, we derive a measure of country-level migration intensity, or exposure to migration, by summing all immigration and emigration for a country over each five-year period.

We also make use of a number of relevant control variables, including gross domestic product per capita (GDPPC) (Dollar and Kraay, 2002; Fosu, 2017), and foreign direct investment (inflows), all of which were obtained from the World Bank.[28] Unemployment data were obtained from ILOSTAT database. [29] Population data were obtained from the United Nations Population Division,[30] being mid-year estimates of the total population (headcount) counting all residents of each country regardless of legal status or citizenship. We use the secondary school enrolment rate from the UNESCO Institute for Statistics[31] to represent human capital accumulation (Awan, Malik, Awan, and Waqas, 2011; Omoniyi, 2013). We also control for landlockedness. Landlocked countries have no coastline or any direct access to any sea, which creates constraints to accessing world markets (Faye et al., 2004).

Finally, following Ghani et al. (2019) we use two instruments for trade, and one instruments for migration. World Trade Organization[32] (WTO) and General Agreement on Tariffs and Trade (GATT) memberships (see Appendix Table A5) are taken as instruments

[27] UNPD, Trends in International Migrant Stock: Migrants by Destination and Origin, The 2013 Revision
[28] https://databank.worldbank.org/data/reports.aspx?source=2&series=BX.KLT.DINV.CD.WD&country=
[29] International Labour Organization Statistic
[30]https://esa.un.org/unpd/wpp/
[31] United Nations Educational, Scientific and Cultural Organization
[32] World Trade Organization - https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm-WTO|members and observers

for trade. Since our data starts from 1990, we also take GATT membership lists into account, since the WTO was only established in 1995. The average tariff rate consists of the unweighted[33] average of applied rates for all products subject to tariffs, calculated for all traded goods. These data are classified using the Harmonized System of trade at the six- or eight-digit level obtained from the World Bank database. We use international migrant stocks data from the World Bank[34] as an instrument for migration, since it directly influences migration flows (Beine, Docquier, and Özden, 2011). The total international migrant stock for country *i* consists of the total number of people born in country *i* but currently living in some other country.

The nature of this panel is unbalanced, since even once interpolated data for the dependent variables (see above) are included, data are not available for all sample countries for all time periods (five-yearly, from 1990 to 2010).

4.3.2 Methods

The primary interest of this paper is to investigate the effects of trade and migration on poverty and inequality. Two separate regression models were run using poverty and income inequality, respectively, as dependent variables. The baseline model specification, in natural logarithms, is:

$$lnY_{it} = \beta_0 + \beta_1 lnTDE_{it} + \beta_2 lnMIGR_{it} + \beta_2 Z_{it} + \varepsilon_{it} \quad (1)$$

Where *i* indicates countries and *t* indicates years. *Y* is the dependent variable (poverty rate, or Gini index). TDE_{it} is our measure of trade intensity, measured in $US thousands. Mig_{it} is our measure of migration intensity. Z_{it} represents a vector of control variables and ε_{it} is an

[33] An alternative would be to use trade-weighted tariffs. However, using a trade-weighted variable as an instrument for trade would generate endogeneity in our instrument, making it invalid.
[34] https://data.worldbank.org/indicator/SM.POP.TOTL

idiosyncratic error term. β_1 and β_2 are the coefficients that are the focus of this research. All regression models were estimated using Stata 15.

As mentioned earlier, our data is an unbalanced panel. Since panel data are used, there are three main model specifications that can be chosen (pooled OLS, fixed effects, and random effects). We start with the simplest (pooled OLS) model. If some independent variables are correlated with the dependent variable, pooled OLS outcomes may still be valid (Hong and Santhapparaj, 2006). However, the result of pooled OLS may be biased because the error term across countries is serially correlated and heteroscedastic due to omitted (and unobserved) time-invariant differences between countries. Therefore, we next move to panel data models, with robust standard errors to account for both heteroscedasticity and autocorrelation. A Hausman test (p=0.001) indicated that the fixed effects model was more appropriate than random effects (Hsiao, 2014). However, we note that there might be endogeneity between trade, migration and poverty, which both panel fixed effects models and pooled OLS ignore. To reduce these problems, we adopt an instrumental variables regression model as our preferred specification, using two-stage least squares (TSLS). As noted above, we use two instruments (GATT/WTO membership, and average tariff rate) for trade, and one instrument (migrant stock) for migration.

4.3.3 Weakness test and overidentification test

For regression models that have more than one endogenous variable, reporting of the individual *F* statistics is no longer relevant (Sanderson and Windmeijer, 2016). Therefore, for for testing the weakness of the instruments, we look at the significance level of each of the instruments in the first stage of TSLS model. WTO and international migrant stocks are positive and average tariff is negative (see Table 1). All three of our instruments are statistically significant. We conclude that as individual instruments, all of the instruments are not weak. For a test of overidentifying restrictions, which estimates the overall relevance

of the instruments, following Baum, Schaffer, and Stillman (2007) we employed the Hansen's J test. The null hypothesis is that all instruments are uncorrelated with the error terms and based on this test (p = 0.517), we accept the null hypothesis that all excluded instruments are relevant.

4.3.4 Limitations

There are three main limitations to our approach. First, to prove that an instrument is valid, we must test the correlation between the instruments and the error term. Since the error term is unknown, this test is impossible. However, we are confident that our instruments are nevertheless valid because they are plausibly exogenous. We are confident that all excluded variables; WTO accession and average tariff rate are only associated with trade, migrant stocks only associated with migration, and at least not directly associated with our dependent variables. After conducting weakness test on our instrumental variables individually, and as a whole, it is safe to accept that all of our instruments are valid. The second limitation is that the dataset has a number of missing values. It is difficult to get complete data, not only for small countries like Tuvalu, Malta and Marshall Island, but even for countries like New Zealand and Kuwait. Therefore, we interpolated by assuming a linear interpolation between known data points, to fill in missing data within the time period. However, missing data in the first or last period cannot be interpolated. Another limitation is that in this paper, inward and outward flows of trade and migration are treated as if they are the same. Future researcher could study the flows separately, but this would require the identification of additional suitable instruments.

4.4 Results and Discussions

Table 1 presents the regression results for pooled OLS (column 2), fixed effects (column 3), and the preferred instrumental variable model (columns 4 and 5), where the

dependent variable is the poverty headcount rate at $US1.90 per day. The coefficients of interest are in the first two rows.

Table 1: Regression Results for Poverty

Variables	(Pooled OLS) Poverty 1.90	(Fixed Effects) Poverty 1.90	TSLS (1st stage)Trade	TSLS (1st stage)Mig	(2nd stage) Poverty 1.90
Trade	-0.725***	-0.348**			-1.029***
	(0.068)	(0.160)			(0.084)
	[-0.909]	[-0.395]			[-1.102]
Migration	-0.055	0.004			-0.109
	(0.065)	(0.027)			(0.092)
	[-0.052]	[0.005]			[-0.086]
Secondary Education	-0.562***	-0.116	1.360***	0.049	-0.382**
	(0.146)	(0.250)	(0.118)	(0.183)	(0.190)
FDI	0.068	-0.090	0.183**	-0.201**	0.139*
	(0.059)	(0.063)	(0.057)	(0.063)	(0.071)
GDPPC	0.124	-0.011	0.012**	0.026***	0.025***
	(0.103)	(0.008)	(0.007)	(0.005)	(0.009)
Population	0.006	0.949	0.698***	0.450***	0.912***
	(0.009)	(0.823)	(0.052)	(0.118)	(0.104)
Unemployment	0.690***	0.150	-0.078	-0.033	-0.060
	(0.088)	(0.111)	(0.092)	(0132)	(0.113)
landlockness	-0.130		-0.664***	-0.410	-0.562***
	(0.157)		(0.206)	(0.327)	(0.182)
WTO			0.434***	-0.361	
			(0.171)	(0.255)	
Average tariff			-0.464***	0.183	
			(0.107)	(0.129)	
Migrant stock			0.264***	0.243***	
			(0.623)	(0.010)	
Hansen's J Test (pvalue)					0.517
Observations	239	239			169
R-squared	0.675	0.346			0.760

Notes: Clustered standard errors by countries in parentheses. Standardised betas are reported in square brackets for trade and migration. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model, and Columns 4,5 and 6 report the results for the first and second stage, respectively, of an instrumental variable model.

As the regression is specified in natural logarithms, the coefficients can be interpreted as elasticities. Thus, the pooled OLS results shows that one percent higher trade flows are associated with a 0.725 percent lower poverty rate. In contrast, the coefficient for migration is negative, but smaller (both in absolute terms and as a standardized coefficient) and statistically insignificant.

For control variables, the coefficient for secondary education enrollment is negative as expected since higher education is associated with higher incomes and better employment prospects (Migali and Scipioni, 2019). The sign of the coefficient for unemployment is positive as expected, since the more people without work, the higher the rate of poverty. The coefficients for other control variables are statistically insignificant.

The results for the fixed effects model are qualitatively similar with OLS, but the estimated poverty elasticity of trade is substantially smaller than the corresponding elasticity in OLS model (although still larger than the positive and statistically insignificant coefficient for migration). However, as Cameron and Poot (2018) note, the coefficients obtained from OLS and fixed effects models can't be compared directly due to differences in the way the variables should be interpreted. Moreover, both pooled OLS and fixed effects models overlook endogeneity issues.

Our preferred model specification is the instrumental variables model in the third and fourth columns. This model shows that one percent higher trade flows lead to a 1.029 percent lower poverty rate, while the coefficient for migration is negative but statistically insignificant. Again, the results (including the standardized beta coefficient) demonstrate that trade has a larger negative impact on poverty than does migration.

Table 2 presents the regression results for pooled OLS (column 2), fixed effects (column 3), and the preferred instrumental variables model (column 4), where the dependent

variable is the Gini coefficient measure of inequality. The coefficients of interest are in the first two rows. The first stage for the instrumental variables model is identical to that for poverty (as shown in Table 1).

Table 2: Regression Results for Inequality

	(Pooled OLS)	(Fixed Effects)	TSLS (2^{nd} Stage)
Variables	Gini	Gini	Gini
Trade	-0.036***	-0.056**	-0.066***
	(0.011)	(0.022)	(0.015)
	[-0.330]	[-0.196]	[-0.558]
Migration	0.017*	0.021**	0.010
	(0.009)	(0.009)	(0.010)
	[0.135]	[0.172]	[0.076]
Secondary Education	-0.087***	-0.124***	-0.065*
	(0.025)	(0.022)	(0.038)
FDI	-0.001	-0.006	0.005
	(0.010)	(0.011)	(0.012)
GDPPC	0.001	0.002	0.002
	(0.002)	(0.010)	(0.002)
Population	0.001	-0.044***	0.037**
	(0.013)	(0.012)	(0.016)
Unemployment	0.029*	0.029*	0.025
	(0.017)	(0.017)	(0.020)
landlockness	-0.128***		-0.150***
	(0.026)		(0.031)
Observations	330	330	230
R-squared	0.220	0.213	0.329

Notes: Clustered standard errors by countries in parentheses. Standardised betas are reported in square brackets for trade and migration. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model, and Columns 4 report the results for the second stage of an instrumental variable model.

As for Table 1, the coefficients in Table 2 can be interpreted as elasticities. The pooled OLS results show that one percent higher trade flows are associated with 0.036 percent lower inequality, while the coefficient for migration is positive and shows that one percent higher migration flows are associated with 0.017 percent higher inequality. The latter result is consistent with the theory that more migration in a country (especially immigration) would cause wider income inequality (Card, 2009).

The results for the fixed effects model are again similar with OLS, with trade statistically significant and negative, but migration statistically significant and positive. The

results show that one percent higher trade flows are associated with 0.056 percent lower inequality, while the coefficient for migration shows that one percent higher migration flows are associated with 0.022 percent higher inequality. The standardized betas show that trade has a larger relationship with inequality in both OLS and fixed effects models.

In our preferred IV model, the coefficient for trade implies that a one percent increase in trade flows reduces the Gini coefficient by 0.066 percent, while the coefficient for migration is positive but statistically insignificant. As for poverty, the results demonstrate that increased trade flows help reduce country-level inequality. The larger effect of trade, when compared with migration, is also supported by the larger standardized beta.

4.4.1 Robustness Checks

To confirm the robustness of the poverty results, we re-estimated the models using poverty headcount below a US$5.50 poverty line, and the same conclusion is obtained. The results show that in the preferred IV specification, each one percent increase in trade flows reduces poverty by 1.2 percent. See appendix Table A1.

Given that China has provided the majority of global poverty reduction in recent decades (see the Introduction for details), we might be concerned that our results are driven entirely by China. Using the original poverty line (US$1.90), we re-ran the models excluding China. The coefficient for trade in the preferred IV specification is only slightly smaller compared to the main results, and all other signs and significant levels are similar (see appendix Table A2). We also re-ran the same robustness test for inequality (see appendix Table A3). The signs and statistical significance are the same as in our main results.

The sample sizes for the IV models are smaller than for the OLS and fixed effects models, due to lesser availability of data for the instruments. To ensure that our results are not sensitive to the smaller sample size in the IV regressions, we re-ran the OLS and FE

regressions using the smaller sample. The results obtained are qualitatively similar (see appendix Table A4 and Table A5).

4.5 Conclusions

Reducing poverty and inequality has been an ongoing policy and action focus among governments, NGOs and philanthropic organisations. Despite a variety of actions, poverty and inequality remain stubbornly high in many countries, and there is a need for evidence as to the effectiveness and implications for the various levers available to policy makers. Among the highest-level policy levers to address these rates are free trade and migration. However, at a country level there is theoretical ambiguity as to the impact of the interrelationship of these levers on poverty and inequality, in part due to problems of endogeneity and data availability. This ambiguity is reflected in applied research, with a range of often conflicting results in the literature.

This paper addressed this important gap in the literature by unpacking the relationship between trade and migration with poverty and inequality. Our research question: "How do international trade and migration affect poverty and inequality, and which has the largest effect?", is one that has been asked before in the literature. However, to our knowledge, no paper has dealt with the endogeneity issues for *both* trade and migration. Our contribution is enabled by both the use of a novel dataset and an instrumental variables approach that includes instruments for both migration and trade.

Our results support the hypothesis that there is a causal relationship between international trade and poverty and inequality at the country level. However, the role of international migration is less clear. In answer to on our research question, we find that trade is more effective in reducing both poverty and income inequality than migration. Trade is consistently associated with both poverty and inequality reduction across our models, with

the preferred model suggesting that a one percentage point increase in trade flows lowers the poverty rate by 1.03 percent and lowers income inequality by 0.07 percent. In contrast, migration has a statistically insignificant effect on poverty in all models and is weakly associated with an increase in inequality in some models, but this effect is statistically insignificant in our preferred model.

These results suggest important policy implications. If a resource-constrained policymaker wishes to reduce poverty and/or inequality, then ceteris paribus is it better to devote scarce resources towards promoting greater international trade rather than facilitating international migration. Our results suggest that reducing the barriers to enhance international trade flows will have important positive effects on poverty and inequality. Trade policy is clearly an important tool for poverty and inequality reduction, while the role of migration is less clear.

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Chapter Appendix

Table A1: Robustness Test - Regression Results

Variables	(Pooled OLS) Poverty 5.50	(Fixed Effects) Poverty 5.50	(TSLS) Poverty 5.50
Trade	-1.121***	-0.104*	-1.216***
	(0.070)	(0.177)	(0.086)
Migration	-0.039	-0.002	-0.085
	(0.068)	(0.051)	(0.099)
Secondary	0.397***	-0.205	0.511**
	(0.151)	(0.282)	(0.207)
FDI	0.109*	0.003	0.127*
	(0.063)	(0.059)	(0.075)
GDPPC	0.010	-0.011	0.017*
	(0.008)	(0.044)	(0.010)
Population	0.903***	0.484	1.070***
	(0.082)	(0.798)	(0.107)
Unemployment	0.079	0.052	0.080
	(0.105)	(0.138)	(0.121)
landlockness	-0.368**		-0.327*
	(0.157)		(0.192)
Observations	176	176	176
R-squared	0.707	0.681	0.725

Notes: Clustered standard errors by countries in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model, and Columns 4 and 5 report the results for the first and second stage, respectively, of an instrumental variable model. Table shows regression results using poverty headcount ratio at $5.50 a day for robustness check. Sample size already reduced to be compatible with TSLS model. Interestingly, we obtained the same signs and significant status for the main two independent variables as Table 1.

Table A2: Robustness Test - Regression Results -Poverty 1.90 without China

Variables	(Pooled OLS) Poverty 1.90	(Fixed Effects) Poverty 1.90	TSLS (1st stage)Trade	TSLS (1st stage)Mig	(2nd stage) Poverty 1.90
Trade	-0.714***	-0.342**			-1.021***
	(0.068)	(0.156)			(0.083)
	[-0.879]	[-0.379]			[-1.073]
Migration	-0.039	0.004			-0.087
	(0.066)	(0.043)			(0.092)
	[-0.036]	[0.003]			[-0.067]
Secondary Education	-0.591***	-0.111	1.001***	0.065	-0.397**
	(0.146)	(0.278)	(0.115)	(0.181)	(0.189)
FDI	0.049	-0.092*	0.109	-0.200***	0.116
	(0.060)	(0.047)	(0.040)	(0.063)	(0.071)
GDPPC	0.138	-0.010	0.011***	0.026***	-0.052
	(0.103)	(0.009)	(0.004)	(0.006)	(0.112)
Population	0.006	0.926	0.527***	0.474***	0.024***
	(0.009)	(0.713)	(0.078)	(0.122)	(0.009)
Unemployment	0.634***	0.151	-0.151	-0.0312	0.848***
	(0.091)	(0.149)	(0.084)	(0.131)	(0.108)
landlockness	-0.126		-0.066***	-0.340	-0.586***
	(0.156)		(0.203)	(0.319)	(0.181)
WTO			0.490***	-0.230	
			(0.179)	(0.281)	
Average tariff			-0.441***	0.177	
			(0.082)	(0.129)	
Migrant stock			0.281***	0.243***	
			(0.631)	(0.100)	
Hansen's J Test					0.517
Observations	160	160			160
R-squared	0.680	0.720			0.760

Notes: Clustered standard errors by countries in parentheses. Standardised betas are reported in square brackets for trade and migration. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model, and Columns 4,5 and 6 report the results for the first and second stage, respectively, of an instrumental variable model. Sample size already reduced to be compatible with TSLS model. We obtained smaller coefficients but same signs and significant (insignificant) status for the main two independent variables as Table 1.

Table A3: Robustness Test - Regression Results -Gini without China

Variables	(Pooled OLS) Gini	(Fixed Effects) Gini	TSLS(2nd Stage) Gini
Trade	-0.058***	-0.067**	-0.067***
	(0.016)	(0.031)	(0.015)
Migration	0.021**	0.025**	0.009
	(0.010)	(0.011)	(0.010)
Secondary Education	-0.053	-0.106***	-0.064*
	(0.038)	(0.032)	(0.038)
FDI	-0.008	-0.015	0.007
	(0.014)	(0.015)	(0.013)
GDPPC	-0.001	-0.013	0.002
	(0.002)	(0.014)	(0.002)
Population	0.026	-0.034*	0.041**
	(0.019)	(0.018)	(0.017)
Unemployment	0.028	0.032	0.024
	(0.023)	(0.023)	(0.020)
landlockness	-0.088**		-0.148***
	(0.035)		(0.032)
Observations	222	222	222
R-squared	0.266	0.257	0.331

Notes: Clustered standard errors by countries in parentheses. Standardised betas are reported in square brackets for trade and migration. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model, and Columns 4 report the results for the second stage of an instrumental variable model. Sample size already reduced to be compatible with TSLS model. We obtained bigger coefficients but same signs and significant (insignificant) status for the main two independent variables as Table 2

Table A4: Robustness Test - Regression Results for Poverty (reduced sample size).

Variables	(Pooled OLS) Poverty 1.90	(Fixed Effects) Poverty 1.90
Trade	-0.998***	-0.315**
	(0.076)	(0.190)
Migration	-0.014	-0.004
	(0.068)	(0.052)
Secondary Education	-0.321**	-0.443
	(0.153)	(0.300)
FDI	0.116*	-0.140**
	(0.065)	(0.068)
GDPPC	0.012	-0.011
	(0.008)	(0.010)
Population	0.793***	1.404*
	(0.087)	(0.804)
Unemployment	-0.056	0.269
	(0.107)	(0.156)
landlockness	-0.290*	
	(0.161)	
Observations	169	169
R-squared	0.737	0.408

Notes: Clustered standard errors by countries in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model. The same signs and significant status for the main two independent variables are obtained.

Table A5: Robustness Test - Regression Results for Gini (reduced sample size).

Variables	(Pooled OLS) Gini	Fixed Effects) Gini
Trade	-0.058***	-0.067**
	(0.016)	(0.031)
Migration	0.021**	0.025**
	(0.010)	(0.010)
Secondary Education	-0.053	-0.106***
	(0.037)	(0.032)
FDI	-0.008	-0.015
	(0.014)	(0.015)
GDPPC	-0.001	-0.013
	(0.002)	(0.014)
Population	0.025	-0.034*
	(0.019)	(0.018)
Unemployment	0.028	0.032
	(0.023)	(0.023)
landlockness	-0.088**	
	(0.035)	
Observations	230	230
R-squared	0.267	0.258

Notes: Clustered standard errors by countries in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Column 2 reports the results for pooled ordinary least squares (OLS), Column 3 reports the results for a fixed effects panel model. The same signs and significant (insignificant) status for the main two independent variables are obtained for models with the same sample size.

5. Conclusion

Globalisation brings many impacts as it is associated with increased flows of capital, investment, community, information, lifestyle, diseases, or in other words, more interdependence among countries (Scholte, 2005), including the exchanging of cultures, attitudes, and people (Bergstrand, 2013). International trade and migration flows have increased in recent years due to globalization and have been at the centre of the study of globalization.

Understanding the impact of increasing of trade and migrations flows due to globalization is important, especially the impacts on poverty and inequality. International trade and migration flows bring a lot of opportunities (i.e. investments, jobs). Meanwhile, increasing movement of people might encourage trade from origin to destination countries, since migrants want to have access to familiar foods and other products. When it is tempting to believe that increasing trade and migration flows will reduce poverty and inequality, the reality is complicated. People want to migrate basically to improve their standard of living. But if people who actually able to migrate are the people who have the resources necessary to migrate (i.e. they are non-poor), this situation will only increase inequality and has much lower contribution to alleviating poverty. How trade, migration, poverty, and inequality interact with each other is still the subject of debate.

This thesis aimed to shed fresh light on the relationships between trade and migration and how they relate to global poverty and inequality. The thesis answered several research questions using empirical studies, including: (i) are trade flows associated with migration flows and vice versa ?; (ii) will an increase in trade cause migration to increase ?; and (iii) are international trade or migration flows more effective in reducing global extreme poverty and inequality?

5.1 Main Findings

Chapter 2 identified the correlation between global bilateral trade flows and migration flows. There has been a lot of variation in the outcomes in previous studies and not many researchers have made use of large global datasets of trade and migration flows. The results from the preferred model, which was a combination of SUR and PPML, show that trade and migration have positive coefficients, meaning that trade and migration are complements. The results suggest that an increase of migration from country *i* to country *j* is associated with higher trade flows from country *i* to country *j*, and vice versa, where an increase in trade flows from country *i* to country *j* is associated with higher migration flows from country *i* to country *j*.

Chapter 3 expanded the investigation in Chapter 2 by examining the *causal* relationship between trade and migration. In the preferred model, which combined TSLS and PPML, trade was found to have a positive causal impact on migration. The results are robust to the exclusion of China and the U.S. from the dataset.

Chapter 4 compared the ability to reduce poverty and income inequality between international trade and migration. Our preferred model is TSLS. The chapter concluded that trade has a stronger effect on reducing poverty and inequality than does migration. These results are robust to an alternative poverty line, and to the exclusion of China from the dataset.

5.2 Policy Implications

The findings of Chapter 2 have important implications based on current events. To give an example, President Trump has stressed immigration reform would be a priority of his government, especially in reducing family-based immigration of what the president called “chain migration”. This increase of barriers to prevent migration will be correlated to

US trade flows since based on our findings, fewer migrants are associated with lower trade flows, and demand for goods and services, and discourage economic activity, since migration and trade are positively correlated.

The findings of Chapter 3 might be important to policy makers to advise against employing extensive trade barriers. The United States is currently engaged in a period of imposing new trade barriers and has proposed to increase barriers to the movement of people through their borders. Our findings imply that more trade protection will cause a decrease in migration flows. Given that international trade and migration are among the main sources of wealth and welfare for countries, our results argue against trade restrictions. However, on the other hand, another policy implication is that restricting trade flows could help a country to achieve a target to reduce the migration flows.

The findings of Chapter 4 might be important to policy makers to assist them in considering the impacts of opening their economy up to more international trade or migration, or restricting trade or migration, in terms of the impacts on poverty and inequality in their country. As an example, Malaysia has been involved in negotiations for the Comprehensive and Progressive Trans Pacific Partnership (CPTPP) Agreement and the Regional Comprehensive Economic Partnership (RCEP) Agreement in order to promote their free trade (Maria, 2018). Based on our results, increasing trade flows in Malaysia would help this country in the process of alleviating poverty and reducing inequality.

5.3 Limitations

This section recognizes some limitations of this thesis and indicates interesting areas for future research and extensions from the studies conducted in this thesis. The first limitation is the availability of data. Since a global dataset with many variables was used, it is difficult to get complete data, especially for the dependent variables in Chapter 4 (poverty

and inequality), which had a number of missing values. Even though we did data interpolation, not all values could be interpolated since not all of the unknown values were bounded on either side by known values. We avoided extrapolating at either the beginning or the end of the dataset. However, the data still represents the most comprehensive data available at this time.

The analysis in Chapter 2 demonstrated that trade is correlated with migration. But the trade values we used only including trade of manufactured goods. We need more evidence on how services trade correlates with migration flows since we believe that services or intangible trade is an increasingly important component of total trade flows.

The analysis in Chapter 4 was unable to establish that migration is a statistically significant determinant of poverty or income inequality. One of the factors that may contribute to this outcome might be the missing values the dataset used. Plus, this paper used migrant measure of migration intensity that does not consider separately the direction of migration flows. This creates a double counting issue in the data, since all emigration from one country is also immigration to another country. Future research could usefully consider flows in both directions separately, although for causal analysis this would require additional suitable instruments to be identified.

Although this thesis provided evidence that trade affects migration, the estimated migration data only included regular migration. This is another limitation of the thesis, knowing that there are influx of irregular migrants all over the world, which are relevant to the research questions in this thesis. For instance, in the UK the number of irregular migrants

in 2017 was estimated to be between 800,000 and 1.2 million.[35] The estimated number of irregular immigrants living in the U.S in 2016 was between 10.5 million to 12 million.[36]

Finally, assessing the causal effect of trade on migration flows is not an easy task since there is potential for reverse causality. Therefore, this thesis used instrumental variable estimators. The next limitation concerns the instruments. The correlation between the instruments and the error term must be tested, in order to prove that an instrument is valid. Since the error term is unidentified, this test is impossible. The best that can be done is to run a weak instruments test and an overidentifying test to validate the instruments. Even though the tests validate the instruments, there is still a possibility that the instruments don't fully satisfy all of the assumptions. It will be important for future researchers to test a broader range of potential instruments for migration flows, besides migration stocks and migration networks, which are already widely used in this area of study.

In sum, although there still some uncertain issues in the thesis, the thesis has contributed new knowledge to our understanding on the relationship and causation between trade and migration and how they affect poverty and inequality.

5.4 Future research

Instead of using mainstream manufacturing trade data, one interesting area for future research is to look at how services, including intangible and digital trade, are related to migration, poverty and inequality. The potential outcome will contribute to new knowledge, and to date there is not much study on this area of trade.

Next, it is really important that future research could answer all three research questions using inflow and outflow data separately for trade and migration. These steps will

[35] https://www.bbc.com/news/uk-50420307
[36] https://www.brookings.edu/policy2020

provide more information and knowledge on how trade, migration, poverty and inequality relate with each other.

Another interesting future research topic which is worth exploring would be to study the connection between trade and illegal migration flows, including who entered a country legally and overstayed, which is still scarce since the literature only focuses on how trade policy affects legal migration (Gallegos, 2004). It might also be interesting to know whether formal and informal migration have different effects on macroeconomic conditions. The only challenge is, due to the nature of irregular migrants, that it is hard to collect reliable global data. Therefore, the best thing that can be done is to come out with estimated data. This is another way to understand whether migration is actually a good mechanism for reducing poverty and income inequality.

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Thesis Appendix

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Nature of contribution by PhD candidate	DATA DOWNLOADING, DATA WRANGLING, DATA ANALYSIS, RESULT INTERPRETATION, PREPARING THE FULL DRAFT, ADDRESSING SUPERVISOR'S COMMENTS
Extent of contribution by PhD candidate (%)	60

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WILLIAM COCHRANE	HELPING IN IMPROVEMENT OF THE CHAPTER, PROVIDING CRITICAL FEEDBACK
MATTHEW ROSKRUGE	HELPING IN IMPROVEMENT OF THE CHAPTER, PROVIDING CRITICAL FEEDBACK

Certification by Co-Authors

The undersigned hereby certify that:

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CHAPTER 3 "THE CAUSAL IMPACT OF TRADE ON MIGRATION - A GRAVITY MODEL ESTIMATION" IS A DEPARTMENTAL WORKING PAPER.

Nature of contribution by PhD candidate	DATA WRANGLING, DATA ANALYSIS, RESULTS INTERPRETATION, WRITING THE FULL DRAFT, ADDRESSING SUPERVISOR'S COMMENTS
Extent of contribution by PhD candidate (%)	60

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MATTHEW ROSENUGE	HELPING IN IMPROVEMENT OF THE CHAPTER, PROVIDING CRITICAL FEED BACK

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The undersigned hereby certify that:

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Co-Authorship Form

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CHAPTER 4 "INTERNATIONAL TRADE OR MIGRATION: WHICH IS THE STRONGEST AVENUE TO WEB POVERTY AND INEQUALITY" IS A DEPARTMENTAL WORKING PAPER.

Nature of contribution by PhD candidate	DATA WRANGLING, DATA ANALYSIS, RESULTS INTERPRETATION, PREPARING THE FULL DRAFT, ADDRESSING THE CUMULATIVE COMMENTS
Extent of contribution by PhD candidate (%)	60

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WILLIAM COCHRANE	HELPING IN IMPROVEMENT OF THE CHAPTER, PROVIDING CRITICAL FEEDBACK
MATTHEW ROSENBERG	HELPING IN IMPROVEMENT OF THE CHAPTER, PROVIDING CRITICAL FEEDBACK

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

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