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Three Essays on International Trade and Migration

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THREE ESSAYS ON INTERNATIONAL TRADE AND MIGRATION

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by

Yun Wang

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To: Dean John F. Stack, Jr.
School of International and Public Affairs

This dissertation, written by Yun Wang, and entitled Three Essays on International Trade and Migration, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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The dissertation of Yun Wang is approved.

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Florida International University, 2018

DEDICATION

To my parents.

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ABSTRACT OF THE DISSERTATION

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This dissertation encompasses three different topics on international trade and migration. The first chapter is the introduction. The second chapter investigates the short run effects of regional trade agreements on trade costs. It is widely accepted that the reinforcement of Regional Trade Agreements (RTAs) aiming at trade costs reduction among trade partners requires time. This paper investigates the effects of RTAs on trade costs over time by using unique micro-price data. As a key factor compared to the literature, excluding the local distribution costs, the trade costs we calculated are based on the arbitrage condition to equalize traded input prices across international cities. We confirm that having an RTA on average lowers trade costs significantly. Furthermore, data shows significant and negative effects of RTAs on trade costs over time. Specifically, besides the initial impact on trade costs, having an RTA continuously lower trade costs every year after the commencement of the RTA.

Gravity variables such as distance, common language, colonial ties, free trade agreements, and adjacency are used to capture the effects of trade costs in empirical studies. The third chapter decomposes the overall effects of gravity variables on trade through three gravity channels: duties/tariffs (DC), transportation-costs (TC), and dyadic-preferences (PC). When PC is ignored as is typical in the literature, it is shown that nearly all gravity effects are trough distance; 29 percent

through DC and 71 percent through TC. However, the additional channel of PC is introduced and shown to dominate other channels, with adjacency contributing about 45 percent, distance about 32 percent, colonial ties about 14 percent, free trade agreements about 7 percent, and common language about 2 percent. These results imply that gravity variables mainly capture the effects of demand shifters rather than supply shifters (as implied by the existing literature). The results are further connected to several existing discussions in the literature, such as welfare gains from trade and the distance puzzle.

The fourth chapter utilizes an immigration inflow data set from OECD countries during the period of 1984 to 2015 to shed lights on how institutional quality affects the immigration rate. With the analysis in the fixed-effects framework, we construct a set of country-time specific institutional quality indexes to examine their effects on the immigration rate. The paper shows that other than the network effects, GDP difference, and migration costs, institutional qualities in both destination and source countries matter when it comes to potential migration decisions. Specifically, better socioeconomic conditions in the destination countries, and worse foreign debt, budget balance, government stability, internal conflicts, and corruption conditions in the source countries increase the immigration inflow.

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CHAPTER 1

INTRODUCTION

The gravity model has been introduced into numerous empirical international trade and migration studies for decades. Gravity variables share bilateral information such as distance, common language, border, colonial ties, and regional trade agreements. They have been employed to connect trade and migration through a number of economic activities at source and destination countries. Specifically, gravity variables have been mainly used as proxies for trade costs and migration costs (Anderson and van Wincoop, 2004).

Trade costs include both observable and unobservable elements such as transportation costs, tariffs, duties, searching costs and information/language barriers. Migration costs represent physical and cultural barriers occurred when migrants reallocate. This dissertation mainly focuses on the gravity model and how well the gravity variables can explain trade and migration. Therefore, three questions have been asked in the following chapters: (i) how regional trade agreements affect trade costs, especially when there is evidence that time is required for a trade agreement to come into force, (ii) what are the gravity channels on trade, especially concerning the preferences factors, and (iii) do institutional quality of both destination and source countries matter when potential migrants decide to reallocate. I use theory and data to provide quantitative answers to these questions.

Regional Trade Agreements (RTAs) are one of the most important gravity variables in international trade literature. The second chapter explores the effects of RTAs on trade costs. The literature shows different results of the elasticity on trade due to the specialized data sets, sample sizes and methodologies. Cipollina and Salvatici (2010) used meta-analysis to summarize the existing empirical results.

The results support the hypothesis that having an RTA increase trade flows between two countries significantly.

Understanding the gravity effects is the key for economists to figure out how elastic trade is with respect to changes in trade frictions. However, the gravity variables regarding bilateral attributes are mainly used for trade frictions approximation instead of trade flows, it is best to choose trade costs as the main focus in our study. Due to the limitation of the trade costs data, existing literature transfers to use micro-level price data and the arbitrage condition as a measurement of trade costs (Eaton and Kortum, 2002; Simonovska and Waugh, 2014; Yilmazkuday, 2016). This method to proxy trade costs has the advantage of covering the widest range of definition of trade frictions from the observable (direct) costs, such as transportation costs and duties/tariffs, to the unobservable (indirect) costs, such as information costs, search costs, and potentially the preferences from the demand side.

This measurement of trade costs also gets improved when we use it in this chapter. We distinguish the sources of the price differentials in two locations from international trade frictions and local distribution costs. Crucini and Yilmazkuday (2014) suggests to distinguish retail prices in the data by both trade and non-traded input prices. Therefore, the trade costs acquired through the arbitrage condition only come from the trade-input prices other than the non-traded inputs, where the latter is mainly treated as local distribution costs.

Using the arbitrage condition and the prices of 22 tradable goods recorded from 102 major cities in 58 countries, the second chapter investigates the effects of RTAs on trade costs in the fixed effects framework. We examine the robustness of the existing conclusion of negative effect of the RTA dummy variable on trade costs. One step further to investigate phased-in effect of RTAs, we create a new time-related variable to indicate the year after an RTA entered into force. The empirical model contains the log term of trade costs on the left-hand side, gravity variable, time-related RTA variable, and fixed effect for unobserved heterogeneity on the right-hand side. We also consider the endogeneity problem and different robustness tests. The results show that the average regional trade agreements have significant anticipatory effects on trade costs and continue to affect trade costs after the trade deals begin.

The third chapter tries to distinguish the effect of the gravity variables between trade costs and dyadic-preferences. Head and Mayer (2013) point out that only 30% of the trade flow variations can be explained by observable trade costs data, such as transportation costs and duties/tariffs. Almost 70% of the variations of trade flows come from unobservable dark costs that consist of the information barriers, consumers preferences and producers pricing to market, etc. It is understandable that the gravity/dyadic variables may also capture the demand-side preferences. Anderson (2011) also addressed this concern as the difficulty to distinguish demand-side home bias from the effect of trade cost, since the dyadic variables pick up both the demand and the supply side.

Although the existing literature has used these gravity variables extensively, there have not been sufficient attempts to decompose the overall gravity effects on trade (across time and space) into those through direct versus indirect trade costs. This has been mostly due to data limitations on trade costs, especially indirect trade costs. Thanks to the detailed data on U.S. imports and the corresponding measured trade costs, our study has achieved to identify the effects of gravity channel on direct costs and preferences, and externalized the indirect costs.

We first develop a simple theoretical model considering the imports of the U.S. at the individual goods level, optimization problems of individuals in the U.S, and the firms profit maximization problem in the source countries. We follow the standard approach as our consumer utility function has constant elasticity of substitution, the iceberg trade cost is introduced at destination prices and the cost function is linear. To differentiate the effects of gravity/dyadic variables on preferences and trade cost, two types of preferences will be considered. The first type is random preferences, which implies that gravity/dyadic variables only capture the effects of measured trade costs. The second type is dyadic preferences, which implies that gravity variables not only capture the effects of measured trade costs but also those of preferences treated as error term in a typical gravity regression.

In this study, overall effects of gravity variables on trade are mostly shown to be through dyadic preferences rather than the measured trade costs of transportation costs or duties/tariffs. This additional channel of dyadic preferences has not been given enough importance in the existing literature, mostly due to the lack of available data on the subject.

Similar to international trade, international migration is also a key component of modern globalization. The fourth chapter focus on the other side of the story by using gravity models in the analysis on international migration. It seems that the institutional quality of a country affects the human capital flow and introduces different effects in the destination and source countries. Much of the migration literature (Docquier and Rapoport, 2012; Dreher et al., 2011; Dimant et al., 2013; Fitzgerald et al., 2014; Hatton and Williamson, 2003; Mayda, 2010) focuses on only one or some aspects of the institutional quality of a country, such as political instability, social and economic issues, conflicts, and corruption. This paper contributes to the existing literature by constructing a set of institutional quality indexes to consider all the possible socioeconomic and political conditions.

We use an updated source-country specific immigration inflow data set from 33 OECD destination countries between 1984 and 2015 to examine the gravity model in migration. Combining institutional quality indexes from the International Country Risk Guide (ICRG), this paper shows the importance of institutional quality in both destination and source countries in determining the migration flow.

The modified empirical model summarizes the findings in the previous studies. The common gravity variables as proxies for the migration costs affect migration flow negatively, such as geographic distance, common border, colonial ties, and common language. The results of the estimations also show that one of the most important factors is network effects from existing immigration stocks in the destination country. These network effects provide information to potential immigrants from family and friends who reside in the destination countries. As predicted, network effects reduce the migration costs, and increase the chance for potential immigrants to land jobs and settle after reallocation.

Last but not least, the innovation of this paper is to incorporate the unique institutional quality measurements into explaining the pull and push effects in the model. This is the first study to fully integrate both economic and political, pull and push effects with institutional quality indexes to explain the patterns of migration flow. The results are aligned with the literature, where institutional quality matters for the determination of migration. Better socioeconomic condition in the destination countries, worse debt and budget conditions, lower stability of the government, more internal conflicts and corruption in the source countries yield larger immigration inflows from source to destination countries.

The policy implications are important for developing and underdeveloped countries specifically. These countries should create related policies to retain their labor force and citizens, and prevent brain-drain effects which could potentially impact the labor market and economic growth of those countries in the long run.

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CHAPTER 2

ON REGIONAL TRADE AGREEMENTS AND TRADE COSTS

2.1 Introduction

The gravity model has been the empirical workhorse for studying bilateral trade. Regional Trade Agreements (RTAs) are one of the most important gravity variables in the international trade literature. Even though not all of the motivations to form RTAs are based on economic considerations (WTO, 2011), it is the case that when forming an RTA, trade partners aim at the promotion of trade and the reduction of trade barriers. Therefore, we would expect RTAs to reduce trade costs and create additional trade flows among trade partners.

In this paper, we mainly focus on the effects of RTAs on trade costs, since the benefits of negotiating RTAs are twofold (RTAs potentially lead to the decreasing of trade costs and increasing of bilateral trade flows). There are a few studies that attempt to emphasize how policies impact the changes of trade costs. The topic is gaining more attention due to the rapid increase in the number of RTAs during the past few decades. The contents and the scope of the RTAs have considerably expanded at the same time. Recently, signed RTAs tend to be categorized as "deep integration" agreements, due to the fact that the new agreements go beyond conventional market access issues. They are not limited to only the promotion of preferential tariffs and their elimination, but recently formed RTAs encompass a broad range of trade-related issues, in particular, trade facilitation issues. RTAs deal more with "behind-the-border" policies and domestic regulations that aim at increasing the efficiency of entire trade procedures. Therefore, trade facilitation, as an important element, is now systematically included in most newly formed RTAs

From the perspective of trade costs, we can also see the impact from the transformation of the RTAs with respect to trade facilitation. As tariffs and all the other quantitative restrictions on trade, such as freight rate, have fallen over recent decades, attention has shifted towards the reduction to the other forms of trade barriers in RTA negotiations. Through the wide acceptance of the broad trade costs definition in Anderson and Wincoop (2004), we recognize that tariffs only account for less than 5% of the overall ad valorem equivalent trade costs. Trade facilitation has the potential to have a greater impact on trade costs by potentially changing the poor trade infrastructure and logistic service markets, both of which contribute to larger trade barriers between partners. Nevertheless, given the obvious motivations for the promotion of trade facilitation in RTA negotiation, does having an RTA truly help trade partners in reducing their trade costs with each other? We attempt to answer this question in this paper. Most importantly, we are seeking to understand how to quantify the effects of RTAs on trade costs, since there is a lack of literature addressing this issue in a more general form.

Several recent studies explore the effects of RTAs on trade costs. Emphasizing the significant impact of trade facilitation provisions in RTAs, Duval et al. (2016) ask whether including trade facilitation in RTAs truly helps trade partners reduce their trade costs. They create a variable that denotes the number of trade facilitation provisions in all the RTAs to which both trade partners belong. As a replacement of the standard RTA dummy variable, this main explanatory variable helps the authors find that each additional trade facilitation provision in an RTA cuts the trade costs of both trade partners by 1%. By differentiating between the types of RTAs, Miroudot and Shepherd (2012) address the question of whether services RTAs have any impact on trade costs. In the case of services, they find a modest 6.5% decrease in trade costs if trade partners have service RTAs. By focusing on the regionalization of trade in East Asia, Pomfret and Sourdin (2009) define trade costs as the difference between free-on-boat (fob) values when a good reaches the port in the exporting country and import values that include the cost, insurance and freight (cif). Additionally, they argue that the trade costs of East Asian countries dropped over the whole regionalization period. However, they do not include the RTA variable as an explanatory variable in the regression analysis. Therefore, there is potential exogeneity bias in their results, as they cannot explain whether it is the trade agreement that reduces the trade costs.

Studies in the field of Economics focusing on RTAs and trade costs seemingly lack a formal analysis of the structured gravity model. On the other hand, more standard gravity studies mainly focus on the effects of RTAs on bilateral trade flows. Studies show different results of RTA elasticity of trade volume (after treatment effects of RTAs) due to the specialized data sets, sample sizes and methodologies. Cipollina and Salvatici (2010) use meta-analysis to summarize the empirical results of 1,827 estimates gathered from a set of 85 studies. The random effects estimate demonstrated a 65% increase in trade with RTAs. After filtering biases and impacts, the meta-analysis confirmed the robust and positive impact of RTAs on trade flows, which contribute to an increase of approximately 40%. As a comparison to the random effects estimator, the more modest fixed effects estimate, which drops the after treatment effects of the RTAs to approximately 10%, is demonstrated to be unreliable because of the undermined obvious heterogeneity when authors try to compare different RTAs. Moreover, due to the limitations of cross-sectional analysis, comparing the estimates in different time frames with different RTAs shows the upper trending results over the time, which undermines the "consequence of the evolution from shallow to deep trade agreements," as the author describes in the study.

However, we still can not accurately quantify the effects of RTAs with concrete support, due to the endogeneity problem of the RTA dummy variable. This problem has been documented in many studies. Wonnacott and Lutz (1989) propose a "natural trading partner" hypothesis, which states that two countries tend to form an RTA if they already have significant international trade between them, and forming of an RTA will create additional trade. Magee (2003) considers the question of whether a higher level of trade flows will cause the formation of RTAs. Using a simultaneous model, he confirms the higher likelihood of forming RTAs due to high trade flow level. As formally addressed in Baier and Bergstrand (2007), trade policy is not an exogenous variable. RTAs could be one of the reasons for trade expansion. It is also plausible that there is tendency for countries to form more RTAs for further integration when their bilateral trade is already larger than with countries that have comparatively small trade flows. Baier and Bergstrand (2007) suggest the panel approach with different fixed effects: adding bilateral fixed and county-time effects yields almost a quintupled effect of RTA in the literature on trade flows, which means the existence of an RTA doubles the trade flow of both countries.

Along with the many challenges introduced by the endogeneity problem, the gravity model estimates of RTA effects are also sensitive to the sample size, sample selection for country pairs, types of RTAs, and the differences in the time periods. Cipollina and Salvatici (2010) cite multiple "implausible results" in their MATA study and find the evidence in the studies of RTAs using the gravity model to be sensitive. Haveman and Hummels (1998) show that changing the sample of countries results in a different predictions of trade flows, which results in very different RTA effects in their study. Additionally, Ghosh and Yamarik (2004) point out that the estimation results in the gravity model are very sensitive to the variables included in the regression and to the prior beliefs of the researchers.

The panel approach and time-series data bring up another question. Intuitively, the effects of an RTA are time-related, which makes it impossible to capture all the effects by the time the agreement enters into force. Are there phased-in effects of RTAs on trade flows and how can they be captured? Baier and Bergstrand (2007) use lagged terms of RTA to show that the effects of RTAs can be extended up to 10 years, with an overall 114% increase in the trade level. With a similar approach, Magee (2008) concludes that, on average, RTAs would affect trade for up to 11 years after the initial impact.

Most of the literature uses macro data on trade flows or measures trade costs derived from different theoretical models using observable trade data (Novy, 2011; Jacks, Meissner and Novy, 2007). We try to use micro price data in this study to obtain trade costs through the arbitrage condition. This strategy is commonly used in the literature, such as in the studies of D. Yilmazkuday and H. Yilmazkuday (2016), Eaton and Kortum (2002), and Simonovska and Waugh (2014). Due to the lack of a direct measurement, studies find an alternative way to measure trade costs through the retail price data. In Eaton and Kortum (2002), the model indicates that the relative trade shares of two trade partners is a product of the relative price and the geographic barriers, which are regulated by the elasticity θ (also known as the comparative advantage in the study). To obtain θ, they use the standard trade flows data, and proxy geographic barriers from country n to country i "d_{ni}" by the relative price. In detail, they assume that for any given commodity, the log term of the relative price in two locations is bounded above log "d_{ni}". They take the highest value of these relative price terms across commodities to obtain the measurement of log "d_{ni}". These trade costs capture much broader definitions, which include direct and indirect trade costs, the price to marking and potential preferences from the demand side. In D. Yilmazkuday and H. Yilmazkuday (2017), the authors obtain trade costs in a similar way, but the specification of trade costs in their study is more precise. Their definition of trade costs obtained through the arbitrage condition is narrowed by excluding the local distribution costs. The purpose of our study requires us to adopt the trade costs with the narrowed the definition.

Can we examine the phased-in effect of RTAs through micro-level disaggregated price data? We want to know the effects of RTAs on trade over time. With the standard approach, the exchange rate captures the short-run price volatility, and the trade costs contribute to the long-run price divergence, which causes most gravity model estimations to focus on the long-run effects rather than the short-run fluctuations. Would this short-run trade costs volatility caused by RTA statues change over time? By using micro-price data at the city level, this paper investigates the effects of the RTA variable on trade costs. With the advantage of the data set, prices of 39 goods recorded from 102 major cities in 58 countries are separated by non-traded goods (local retail cost) and traded goods (traded input price). The updated RTA dummy variables are incorporated with a group of gravity variables such as distance, common language and boarder, etc. from Reuven and Rose (2016). The entire time span is from 2010 to 2016. The methodology to determine trade costs is through the arbitrage condition by the measurement of the traded input price differential across cities (intranational and international). Our trade costs, calculated by traded input prices, cover the direct and indirect trade costs (duties/tariffs, transportation costs, information and language barriers) but do not include distribution costs at the destination. We examine the robustness of the existing conclusion of the negative effect of the RTA dummy variable on trade costs. We go one step further to investigate the phased-in effect of RTAs. We created a new variable to indicate the year after an RTA entered into force. The empirical model contains the log term of trade costs on the left-hand side, the RTA dummy variable, a time-related RTA variable, other gravity variables and a fixed effect for unobserved heterogeneity. We also consider the endogeneity problem of the gravity variable RTA with different robustness tests at the end as a comparison. As a conclusion, the random effects estimator has the most consistent and negative after-treatment effects for RTAs on trade costs. The after-treatment effects for the time-related RTA variable are inconsistent when we switch form the random effects estimator to different fixed effects estimators.

The rest of the paper is organized as follows. Section 2 presents the method for obtaining our trade costs, excluding the local distribution costs. Section 3 provides the empirical estimation methodologies with mixed random effects and fixed effects estimators, considering multilateral resistant terms or not. Section 4 summarizes the empirical results together with many robustness checks. Section 5 concludes.

2.2 Trade Costs Measurement and Specification

In this section, we present a specific way to determine the after-treatment effects of RTAs on trade costs by proxying trade costs in a novel way through micro-price data and the arbitrage condition. Most of the literature conducts a gravity study on trade by using the bilateral trade flows or trade flows with a specific direction as the independent variable. There are many reasons that the gravity studies on trade costs are limited. One of the main reasons is the easy access to the trade flows data from a wide range of goods and services categories, country selections and year spans. The other reason is that the trade costs data are difficult to acquire in practice. In most cases, the trade costs we can get from the existing data are very limited to specific time frames and selections[1], which would cause problems, especially when we are using panel data instead of long-run analysis with the cross-sectional data. The other concern is indirect (dark) costs. Head and Mayer (2013) point out that only 30% of the trade flow variations can be explained by observable trade costs data, such as transportation costs and duties/tariffs. Almost 70% of the variations of trade flows come from unobservable costs that consist of information barriers, consumers preferences and producers pricing to market, etc.

2.2.1 Trade-input Price Acquisition

Due to the limitation of the trade costs data, many existing studies use micro-level price data and the arbitrage condition as a measurement of trade costs[2]. This method to proxy trade costs has the advantage of covering the widest range of definitions of trade barriers from the observable (direct) costs, such as transportation costs and duties/tariffs, to the unobservable (indirect) costs[3], such as information costs, search costs, and potentially the preferences from the demand side. The difference in this paper is that the trade costs we use are international trade costs. This can distinguish the sources of the price differentials of two locations (in this paper, we analyze city pairs) from international barriers and local distribution costs. Crucini and Yilmazkuday (2014) suggest that we should distinguish retail prices in

[1]For example, we have the most detailed international trade data from USITC (http://dataweb.usitc.gov/), including the detailed information of the calculated duties, the costs of all freight, insurance, and other charges incurred. However, it only covers the data between trading partners of US. and US. itself.

[2]Andrews, Berry and Jia (2004), Andrews and Guggenberger (2009), Andrews and Soares (2010), Eaton and Kortum (2002), Ponomareva and Tamer (2011), Rosen (2008) and Simonovska and Waugh (2014).

[3]In Head and Mayer (2013), they describe the whole bundle of these unobservable trade barrier as "dark costs".

the data by both trade and non-traded input prices. Therefore, the trade costs we obtain through the arbitrage condition should only come from the trade-input prices rather than the non-traded inputs, where the latter is mainly treated as local distribution costs. The other reason that we use this specification of trade costs, excluding the local distribution costs, is that the purpose of this paper is to analyze the after treatment effects of RTAs, currency unions and other bilateral gravity variables. We do not want to add any elements of trade barriers outside of the costs occurring during crossing the boarders. Thus, the changes of local retailer/distribution costs are not affected by the after-treatment effects of RTAs, CUs and other gravity variables. To control the retail prices of traded goods from the local distribution costs, we follow the methodology in the studies to untangle the trade costs in this paper.

We know that the retail prices of traded goods reflect the optimum resources reallocation decisions among technologies, production inputs etc. Based on the model introduced in Crucini and Yilmazkuday (2014), the definition of the retail prices of any tradeable good is in a Cobb-Douglas form, as shown below:

$$P_{ij} = \frac{W_i^{\alpha_i} Q_{ij}^{1-\alpha_i}}{A_j} \tag{2.1}$$

where P_{ij} is the retail price of a traded good i in location j, W_i is the local wage or local input price in location i, Q_{ij} is the good specific trade-input price of good i in location j, A_j is a location specific total-factor-productivity in location j. In the model, α_i is good specific local wage input share for good i that is universal across all locations. The pattern obviously shows that the retail price of good i in location j increases whenever the total-factor-Productivity at location j A_j drops, and the local wage W_j, and traded-input price Q_{ij} increase.

Additionally, using the equation above, we can obtain the relative retail price of good i between location j and k as follows:

$$\frac{P_{ij}}{P_{ik}} = \frac{A_k}{A_j}\left(\frac{W_j}{W_k}\right)^{\alpha_i}\left(\frac{Q_{ij}}{Q_{ik}}\right)^{1-\alpha_i} \tag{2.2}$$

After linearizing equation (2.2) with logs, we have the following:

$$p_{ijk} = -a_{jk} + \alpha_i w_{jk} + (1-\alpha_i)q_{ijk} \tag{2.3}$$

where $p_{ijk} = log(P_{ij}/P_{ik})$,$a_{jk} = log(A_j/A_k)$,$w_{jk} = log(W_j/W_k)$, and $q_{ijk} = log(Q_{ij}/Q_{ik})$.

The relative retail price for a specific good p_{ijk} is available from the data, and the relative price of traded inputs q_{ijk} for a particular good is used to calculate the trade costs through the arbitrage condition. For the identification process of Q_{ijk}, we follow the two-stage approach to control for the local distribution/retail costs.

In line with Crucini and Yilmazkuday (2014), we use the geometric mean regression (GMR) in equation (2.3) with some modification in the retail prices and wage data , so the estimation take the following form:

$$\underbrace{p_{ijk}}_{Relative\ retail\ price} = \alpha_i \underbrace{w_{jk}}_{Wage} + \underbrace{\theta_{ijk}}_{Relative\ prices\ controlled\ for\ wages} \tag{2.4}$$

according to the model above, the residual term θ_{ijk} from the regression takes the form of $-a_{jk} + (1-\alpha_i)q_{ijk}$, which is the combination of the relative total-factor-productivities and the relative traded-input prices. The GMR estimator provides the consistent estimation of value α_i and the residual. To be precise, the wage in the model is assumed to be orthogonal to the trade-input prices and total-factor-productivities. Therefore, the effects of a_{jk} on relative retail prices are not correlated with the effects of wage w_{jk} on relative retail prices.

In the second stage of the estimation, we use the relative prices controlled for wages to estimate the following:

$$\underbrace{\theta_{ijk}}_{Relative\ prices\ controlled\ for\ wages} = \underbrace{-a_{jk}}_{Goods\ and\ source\ location\ fixed\ effects} + (1-\alpha_i) \underbrace{q_{ijk}}_{Relative\ traded-input\ prices}$$

where the fixed effects (total-factor-productivities) are also orthogonal to the relative trade-input prices. The last part of this equation (relative trade-input prices q_{ijk})) is the residuals term. After calculating the fitted value of the estimation, we obtain the residuals term $(1-\alpha_i)q_{ijk}$ as the value calculated and combine with the value of α_i obtained from stage one, and we can finally identify the relative traded-input prices term q_{ijk}.

2.2.2 Trade Costs Approximation

After we obtain the relative trade-input prices q_{ijk}, they are subject to the arbitrage condition for trade costs. We follow the strategy in Eaton and Kortum (2002) to approximate trade costs by using traded-input prices. To elaborate, the maximum traded-input price difference across goods between two locations bounds the trade costs.

Specifically, we observe the traded-input prices of good i across different locations. Since we do not know which location it is that the particular price is provided, We assume that the traded-input price of good i from location j relative to location k needs to satisfy the following:

$$\frac{Q_{ij}}{Q_{ik}} \leq \tau_{kj} \tag{2.5}$$

where τ_{kj} stand for the trade costs from location k to location j. That is to say, the relative traded-input price of good i must be less than or equal to the trade/arbitrage costs τ_{kj} from location k to location j. This inequality must hold. Otherwise, the case would be $Q_{ij} > \tau_{kj}Q_{ik}$, in which situation, a producer in location j could import this trade-input for good i at a lower price from location j, since the trade costs would not make up the price difference. Therefore, the inequality in equation (2.5) places a lower bound on the trade friction. We can rewrite the inequality in log term as follows:

$$q_{ijk} = q_{ij} - q_{ik} \leq log\tau_{kj} \tag{2.6}$$

This inequality will hold all the time as long as trade costs exist. Because the arbitrage can happen from any location to another location, and trade costs can be distinguished from different directions too, this bilateral inequality also holds for the potential arbitrage from location i to location k, as follows:

$$q_{ikj} = q_{ik} - q_{ij} \leq log\tau_{jk} \tag{2.7}$$

Since the trade costs are symmetric in the model, that is, $\tau_{kj} = \tau_{jk}$, the last two arbitrage conditions can be combined as follows:

$$|q_{ij} - q_{ik}| \leq log\tau_{jk} \tag{2.8}$$

We can see this bound is possible from both directions.

Improvements on this bound are possible if we observe a relatively large sample of L goods across locations. This follows by noting that the maximum relative price must satisfy the same inequality:

$$log\tau_{jk} = \max_{i \in L}\{|q_{ij} - q_{ik}|\} \tag{2.9}$$

notice the inequality becomes an equality when it is at the upper bound. This is the measurement that we use as trade costs in this paper. Here, τ_{jk} stands for the approximated value of trade costs, and L indicates the sample size of the trade-input prices.

As for the importance of defining trade costs, it is crucial to understand the difference in the trade costs in this paper from that in the literature. Our trade costs cover a wider range of costs than those studies using observable data, such as transportation costs, international boarder related costs, duties/tariffs etc. On the other hand, comparing it with the studies using a similar method to approximate trade costs, such as in Simonovska and Waugh (2014), their trade costs have a boarder definition due to the presence of local distribution/retail costs. Our trade costs cover all trade barriers incurred when crossing the border, such as transportation costs and policy related costs, excluding the local distribution/retail costs. Since our interest is to examine the after treatment of an RTA, CU and other gravity variables on international trade barriers, we prefer to use this definition of trade costs in the analysis.

2.3 Empirical Methodology

In the previous section, we obtained the trade costs through trade-input prices and arbitrage condition. The next step is to investigate the effect of RTA on trade costs. The gravity model and gravity equation are introduced first by Tinbergen (1962), and it is used prominently in international trade studies. Interestingly, Anderson and Wincoop (2003) address the concerns that how gravity variables approximate trade costs lack a theoretical foundation, despite the development of the gravity model itself. Most empirical studies use bilateral gravity variables, such as distance between locations, whether they share a common border and many other bilateral variables. Accordingly, we consider the following regression, as our main interest is to investigate the effect of RTAs on trade costs between city i and city j:

$$log\tau_{ijt} = \beta_0 + \beta_1\ rta_{ijt} + \beta_2\ RTA_{ijt} + \beta_3\ log\ d_{ij} + \beta_4\ b_{ij} + \sum_k \beta_{5+k}\ x^k_{ijt} + \varepsilon_{ijt} \quad (2.10)$$

where our dependent variable is the log term of the trade costs between two international locations i and j (we can obtain it by using the methodology in the previous section), rta_{ijt} is a dummy variable taking a value of 1 if the countries where two international cities i and k belong to are involved in any regional trade agreement. Notice that this dummy variable is time-related, since the panel data with time information[4] are given. RTA_{ijt} is a time-related variable that reflects the years of the RTA being formed, which is related to the previous rta_{ijt} dummy variable[5]. d_{ij} is the great circle distance in miles between city i and city j, which is time irrelevant. b_{ij} is also a dummy variable that takes a value of 1 when there is an international border between city i and city j; notice that it is also time-irrelevant. Finally, the vector x^k_{ijt} represents a set of other control variables which potentially can determine the trade costs, including the Currency Union (CU) dummy variable, time-related CU variable, and bilateral gravity variables, such as common language, colonial ties, colonial ties, etc.

One might be concerned about the problems with the equation above. The first obvious problem is the multilateral resistant terms. It is common to include both national incomes and price levels of source country and destination country in the

[4]The statue of two countries regarding RTA can change at any time available. For example, assume two international cities i and j that coming from two countries that were not involved in any RTA before 2013, but these two countries form an RTA in 2013. The value of the dummy variable $rta_{ij\ 2012}$ and all beyond year 2012 should be 0, and starting from year 2013, the dummy for rta_{ijt} should take the value 1.

[5]This time-related RTA variable takes value that is greater and equal to 0. For example, when two countries the international cities i and j belong to just form an RTA in year 2013, the time-related RTA variable $RTA_{ij\ 2013}$ takes the value of 0, and a year after that in 2014, the time-related RTA variable $RTA_{ij\ 2014}$ takes the value of 1. In summary, the value of RTA_{ijt} reflects the years an RTA has been formed or went through.

estimation, as follows:

$$\begin{aligned} log\tau_{ijt} = \beta_0 + \beta_1 \ log \ Y_{it} + \beta_2 \ log \ Y_{jt} + \beta_3 \ rta_{ijt} + \beta_4 \ RTA_{ijt} + \beta_5 \ log \ d_{ij} \\ + \beta_6 \ b_{ij} + \sum_k \beta_{6+k} \ x^k_{ijt} - log \ P^{1-\sigma}_{it} - log \ P^{1-\sigma}_{jt} + \varepsilon_{ijt} \end{aligned} \tag{2.11}$$

where the main differences are the added log terms of incomes and price indexes in city i and city j. All of these added variables controlling for multilateral resistant terms are time-varying. Consequently, the estimation results from equation (2.10) suffer from omitted variable bias due to the lack of time-varying terms. At the same time, since these city-specific income and price data are impossible to observe, we will instead use the city-time fixed effects to capture the time-varying and city specific characters. Therefore, we can rewrite the equation (2.11) as follows:

$$log\tau_{ijt} = \beta_0 + \beta_1 \ rta_{ijt} + \beta_2 \ RTA_{ijt} + \beta_3 \ log \ d_{ij} + \beta_4 \ b_{ij} + \sum_k \beta_{4+k} \ x^k_{ijt} + \alpha_{it} + \alpha_{jt} + \varepsilon_{ijt} \tag{2.12}$$

where α_{it} stands for city-time fixed effects of city i, and α_{jt} stands for city-time fixed effects of city j. Therefore, all the city-time specific characteristics can by captured at same time such as city incomes, price indexes, etc.

Santos Silva and Tenreyo (2006) point out several concerns when we estimate the equations above by ordinary least squares (OLS). They mention three major issues, the first of which is the heteroskedasticity problem. The error term is biased and correlated with the explanatory variables in the estimation. The second issue is that it cannot address the value of zero. Since the natural log term of zero is undefined, the city pairs with zero trade costs in between them in special cases have to be dropped or ignored. The third issue involves the concern of the exogeneity of the dependent and independent variables. They suggest that a Poisson quasi-maximum likelihood estimator of the gravity model provides consistent estimates of the parameters even with heteroskedasticity errors and solves all the issues mentioned above.

As a robustness check for the after-treatment effects of RTA, the biggest concern is the endogeneity problem following equations (2.10) or (2.12). Particularly, we need to address the omitted variables issue, since there is no way to list all the factors that could potentially affect trade costs. Another issue with the regressions so far is the correlation of independent variables. For example, we are interested in the after-treatment effects of RTAs on trade costs, so suppose that a city pair belongs to countries that share the same common language. Of course, intuitively, this strong cultural tie would lead to smaller trade costs between the city pair, and at the same time, it would be more likely for their countries to form an RTA. Therefore, the error term of the estimation is correlated with the RTAs and the common language dummy variable, and the coefficients estimated are biased.

We want to find a method to solve the issue mentioned above that captures all the time-irrelevant unobserved city-pair characteristics that would affect the trade costs, and this term should also not be correlated with the RTA variable that we mainly focus on. The bilateral-pair (city-pair) fixed effects seems to solve the issue; this added term would capture all the time-irrelevant city-pair-specific factors, such as all the bilateral gravity variables. Thus, we can rewrite equations (2.10) and (2.12) as follows:

$$log\tau_{ijt} = \beta_0 + \beta_1 \, rta_{ijt} + \beta_2 \, RTA_{ijt} + \sum_k \beta_{2+k} \, x^k_{ijt} + \underbrace{\alpha_{it} + \alpha_{jt}}_{Multilateral\ Resistant\ Terms} + \alpha_{ij} + \varepsilon_{ijt} \tag{2.13}$$

where α_{ij} stands for this bilateral pair fixed effects. Since this term captures all the time-irrelevant country pair features, all the city (country) pair -specific dummy variables, such as distance, common border, etc., are omitted. The vector x^k_{ijt} contains only the CU dummy variable and the time-related CU variables. They are both time-varying and are not omitted due to the fact that they still capture the time-sensitive characteristics that affect the trade costs.

There are many other ways to solve this endogeneity issue. To summarize, Baier and Bergstrand (2007) point out the modern solutions to address the endogeneity issue when we estimate the gravity model are to take advantage of the panel approach instead of cross-sectional data analysis, where studies use traditional methods. The instrumental-variable techniques and control-function techniques do not adjust for the endogeneity issue well, and they are subject to changes in data selection and sample sizes.

As mentioned, the bilateral city fixed effects should capture all the time-irrelevant unobserved bilateral pair characteristics. Many studies also use the first-differencing method. Wooldridge (2002) concludes that when the time periods in the panel data that are available exceeds two, the fixed-effects estimator is more efficient than the first-differencing estimator under the assumption that the error terms are serially uncorrelated. If the assumption changes the error term of the first-differenced estimation following a random walk, the first-differencing estimator is going to be more efficient. We consider the time-differencing estimator as our further robustness check considering the potential endogeneity issue. Therefore, we estimate as follows:

$$\begin{aligned} \triangle log\tau_{ij,t-(t-1)} &= \beta_0 + \beta_1 \triangle rta_{ij,t-(t-1)} + \beta_2 \triangle RTA_{ij,t-(t-1)} \\ &+ \underbrace{\alpha_{it} + \alpha_{jt}}_{Multilateral\ Resistant\ Terms} + \nu_{ij,t-(t-1)} \end{aligned} \tag{2.14}$$

where $\nu_{ij,t-(t-1)} = \varepsilon_{ijt} - \varepsilon_{ij,t-1}$ is white noise. Since this is a replacement of bilateral fixed effects approach, we do not have the bilateral fixed effects term α_{ij} in equation

(2.13). We consider both the scenarios with or without the multilateral resistant terms $(\alpha_{it} + \alpha_{jt})$.

2.4 Data

As mentioned in the previous sections, to obtain trade costs through the arbitrage condition, we need to have micro-level data available. Our price data come from Numbeo[6], which is the world's largest database for user contributed data about cities all around the world. Numbeo provides current and timely information on world living conditions, including cost of living, housing indicators, healthcare, traffic, crime and pollution. It allows for users to access the price database among its large city list. For the concern regarding the accuracy of the data, Numbeo uses several methodologies to counteract the drawbacks of the user self-contributed information. The first step is to check, pick up and drop the outliers among those data provided from online users. Second, one-quarter of the lowest and highest inputs are discarded as borderline cases. Finally, Numbeo uses heuristic technology that discards data that are most likely statistically incorrect.

The micro-price data set extracted from Numbeo includes 49 retail goods and their retail prices. We drop all the non-traded local goods due to the fact that local distribution costs are not considered in the scope of international arbitrage, and the prices of non-traded goods are not subject to arbitrage according to our trade costs specification. Therefore, in the calculation of trade cots, overall, we have 22 traded goods that are available to provide prices at the retail level. All the trade goods come from 512 cities (covering 56 countries) for the years between 2010 and 2016

[6]Numbeo has their customer interface through link: http://www.numbeo.com/

[7]. The 22 traded good prices are all available for 478 cities, so we pair every city with all other cities that have all the price data available in that particular year. Doing so results in the generation of 215,134 observations, overall, for city pairs that have price data available for all year spans. In all the city pairs, the number of international city pairs is 2,230 (116 city pairs are intranational pairs in which both cities are from the same country). Since all city pairs have data available for all the years from 2010 to 2016, this data set we created is balanced.

We use the model-implied traded input prices that were acquired from traded good prices data and wage data. Since the price data and wage data are all year-specific, we can get the short-run trade costs for city pairs in the year when price data are available. On average, the trade costs in between all the city pairs are approximately 1.39, while the trade costs between international city pairs are 1.44, on average, and 0.74 for intranational city pairs. These measurements of trade costs are significantly smaller compared to the literature. The well-defined ad-valorem equivalent (ice-berg) trade costs in Eaton and Kortum (2002) are approximately 1.90, and they are approximately 1.70 in Anderson and Wincoop (2004). As mentioned above, the definition of our trade costs is slightly different from the literature. First, the trade costs we obtained are at the city level instead of the country level, as most of the studies use. Second, the trade costs in the literature do not control for retail/local distribution costs, but to serve the purpose of our interests, they are calculated without considering the retail costs.

Other gravity variables are collected during the same time from Reuven and Rose (2016). For the bilateral-specific gravity variables, we exploit the World Factbook from the CIA for a number of country-specific variables, such as island status, language, and colonizers. We create the dummy variables, such as "border", which

[7]See the complete goods list in Table section below.

indicate whether two countries have an international border; "colony", which determines whether two countries were ever in a colonial relationship; "comlang", which shows whether two countries share the same common language; and "island", which is a three way dummy variable that takes the values of 0/1/2, which indicates if either (neither or both) country in the pair is (are) an island country (countries). However, these bilateral variables are all at the country level, and our trade costs are at the city level. Since the international trade from international cities does not account for local distribution costs, all the effects of these country-level bilateral gravity variables capture these effects on trade costs. Finally, we obtain distances in the measurement of miles between city pairs through the latitude and longitude acquired through the Google Map API.

2.5 Empirical Results

2.5.1 Benchmark Case

The benchmark regressions using OLS and the random effects estimator are given in Table 2.1. Column 1 uses only binary dummy variables for regional trade agreements and currency unions to explain trade costs. When two nations have an RTA, the trade costs between two cities in each country decreased by 27.6%. When we include all the control variables to avoid any omitted variable bias, as shown in column 4, the existence of an RTA between two countries reduces the trade costs between two cities from those two countries by 12.3%. This result is smaller compared to 23% in D. Yilmazkuday and H. Yilmazkuday (2016), who include an RTA dummy in their random effects regression of the trade costs on direct fly between cities. However, their study focuses on the analysis of long-run effects by calculating the average trade costs through the entire time period. It smooths out the volatility and hides the details that come from our trade costs calculated on yearly bases. Accordingly, the trade costs used in our study are time-related, which means that the trade costs calculated in our study give a unique number every year, instead of taking the mean of all the values across the whole year span. Currency union also affects trade costs negatively and significantly. Specifically, according to the estimation in column 1, when two countries are in a currency union, the trade costs between two cities in each country will decrease on average by 33% compared with other cities, and after adding other control variables, according to column 4, the effect of having a currency union dropped the trade costs from 33% to 52.9%.

After adding the time-related RTA and currency union variables to the binary dummies without other control variables, as the case shown in column 3, the existence of an RTA reduces the trade costs by 12.3% immediately, and the phased-in effect reduces the trade costs by 1.29% each year after the RTA is introduced. On the other hand, even though the currency union has a significant and negative effect on trade costs instantly, it has the phased-out effect to cause the trade costs to increase 2.48% each year after two countries join a currency union. This finding means that even though a currency union causes a decrease in the trade costs between two cities, it will offset the effect by causing the trade costs to rise to the original level in approximately 15 years. Similarly, for the RTA, the initial impact and phased-in effect on trade costs diminished when all the control variables are included. In column 6, it shows that the RTA has a negative impact on trade costs immediately after the forming of the RTA (coefficient of -12.3%), and the phased-in effect is 0.815% each year after the initial impact of the RTA. Currency union, on the other hand, causes the trade costs to decrease by 52.9% immediately but increase by approximately 3% each year after. The phased-out effect of the currency union is still prominent.

In addition to RTAs and currency union, having a common border between the countries where two cities are located also has a negative influence on trade costs. Specifically, a common border reduces the trade costs by 49.3%. A colonial relationship between two countries reduces the trade costs of city pairs by approximately 34.6%. However, if the city pairs are in countries that share a common language, the trade costs increase by 8.78%. This result contradicts our prediction. If there is only one city in a city pair categorized as an island country, the trade costs are reduced by 7.5%. As the dummy variable for landlocked and island indicators takes 3 values (0/1/2), the case of both cities belong to two island countries will reduce the trade costs by almost 15%. Finally, the effect of distance on trade costs is negative but insignificant, according to column 6, where we include all the control variables. However, in the model in column 5 without RTA and currency union dummies, the distance affects trade costs positively and significantly. This result causes concern regarding the nonlinearity of distance effects, which we will also discuss more in the following subsection.

2.5.2 Robustness Checks

Nonlinearity in Distance Measures

Up to this point, we have evaluated the distance effects using the log term of the distances between cities. Now, we consider nonlinearities in the effects of distance on trade costs. The results are given in Table 2.2. For all the estimations, we include the four most important variables we are focusing on (RTA dummy, CU dummy, time-related RTA variable and time-related CU variable) and all other time-irrelevant control variables. Column 1 replicates column 6 in Table 2.1, with consideration of all the control variables and the random estimator. The second column considers an extra log distance squared variable. The third column includes five distance-interval dummy variables in the replacement of the log distance variable in the first column. Each distance interval represents a 20 percentile of the distance between cities, compared to all the distances in the data.[8] As the results show, in column 2, the coefficient of the log distance square is negative and significant. The coefficient of the log distance is positive and significant. This indicates the potential nonlinearity in the distance effect on trade costs. Column 4 also supports this assumption by presenting different and significant coefficients of different distance interval dummies. Therefore, this provides evidence for nonlinearity in distance effects on trade costs. We can also observe that the treatment effects of the RTA dummy and time-related variable are both negative and significant in random-effect estimators. From column 4 to column 6, we consider the nonlinearity of distance effects with city fixed effects. Column 4 shows that a longer distance between two cities causes higher trade costs. Column 5 yields similar results compared with column 2. Specifically, the coefficient of the log distance square is negative and significant. The coefficients of all distance intervals in column 6 are significant and different from each other. Therefore, we can conclude that there is strong evidence of nonlinearity in the effect of distance on trade costs. For the RTA effects on trade costs, which we mainly focus on, we still observe a negative and significant immediate impact and phased-in effect.

Endogeneity of RTA and CU

In the early gravity studies, the drawback of the cross-sectional data is not able to explain the unobserved time-invariant heterogeneity or provide estimations of enough treatment effects to solve the endogeneity problem. In our study, this

[8]A city pair's distance can only allocated in one of the five distance intervals, and the dummy for that interval has the value equals 1

concern is the multilateral resistant term in the gravity model. Ghosh and Yamarik (2004) address the issue of the insignificance of the effects of RTAs on either trade or trade costs by using cross-sectional data and extreme-bounds analysis to test the robustness of the RTA dummy coefficients. The results show that the effects of most RTAs on trade are not reliable. Instead, Baier and Bergstrand (2007) suggest using the panel approach combined with fixed effects. We combine city and time fixed effects in our analysis to eliminate the unobserved city-time-related heterogeneity.

In addition to the unobserved city-time related heterogeneity, there are more concerns regarding the endogeneity bias in estimating the treatment effects on the RTA dummy. Since the RTA dummy is possibly correlated with the unobserved variables and even potentially has the causality problem with trade costs (LHS variable), the literature has begun using the panel approach to solve the issue. The earliest literature, such as Magee (2003) and Baier and Bergstrand (2002), uses IV or control-function techniques to solve the issue. Later, Baier and Bergstrand (2004) demonstrate the after-treatment effects of the gravity model using IV, or control-function techniques are unstable and lead to fragile conclusions. Baier and Bergstrand (2007) take a step forward to include bilateral fixed effects (country-pair fixed effects) and the first difference method to eliminate the endogeneity problem of the RTA dummy. This requires balanced panel data with all the years' data available for the city pairs.[9] Thereafter, we also include city-pair fixed effects in our estimations.

First, we only include bilateral fixed effects (city-pair fixed effects) to the random effects estimator without considering the multilateral resistant terms in Table 2.3.

[9]Next step is for us to analyze RTA effects with the alternative way beside of fixed effects estimators, such as using first difference, city-pair fixed effects, and considering time lag effects of RTA dummy.

Due to the fact that there are unobserved time-invariant heterogeneity, we can not capture in the regression besides the distance, border, common language, colonial ties, etc., bilateral fixed effects is used in literature, such as Cheng and Wall (2005), Tomz, Goldenstein and Rivers (2007), and Magee (2008). They all conduct similar studies using panel data to estimate the effects of RTA on trade flow. Column 1 to column 3 use the OLS estimator. The results are consistent with the after treatment effects on CU dummy, time-related RTA and CU variables. Accordingly, after considering the city-pair fixed effects, having an RTA causes city pairs to have an overall 120% decrease in trade costs compared to the city pairs belong to countries without an RTA at the point when the RTA forms. Every year after that, the RTA reduce trad costs by approximately 34%. These results are amplified compared with the analysis in Table 1. However, it is still aligned with the finding in literature. For example, Magee (2008) confirms that the cumulative RTA effect on trade is 1.01, which means having an RTA dubble the trade volume between two countries. On the other hand, the after treatment effect on CU dummy remains negative on trade costs, a 128% drop of the trade costs on average if city pairs belong to countries that join in a CU. The effect of the time-related CU variable is small and insignificant.

From column 4 to column 6, we introduce the PQML estimator with city-pair fixed effects as comparison. The results turn out to be consistent with the OLS estimator. However, the magnitude of the immediate impact and phased-in effect are smaller. For the after-treatment effect of the RTA, city pairs belonging to countries in an RTA have 41.3% less trade costs, on average, by the time the RTA is introduced, and every year after that, the RTA will reduce the trade costs by 12.1%. Similarly, there are significant after-treatment effects of CUs. City pairs belong to countries in a currency union have 26% less trade costs than those city pairs that do not belong to a currency union by the time the CU is introduced.

However, there is no significant effect of currency unions on trade costs every year thereafter. Regarding the sensitivity of the RTA after treatment effects, we can see minor differences when we switch the estimator from OLS to PQML. The signs for the two dummy variables and the two time-related variables remain the same. The coefficients are considerably smaller in the PQML estimator compared with the OLS estimator.

Table 2.4 investigates the bilateral fixed effects in the case of considering the multilateral resistant terms. Therefore, the entire estimation includes city-time fixed effects (the multilateral resistant terms) and city-pair fixed effects (bilateral fixed effect). Similarly, the first three columns present the OLS estimator and columns 4 to 6 preset the results using the PQML estimator. Comparing the OLS and PQML horizontally, the signs in front of the significant coefficients do not change, and the values are consistent with minor differences, which again examine the insensitivity of the after treatment effects of the RTA and CU in regard to OLS and PQML. Comparing Table 2.4 with Table 2.3, we still see consistency regarding the signs and values of the coefficients. For CU, considering the multilateral resistant terms (city-time fixed effects) in Table 2.4, the initial impact of CUs on trade costs decreases from -127.7% to -103.8% in OLS and from -26% to insignificant in PQML; the time-related CU variable does not have a significant effect on trade costs for both cases. Large changes come from the after-treatment effects on RTA, considering that the multilateral resistant terms push down the initial impact of the RTA on trade costs from -120% to -54.3% with OLS and -41.3% to -20.6% with PQML. It also decreases the after-treatment effects of the time-related RTA variable on trade costs from -34% to -5.5% in OLS and -12.1% to -2.59% in PQML.

Table 2.5 provides another method to address the endogeneity issue. We expect the first-differencing method to more accurately describe the after treatment effects of the RTA and CU or at least to evaluate the robustness of the bilateral pair fixed effects estimator, since both are aimed to solve the issue of potential omitted variables bias created by time-irrelevant city-pair specific barriers. We also consider the multilateral resistant terms (time-related multilateral price terms) by using city-time fixed effects. Columns 1, 4 and 7 investigate the concurrent changes in RTAs and CUs with only the first-differencing of the RTA and CU dummy variables and the time-related variables. As a comparison to Table 2.4, in columns 1 to 3 with the OLS estimator, the first-differencing method should be consistent with using the bilateral fixed effects. The after-treatment effects of the RTA and CU maintain the same signs as the RTA dummy, which has a positive effect on trade costs, while the CU dummy has a negative effect. Changing from not being in an RTA to joining in an RTA, on average, increases the change of trade costs by 8.59%. Because the first-differencing allows for all other constant time-irrelevant factors to remove the impact themselves, the 8.59% increase in trade costs is due to the joining in an RTA. For the bilateral fixed effects method, the after-treatment effects of an RTA are 11.3%. The results are also consistent when comparing the after-treatment effects of a CU and the first-differencing method. An 18.3% decrease of trade costs, on average, is due to the formation of a CU with the first-differencing method, and the after-treatment effect is 14% in regard to using the bilateral fixed effects method. For the first-differenced time-related variables, the coefficients of both RTA and CU are insignificant compared to the bilateral fixed effects method, where we have a time-related RTA variable that is significant but small. In columns 2, 5 and 8, we include an extra second-differencing lag term for both the RTA and CU dummies and time-related variables. The purpose of using second-differencing is to examine the phased-in (time) effect along with our time-related variables. In this sense, in the model of column 8, the second-differencing of the RTA and CU dummies should have the mirror effects of the first-differencing time-related RTA and CU variables. We can observe the mirror effects from columns 2 and 5, where the coefficient in front of the second-differenced RTA dummy is 0.037, and the coefficient in front of the first-differenced RTA time-related variable is -0.040. They are both significant, and the difference between them is negligible. Then, regarding CUs, the coefficient in front of the second-differenced CU dummy and the first-differenced CU time-related variable are also similar to each other with the values of 0.0725 and 0.0752, even though one of them is insignificant. The other evidence comes from column 8. The second-differenced CU dummy and the second-differenced time-related RTA variable are omitted in this model due to the collinearity problem, which means that these two variables can be linearly explained by the other two variables in the model (the first-differenced time-related CU variable and the first-differenced RTA dummy). We also include the future-change terms for both the RTA and CU dummies and the time-related variables in columns 3, 6 and 9. This method is used to detect the exogeneity of the explaining variable to the independent variable. As we can see, due to the insignificant coefficients in front of all the CU future change terms, the future change in the status of CU has no significant effect on trade costs, which indicates that trade costs are not the reason for the future change in the status of CUs. On the other hand, the future change of the RTA dummy and time-related RTA variable all have significant impacts on the change of trade costs. Recall the results from Table 4 with the bilateral fixed effects and the case considering the multilateral resistant terms, having an RTA means that, on average, city pairs have larger trade costs between them, and the phased-in effect has a negative impact on trade costs after joining in the RTA throughout the years. This high level of trade costs might be the reason to form the RTA. Again, due to the collinearity issue, both the first-differenced and the second-differenced RTA and CU dummies are all omitted from the estimation. Only the first-differenced time-related RTA has a significant impact on trade costs after adding the future change terms.

Finally, as a further robustness check for the phased-in effect of the time-related variables in Table 2.6, we estimate the lag terms of the RTA and CU dummies as the replacement of the time-related RTA and CU variables. We test the lag form of one period to five periods and one future period in the end. Considering the case with both bilateral fixed effects and the multilateral resistant terms, we revisit the case in which only concurrent RTA and CU dummies are considered. On average, there are more trade costs between city pairs that belong to countries that have an RTA, and there are less trade costs in regard to CUs. Since there are examples in the EEC agreement of 1958 or NAFTA, they were all examined in the literature to have phased-in effects in which the after-treatment effect typically affects trade costs over the time span of approximately 10 years. Therefore, we included five-year lags as a replacement for the time-related RTA and CU variables and a future term to address the strict exogeneity problem. We notice that the lag terms for both RTA and CU are not stable and possibly have nonlinearity issues. The lag 1 terms of RTA in different models all have negative coefficients as expected. Within those, only the model including 1 lag term variable is significant. When we look at the lag 2 terms for all RTA variables, they show a significant positive impact on trade costs, as a sign for nonlinearity. Lag 3 terms only have one positive significant estimation. Lag 4 terms have one negative significant estimation. Lag 5 terms and future terms are all insignificant. It is similar in regard to CUs. Most lag terms are insignificant or omitted due to the collinearity problem. This result of CUs is consistent with the results shown in Table 8 with the time-related variable, in which the phased-in effects of CU are unclear. In the end, the insignificant future terms of both RTA and CU suggest the exogeneity of these two variables against the independent variable (trade costs) because it shows the future terms of RTA and CU are uncorrelated with the trade costs with the coefficient in front of the future terms of RTA and CU being -0.007 and 0.03, small and insignificantly different from zero.

2.6 Conclusion

There are multiple complications in regard to examining the effects of regional trade agreements on trade costs. The complications come from determining the appropriate methodology for measuring the trade costs to forming the empirical estimations with different estimators for robustness. There are no direct observable trade costs that are available that cover not only direct costs, such as transportation costs and duties/tariffs, but also indirect costs, such as information barriers and time costs. It is difficult to establish the argument regarding RTA effects where RTAs and trade costs can possibly affect each other in both directions. The impact of RTAs on trade costs can vary across different sample selections and in different RTAs; the after-treatment effects of an RTA can be effective throughout time rather than being immediate. The trade costs in this paper accurately portray the requirement for describing international trade impediments, excluding the local distribution costs. The estimations in this paper utilize different methodologies to account for different considerations, including multilateral resistant terms, time-irrelevant bilateral characteristics and time-related effects on trade costs.

As shown in the previous section, the after-treatment effects of RTAs on trade costs are sensitive to many factors. Overall, the effects of RTAs on trade costs tend to be negative, which means having an RTA will decrease trade costs on average. The results are consistent in the benchmark analysis and with multiple robustness checks considering the city-time fixed effects estimator (multilateral resistant terms) and city-pair fixed effects (time-irrelevant bilateral characteristics). When we add more related gravity variables into the estimations, the negative impacts of RTAs remain significant. Moreover, the effects of the standard gravity variables on trade costs are consistent with the literature.

The estimations also reveal more interesting results when we included a time-related RTA variable. Specifically, in both the benchmark analysis and the robustness checks, this new added variable has a negative impact on trade costs, which means that the trade costs keep decreasing throughout time after the RTAs has been introduced. These phased-in effects of RTAs have been caught in all random and fixed effects estimators, which confirms the results found in the literature, such as Baier and Bergstrand (2007) and Magee (2003), that RTAs will continue to effect trade for almost a decade after the trade deal begins. Finally, the results indicate that it is still a puzzle as to how we can explain the causality of forming RTAs and trade costs reduction. The study shows mixed results regarding the exogeneity of the RTA dummy variable. With positive effects on trade costs when forming an RTA one period in the future, this study suggests that relatively higher trade costs could be related to the forming of an RTA. There are numerous questions in this area that need answers, and it is interesting to see more disaggregate analysis regarding different specific RTAs and what caused these phased-in effects for different RTAs.

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Table 2.1: Benchmark Estimation Results for Trade Costs

	Dependent Variable: Log Trade Costs					
	(1)	(2)	(3)	(4)	(5)	(6)
RTA	-0.276***		-0.123***	-0.196***		-0.123***
	(0.00907)		(0.0122)	(0.0110)		(0.0128)
CU	-0.330***		-0.447***	-0.321***		-0.529***
	(0.0363)		(0.0669)	(0.0356)		(0.0657)
Time-related RTA		-0.0177***	-0.0129***		-0.0117***	-0.00815***
		(0.000513)	(0.000693)		(0.000636)	(0.000737)
Time-related CU		-0.0115**	0.0248***		-0.0122***	0.0302***
		(0.00363)	(0.00665)		(0.00356)	(0.00651)
Common Border				-0.545***	-0.458***	-0.493***
				(0.0207)	(0.0213)	(0.0213)
Common Colony				-0.336***	-0.335***	-0.346***
				(0.0266)	(0.0267)	(0.0265)
Common Language				0.0787***	0.0817***	0.0878***
				(0.00914)	(0.00917)	(0.00914)
Island				-0.0761***	-0.0916***	-0.0750***
				(0.00985)	(0.00971)	(0.00981)
Log Distance				0.00986	0.0237***	-0.00625
				(0.00681)	(0.00649)	(0.00694)
_cons	1.411***	1.392***	1.411***	1.332***	1.197***	1.468***
	(0.00463)	(0.00426)	(0.00458)	(0.0581)	(0.0547)	(0.0592)
Sample Sizes	15610	15610	15610	15610	15610	15610
R-squared	0.069	0.079	0.089	0.124	0.121	0.131
Adjusted R-squared	0.069	0.079	0.089	0.123	0.121	0.130
F-value	576.1	672.3	380.9	314.4	307.8	261.1

Notes: The dependent variable is the natural logarithm of trade costs. The estimation method is OLS. All models use random fixed effects. Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 2.2: Estimation Results for Trade Costs: Nonlinearities in Distance Measures

	Dependent Variable: Log Trade Costs					
	(1)	(2)	(3)	(4)	(5)	(6)
RTA	-0.123***	-0.123***	-0.150***	-0.0465***	-0.0495***	-0.0373**
	(0.0128)	(0.0127)	(0.0132)	(0.0116)	(0.0117)	(0.0118)
CU	-0.529***	-0.537***	-0.561***	-0.116*	-0.122*	-0.112*
	(0.0657)	(0.0656)	(0.0658)	(0.0545)	(0.0545)	(0.0542)
Time-related RTA	-0.00815***	-0.00787***	-0.00873***	-0.00835***	-0.00810***	-0.00885***
	(0.000737)	(0.000737)	(0.000733)	(0.000650)	(0.000652)	(0.000645)
Time-related CU	0.0302***	0.0310***	0.0321***	0.0108*	0.0116*	0.0120*
	(0.00651)	(0.00650)	(0.00651)	(0.00535)	(0.00535)	(0.00530)
Common Border	-0.493***	-0.469***	-0.522***	-0.211***	-0.198***	-0.248***
	(0.0213)	(0.0216)	(0.0213)	(0.0197)	(0.0200)	(0.0191)
Common Colony	-0.346***	-0.344***	-0.360***	-0.187***	-0.191***	-0.148***
	(0.0265)	(0.0265)	(0.0267)	(0.0283)	(0.0283)	(0.0286)
Common Language	0.0878***	0.0880***	0.0970***	-0.159***	-0.151***	-0.165***
	(0.00914)	(0.00913)	(0.00914)	(0.0123)	(0.0125)	(0.0127)
Island	-0.0750***	-0.0606***	-0.0614***	-0.467***	-0.462***	-0.483***
	(0.00981)	(0.0100)	(0.00983)	(0.0671)	(0.0670)	(0.0665)
Log Distance	-0.00625	0.487***		0.0230**	0.296***	
	(0.00694)	(0.0725)		(0.00727)	(0.0621)	
Log Distance Squared		-0.0316***			-0.0175***	
		(0.00463)			(0.00395)	
Log Distance Interval #1			0.0978***			0.0887***
			(0.0164)			(0.0153)
Log Distance Interval #2			0.0501***			0.0359**
			(0.0130)			(0.0116)
Log Distance Interval #3			0.0151			0.153***
			(0.0128)			(0.0109)
Log Distance Interval #4			0.0119			0.160***
			(0.0124)			(0.0108)
Log Distance Interval #5			0			0
			(.)			(.)
_cons	1.468***	-0.428	1.386***	1.146***	0.102	1.208***
	(0.0592)	(0.284)	(0.0106)	(0.153)	(0.281)	(0.142)
City Fixed Effects	No	No	No	Yes	Yes	Yes
Sample size	15610	15610	15610	15610	15610	15610
R-squared	0.131	0.134	0.133	0.463	0.463	0.474
Adjusted R-squared	0.130	0.133	0.133	0.458	0.459	0.469
F-value	261.1	240.4	200.2	93.84	93.43	96.24

Notes: The dependent variable is the natural logarithm of trade costs. The estimation method is OLS. log Distance Intervals refer to the first to fifth 20th percentile of the log distance measures. Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 2.3: Estimation Results for Trade Costs: City-pair Fixed Effects

	Dependent Variable: Log Trade Costs					
	OLS	OLS	OLS	PQML	PQML	PQML
RTA	-1.748***		-1.198***	-0.613***		-0.413***
	(0.204)		(0.203)	(0.0493)		(0.0487)
CU	-2.355***		-1.277*	-0.651***		-0.260*
	(0.590)		(0.594)	(0.113)		(0.129)
Time-related RTA		-0.357***	-0.339***		-0.127***	-0.121***
		(0.0179)	(0.0181)		(0.00524)	(0.00540)
Time-related CU		0.0665	0.0818		0.0107	0.0160
		(0.0847)	(0.0858)		(0.0174)	(0.0216)
_cons	3.576***	4.256***	4.537***			
	(0.0590)	(0.0614)	(0.0773)			
City-pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	15354	15354	15354	15354	15354	15354
R-squared	0.007	0.030	0.033			
Adjusted R-squared	-0.162	-0.135	-0.131			
F-value	44.85	204.9	112.5			

Notes: The dependent variable is the natural logarithm of trade costs. The estimation method in column 1-3 is OLS. The estimation method in column 4-6 is PQML (quasi-maximum likelihood estimation). Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 2.4: Estimation Results for Trade Costs: City-time and City-pair Fixed Effects

	Dependent Variable: Log Trade Costs					
	OLS	OLS	OLS	PQML	PQML	PQML
RTA	-0.586***		-0.543***	-0.231***		-0.206***
	(0.184)		(0.185)	(0.0489)		(0.0489)
CU	-1.078**		-1.038*	-0.202		-0.144
	(0.527)		(0.537)	(0.126)		(0.130)
Time-related RTA		-0.0612***	-0.0547***		-0.0282***	-0.0259***
		(0.0190)	(0.0190)		(0.00557)	(0.00560)
Time-related CU		0.0598	0.0780		0.00505	0.00874
		(0.0764)	(0.0776)		(0.0139)	(0.0157)
_cons	5.496***	5.488***	5.617***			
	(0.0648)	(0.0649)	(0.0779)			
City-time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
City-pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Sizes	15354	15354	15354	15354	15354	15354
R-squared	0.210	0.210	0.211			
Adjusted R-squared	0.075	0.075	0.076			
F-value	436.1	435.5	349.9			

Notes: The dependent variable is the natural logarithm of trade costs. The estimation method in column 1-3 is OLS. The estimation method in column 4-6 is PQML (quasi-maximum likelihood estimation). Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 2.5: Estimation Results for Trade Costs: A Time-differenced Approach with City-time Fixed Effects

	Log Trade Costs - First Differenced								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
dRTA	-0.555**	-0.465*	-0.630**				-0.541^{+}		
	(0.278)	(0.275)	(0.283)				(0.279)		
dCU	-1.659**	-0.889	-0.943				-1.652*		
	(0.741)	(0.932)	(0.953)				(0.743)		
ddRTA		0.369	0.181						
		(0.229)	(0.246)						
ddCU		1.267**	2.832***					3.750***	3.750**
		(0.635)	(0.883)					(1.296)	(1.296)
fRTA			-0.691**						
			(0.322)						
fCU			-1.166						
			(0.953)						
dTime-related RTA				0.0413	0.400*	0.806**	0.0393	0.806**	0.806**
				(0.0602)	(0.229)	(0.359)	(0.0605)	(0.359)	(0.359)
dTime-related CU				0.220	1.287**	3.750***	0.197		
				(0.235)	(0.637)	(1.296)	(0.235)		
ddTime-related RTA					-0.379	-0.154		-0.154	-0.154
					(0.232)	(0.249)		(0.249)	(0.249)
ddTime-related CU					-1.156*	-2.798***		0.951	0.951
					(0.664)	(0.908)		(0.981)	(0.981)
fTime-related RTA						-0.549^{+}		-0.549^{+}	-0.549^{+}
						(0.283)		(0.283)	(0.283)
fTime-related CU						-0.958		-0.958	-0.958
						(0.954)		(0.954)	(0.954)
_cons	-0.800	-1.089	-0.465	-0.839	-1.110	0.339	-0.838	0.339	0.339
	(1.076)	(1.007)	(1.146)	(1.078)	(1.008)	(1.148)	(1.078)	(1.148)	(1.148)
City-time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes			
Sample Size	13070	11093	8863	13070	11093	8863	13070	8863	8863
R-squared	0.120	0.074	0.085	0.119	0.074	0.084	0.120	0.084	0.084
Adjusted R-squared	0.110	0.062	0.070	0.110	0.062	0.069	0.110	0.069	0.069
F-value	12.46	6.205	5.636	12.40	6.181	5.609	12.30	5.609	5.609

Notes: The dependent variable is the natural logarithm of trade costs difference from period t to $t+1$. The estimation method is OLS. Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 2.6: Phased-in Estimation Results for Trade Costs: with City-time and City-pair Fixed Effects

	Dependent Variable: Log Trade Costs					
	(1)	(2)	(3)	(4)	(5)	(6)
RTA	-0.374***	-0.599***	-0.918***	-0.888***	-1.276**	-1.089***
	(0.0435)	(0.190)	(0.214)	(0.247)	(0.558)	(0.472)
CU	-0.397**	-0.484	-0.436	-0.424	-0.371	-0.245
	(0.174)	(0.536)	(0.744)	(0.745)	(0.756)	(0.640)
RTAlag1		0.220	0.155	0.242	0.274	0.335
		(0.192)	(0.278)	(0.325)	(0.611)	(0.524)
CUlag1		0.309	0.925	-0.0159	-0.0159	0.211
		(0.556)	(0.898)	(1.052)	(1.067)	(0.870)
RTAlag2			0.420*	0.303	0.864**	0.840***
			(0.182)	(0.283)	(0.339)	(0.303)
CUlag2			-0.726	3.850***	0.227	
			(0.530)	(1.013)	(1.029)	
RTAlag3				-0.0149	-0.183	0.447
				(0.190)	(0.299)	(0.299)
CUlag3				-3.764***		
				(0.712)		
RTAlag4					-0.150	-0.944***
					(0.197)	(0.229)
CUlag4					-0.293	-0.694
					(0.731)	(0.634)
RTA forward1						-0.313
						(0.554)
CU forward1						0.213
						(0.640)
_cons	3.175***	2.829***	2.685***	2.687***	2.749***	2.562***
	(0.0224)	(0.0196)	(0.0203)	(0.0228)	(0.0267)	(0.0277)
City-time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
City-pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	15354	13323	11150	8920	6690	4460
R-squared	0.006	0.009	0.010	0.013	0.016	0.021
Adjusted R-squared	0.006	0.008	0.009	0.012	0.015	0.019
F-value	44.76	28.62	18.81	14.43	12.40	9.711

Notes: The dependent variable is the natural logarithm of trade costs. The estimation method is OLS. Standard errors, clustered at the city level, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

CHAPTER 3

GRAVITY CHANNELS IN TRADE

3.1 Introduction

Since the seminal studies of Ravenstein (1889) and Tinbergen (1962), a wide range of studies have utilized a gravity model to explain international trade and migration activities. The literature uses gravity variables to explain bilateral characteristics between two countries, such as distance, a common language, a common border, colonial ties, and regional trade agreements. The theoretical framework of the gravity model builds on studies such as Anderson (1979) and Anderson and van Wincoop (2003) within the context of homogeneous firms. In recent years, studies have focused on building a gravity model within the heterogeneous firms framework (Eaton and Kortum, 2002; Chaney, 2008; Arkolakis et al.,2012; Arkolakis et al., 2015). Arkolakis et al. (2010) conclude that even though theories use different frameworks, the estimated gravity equation can be expressed in a log-linear format, where log trade enters as the dependent variable, and source and destination country-specific effects and gravity variables explaining the trade costs enter as the independent variables.

Specific studies also use gravity variables as a direct approach to proxy trade costs instead of trade flows. Eaton and Kortum (2002) and Yilmazkuday (2012) introduce gravity variables, especially distance, to explain trade costs (mainly transportation costs). In a study regarding measuring trade costs with gravity variables, Dovy (2011) includes a complete list of the gravity variables mentioned in the literature, such as distance, colonial ties, common boarders, common languages, regional trade agreements, and currency unions.

A survey study by Anderson and van Wincoop (2004) puts together the results and implications of current studies based on the effects of gravity variables on trade. According to their investigation, the tax equivalent of international trade costs is approximately 74 percent, including transportation costs of approximately 12 percent, language barrier costs of approximately 7 percent, and duties/tariffs of approximately 3 percent (for the U.S.), among others, such as information or security barriers.

The economic models in these surveys imply that gravity variables explain trade volume through trade costs, mostly corresponding to the difference between source and destination prices. Home bias or the preferences of consumers can affect trade volume, too. However, the standard assumption for the demand-side preferences in the structural models are homogeneous. Anderson (2011), Anderson and Van Wincoop (2004) both mention this problem, suggesting that these gravity variables may also capture the consumer preferences in the destination country. In particular, as Anderson (2011) writes,

> "In practice it is very difficult to distinguish demand-side home bias from the effect of trade costs, since the proxies used in the literature (common language, former colonial ties, or internal trade dummies, etc.) plausibly pick up both demand and cost differences. Henceforth trade cost is used without qualification but is understood to potentially reflect demand-side home bias."

Anderson (2011) mainly emphasizes the difficulty of distinguishing between the effects of preferences and trade costs on international trade when gravity variables are employed in the gravity model.

In recent studies, gravity variables are mainly used as proxies for both direct and indirect trade costs. The former costs refer to measurable costs, such as transportation costs and duties/tariffs. The latter costs correspond to abstract/dark costs such as information barriers, language barriers, and search costs. Although the existing literature has used these gravity variables extensively, there are insufficient attempts to decompose the overall gravity effects on trade (across time and space) through the channels of direct and indirect trade costs. This is mostly due to data limitations concerning trade costs, especially indirect ones.

By constructing a simple demand-side model, we differentiate the effects of gravity variables on preferences and trade costs. Including both duties/tariffs and transportation costs while excluding local distribution costs, the trade costs of U.S. imports are defined as the difference between source and destination prices. Having data about trade costs directly allows us to calculate the effects of gravity variables on the measured data that we have.

To demonstrate the contribution of this paper in a clear manner, we consider two types of preferences. The first type of preferences is assigned to be random (we call it the case of ”random preferences”), which is mostly the case in the literature, as we show in detail below. Based on these random preferences, the model implies that gravity variables only capture the effects of measured trade costs (i.e., duties/tariffs and transportation costs), as in a typical gravity regression. A post-estimation decomposition further shows that approximately one third of the effects on international trade (of gravity variables) are through the channel of duties/tariffs, whereas the rest are through the channel of transportation costs.

Another type of preferences that we consider depends on gravity variables (we call it the case of ”dyadic preferences”), which correspond to the quote by Anderson (2011) above. Based on dyadic preferences, the model implies that gravity variables not only capture the effects of measured trade costs (duties/tariffs and transportation costs) but also those of preferences in a typical gravity regression. A post-estimation decomposition further shows that virtually all the effects of gravity variables on U.S. imports are due to preferences, whereas the effects through duties/tariffs and transportation costs are very small. Therefore, it is essential to consider the effects of gravity variables on preferences.

When considering the specific contribution of each gravity variable to each gravity channel, we find that distance is the dominant gravity variable for the channels of duties/tariffs and transportation costs with random preferences. However, for the channel of dyadic preferences, which captures virtually all the effects of gravity variables on U.S. imports, having a common border contributes approximately 45.12%, followed by distance (approximately 32.23%), colonial relationships (approximately 13.98%), free trade agreements (FTAs; approximately 6.91%), and language (approximately 1.76%).

Finally, we also investigate the contribution of each given gravity variable through alternative gravity channels. In the case of random variables, the effects of distance, common borders, colonial relationships, and common language are shown to be mostly through transportation costs, whereas the effects of FTAs are through duties/tariffs. In the case of dyadic preferences, however, all gravity variables are shown to be effective through the channel of dyadic preferences rather than duties/tariffs or transportation costs.

As a conclusion, the effects of gravity variables on trade can be both through measured trade costs (of duties/tariffs or transportation costs) and dyadic preferences. Accordingly, when dyadic preferences are ignored, as in the existing literature, we show that the effects of gravity variables on trade are mostly through transportation costs, except for the effects of regional trade agreements that are through duties/tariffs (as predicted). When we consider dyadic preferences, however, we show that the effects of gravity variables on trade are now through the preferences that dominate the channels of duties/tariffs and transportation costs. Since all destination-price effects are already captured by the available data in this study, it is implied that gravity variables mostly work as demand shifters rather than supply shifters, as implied by the existing literature. This is important from a policy perspective because policy tools such as duties/tariffs or investment on transportation technologies are implied as simply not enough to have any impact on trade; it is rather globalization itself that should be promoted to shift the preferences of destination countries toward partner country products. Therefore, the consideration of dyadic preferences is essential to understand the effect of gravity effects on trade.

In summary, the overall effects of gravity variables on trade are mostly shown to be through dyadic preferences rather than the measured trade costs of transportation costs or duties/tariffs. This additional channel of dyadic preferences has not been given sufficient importance in the existing literature, mostly due to the lack of available data on the subject. Thanks to the detailed data on U.S. imports and the corresponding measured trade costs, this paper identifies the effects of each gravity channel by using the implications of a simple model, which is introduced next.

The rest of the paper is organized as follows. Section 2 introduces a simple trade model. The subsection distinguishes the implications of the model for trade in the case of random taste parameters and in the case of dyadic preferences. Section 3 introduces the data and the corresponding descriptive statistics. Section describes the results of the analysis. The subsections depict the estimation results by carefully connecting the effects of gravity variables on trade, and conduct two types of variance decomposition analyses. Section 5 concludes.

3.2 The Model and Empirical Methodology

We model the imports of the U.S. at the good level considering the optimization problems of individuals in the U.S. and the firms in the source countries.

3.2.1 Individuals and Firms

The individual in the U.S. maximizes the utility of a composite index of goods at time t:

$$C_t \equiv \prod \left(C_t^j\right)^{\gamma_t^j} \tag{3.1}$$

where C_t^j represents the composite index of the varieties of good j at time t given by:

$$C_t^j \equiv \left(\sum_i \left(\theta_{t,i}^j\right)^{\frac{1}{\eta_t}} \left(C_{t,i}^j\right)^{\frac{\eta_t - 1}{\eta_t}} \right)^{\frac{\eta_t}{\eta_t - 1}} \tag{3.2}$$

where $C_{t,i}^j$ is the variety i of good j imported from source country i; $\eta_t > 1$ is the elasticity of substitution across varieties; γ_t^j and $\theta_{t,i}^j$ are taste parameters.

The optimal allocation of any given expenditure within each variety of goods yields the following demand functions:

$$C_{t,i}^j = \theta_{t,i}^j \left(\frac{P_{t,i}^j}{P_t^j} \right)^{-\eta_t} C_t^j \tag{3.3}$$

and

$$P_t^j C_t^j = \gamma_t^j P_t C_t \tag{3.4}$$

where

$$P_t^j \equiv \left(\sum_i \theta_{t,i}^j \left(P_{t,i}^j\right)^{1-\eta_t} \right)^{\frac{1}{1-\eta_t}} \tag{3.5}$$

is the price index of good j (which is composed of the prices of different varieties), and

$$P_t \equiv \prod_j \left(\frac{P_t^j}{\gamma_t^j} \right)^{\gamma_t^j} \tag{3.6}$$

is the cost of living index (which is composed of the prices of different goods) at time t. The previous four equations imply that the total value of imports at time t in terms of good j can be written as follows:

$$P_t^j C_t^j = \sum_i P_{t,i}^j C_{t,i}^j \tag{3.7}$$

and the total expenditure at time t for all goods can be written as follows:

$$P_t C_t = \sum_j P_t^j C_t^j$$

The unique firm in source country i specialized in the production of good j maximizes its profits by producing variety i of good j to be exported to the U.S. according to the following profit maximization problem using its pricing to market strategy:

$$\max_{P_{t,i}^j} Y_{t,i}^j \left[P_{t,i}^j - Z_{t,i}^j\right]$$

subject to

$$Y_{t,i}^j = C_{t,i}^j$$

where $Y_{t,i}^j$ is the level of output, and $Z_{t,i}^j$ is the marginal cost of production that is given by:

$$Z_{t,i}^j = \frac{W_{t,i}\tau_{t,i}^j}{A_t^j}$$

where $W_{t,i}$ represents the time and source-country specific input costs, A_t^j is time and good specific productivity, and $\tau_{t,i}^j$ representing trade costs between the source country i and the U.S. for good j at time t is further given by:

$$\tau_{t,i}^j = \tau_{t,i}^{j,D} \tau_{t,i}^{j,T} \tag{3.8}$$

where $\tau_{t,i}^{j,D}$ represents trade costs of duties/tariffs, and $\tau_{t,i}^{j,T}$ represents transportation costs.

The first order condition for the profit maximization problem implies that:

$$P_{t,i}^{j} = \left(\frac{\eta_t}{\eta_t - 1}\right) Z_{t,i}^{j} \tag{3.9}$$

where $\frac{\eta_t}{\eta_t-1}$ represents (gross) markups. The source prices (excluding trade costs) $P_{t,i}^{j*}$ are implied as follows:

$$P_{t,i}^{j*} = \frac{P_{t,i}^{j}}{\tau_{t,i}^{j}} = \left(\frac{\eta_t}{\eta_t - 1}\right) \frac{W_{t,i}}{A_t^{j}} \tag{3.10}$$

3.2.2 Implications for Trade: The Case of Random Taste Parameters

According to Equation (3.3), the value of U.S. imports is implied as follows:

$$M_{t,i}^{j} = P_{t,i}^{j} C_{t,i}^{j} = P_{t,i}^{j} \theta_{t,i}^{j} \left(\frac{P_{t,i}^{j}}{P_t^{j}}\right)^{-\eta_t} C_t^{j} \tag{3.11}$$

which can be estimated in its log format according to:

$$\underbrace{\log M_{t,i}^{j}}_{\text{Trade Data}} = (1-\eta_t) \underbrace{\left(\log P_{t,i}^{j}\right)}_{\text{Destination-Price Data}} + \underbrace{\log\left(C_t^{j}\left(P_t^{j}\right)^{\eta_t}\right)}_{\text{Time and Good Fixed Effects}} + \underbrace{\log \theta_{t,i}^{j}}_{\text{Taste Parameters as Residuals}} \tag{3.12}$$

where (log) taste parameters $\log \theta_{t,i}^{j}$ are assumed to be i.i.d. random variables, and thus they are considered as the residuals. Considering the definition of destination prices $P_{t,i}^{j} = P_{t,i}^{j*} \tau_{t,i}^{j,D} \tau_{t,i}^{j,T}$ due to Equations (3.8) and (3.9), this expression can be rewritten as follows:

$$\begin{aligned}\underbrace{\log M_{t,i}^{j}}_{\text{Trade Data}} = (1-\eta_t) &\underbrace{\left(\log P_{t,i}^{j*} + \log \tau_{t,i}^{j,D} + \log \tau_{t,i}^{j,T}\right)}_{\text{Destination Prices}} + \underbrace{\log\left(C_t^{j}\left(P_t^{j}\right)^{\eta_t}\right)}_{\text{Time and Good Fixed Effects}} \\ &+ \underbrace{\log \theta_{t,i}^{j}}_{\text{Taste Parameters as Residuals}}\end{aligned} \tag{3.13}$$

where source prices $P_{t,i}^{j*}$, together with trade costs of $\tau_{t,i}^{j,D}$ and $\tau_{t,i}^{j,T}$, are simultaneously determined in equilibrium. Accordingly, following Zellner and Theil (1962), we employ the estimation methodology of Three-Stage Least Squares (3SLS) that simultaneously estimates Equation (3.13) (under the restriction that $\log P_{t,i}^{j*}$, $\log \tau_{t,i}^{j,D}$ and $\log \tau_{t,i}^{j,T}$ have the same coefficient of $1-\eta_t$ representing *trade elasticity*) together with the following three expressions representing source prices $P_{t,i}^{j*}$, trade costs due to duties/tariffs $\tau_{t,i}^{j,D}$, and transportation costs $\tau_{t,i}^{j,T}$, respectively:

$$\log P_{t,i}^{j*} = \underbrace{\log\left(\frac{\eta_t}{\eta_t - 1}\right)}_{\text{Time Fixed Effects}} + \underbrace{\log W_{t,i}}_{\text{Time and Source-Country Fixed Effects}} - \underbrace{\log A_t^j}_{\text{Time and Good Fixed Effects}} + \underbrace{v_{t,i}^{j,P}}_{\text{Residuals}}$$

and

$$\log \tau_{t,i}^{j,D} = \delta_t^{j,D} + G_{t,i}^D + v_{t,i}^{j,D} \tag{3.14}$$

and

$$\log \tau_{t,i}^{j,T} = \delta_t^{j,T} + G_{t,i}^T + v_{t,i}^{j,T} \tag{3.15}$$

where $\delta_t^{j,A}$ (for $A \in \{D,T\}$) represents time and good fixed effects, $v_{t,i}^{j,D}$ and $v_{t,i}^{j,T}$ represent the random components (as residuals), and $G_{t,i}^A$ (for $A \in \{D,T\}$) represents the effects of basic gravity variables according to the following specification:

$$G_{t,i}^A = d_{t,i} + bo_{t,i} + la_{t,i} + co_{t,i} + fta_{t,i} \tag{3.16}$$

where $d_{t,i}$ is the effect of (log) distance between the source country i and the U.S., $bo_{t,i}$ is the effect of sharing a land border (i.e., adjacency), $la_{t,i}$ is the effect of sharing a language, $co_{t,i}$ is the effect of any colonial relationship, and $fta_{t,i}$ is the effect of country i and the U.S. having a free trade agreement. It is important to emphasize that the gravity variables that we consider have time-varying effects as suggested by Bergstrand et al. (2015) who have shown that ignoring the changes in gravity variables over time may lead into biased estimates.

In order to see the effects of gravity variables on trade in a better way, once the estimation is achieved, we can rewrite the fitted value of Equation (3.13) as follows:

$$\log \widehat{M}_{t,i}^j = \widehat{G}_{t,i} + (1-\eta_t)\left(\log \widehat{P}_{t,i}^{j*} + \widehat{\delta}_t^{j,D} + \widehat{\delta}_t^{j,T}\right) + \log\left(\widehat{C_t^j \left(P_t^j\right)^{\eta_t}}\right) + \widehat{\delta}_t^{j,U}$$

where $\widehat{G}_{t,i}$ represents the combined fitted effects of gravity variables according to:

$$\widehat{G}_{t,i} = (1 - \eta_t) \left(\widehat{G}^D_{t,i} + \widehat{G}^T_{t,i} \right) \tag{3.17}$$

which can easily be decomposed into effects due to duties/tariffs and transportation costs, as we will achieve below.

3.2.3 Implications for Trade: The Case of Dyadic Taste Parameters

If (log) taste parameters are not just i.i.d. random variables (as in Equation (3.13)) but also functions of gravity variables (i.e., if they are dyadic), they can be written as follows:

$$\log \theta^j_{t,i} = \delta^{j,U}_t + G^U_{t,i} + v^{j,U}_{t,i} \tag{3.18}$$

where $\delta^{j,U}_t$ represents time and good fixed effects, $G^U_{t,i}$ represents the effects of very same gravity variables (as described in Equation (3.16)) on taste parameters, and $v^{j,U}_{t,i}$ represents the i.i.d. random component of taste parameters. When this expression is substituted into Equation (3.13), we can obtain:

$$\begin{aligned} \log M^j_{t,i} \quad = \quad & (1 - \eta_t) \underbrace{\left(\log P^{j*}_{t,i} + \log \widehat{\tau}^{j,D}_{t,i} + \log \widehat{\tau}^{j,T}_{t,i} \right)}_{\text{Destination Prices}} + \underbrace{\log \left(C^j_t \left(P^j_t \right)^{\eta_t} \right) + \delta^{j,U}_t}_{\text{Time and Good Fixed Effects}} \\ & + \underbrace{G^U_{t,i}}_{\text{Taste Parameters as Gravity Variables}} + \underbrace{v^{j,U}_{t,i}}_{\text{Residuals}} \end{aligned} \tag{3.19}$$

which can be estimated with the same methodology introduced above. Compared to Equation (3.13) that considers gravity variables affecting trade through duties/tariffs $\tau^{j,D}_{t,i}$'s and transportation costs $\tau^{j,T}_{t,i}$'s, Equation (3.19) is a more general framework where gravity variables can affect trade also through taste parameters $\theta^j_{t,i}$'s. Therefore, it is very useful to investigate the channels through which gravity variables affect trade.

In order to see the effects of gravity variables on trade in a better way, we can rewrite the fitted value of this expression as follows:

$$\log \widehat{M}_{t,i}^{j} = \widehat{G}_{t,i} + (1-\eta_t)\left(\log \widehat{P}_{t,i}^{j*} + \widehat{\delta}_t^{j,D} + \widehat{\delta}_t^{j,T}\right) + \log\left(\widehat{C_t^j \left(P_t^j\right)^{\eta_t}}\right) + \widehat{\delta}_t^{j,U}$$

where $\widehat{G}_{t,i}$ again represents the combined fitted effects of gravity variables, this time according to:

$$\widehat{G}_{t,i} = (1-\eta_t)\left(\widehat{G}_{t,i}^{D} + \widehat{G}_{t,i}^{T}\right) + G_{t,i}^{U} \tag{3.20}$$

which can also be decomposed into effects due to duties/tariffs, transportation costs, and taste parameters, as we show in details, below.

3.3 Data

The U.S. import data is derived from the U.S. International Trade Commission.[1] The data covers 224 countries at the SITC 4-digit good level for the period from 1996 to 2013. The detailed variables include the following: (1) customs value (defined as the total price actually paid or payable for merchandise, excluding U.S. import duties, freight, insurance, and other charges),(2) unit of quantity, (3) calculated duties in values (i.e., the estimated duties are calculated based on the applicable rates of duty as shown in the Harmonized Tariff Schedule), and (4) import charges (i.e., the aggregate cost of all freight, insurance, and other charges incurred, excluding U.S. import duties).

Total trade costs are decomposed into duty/tariff costs and transportation costs; ad valorem duties/tariffs are calculated by dividing the calculated duties by the cus-

[1] *https://dataweb.usitc.gov/*

toms value, whereas ad valorem transportation costs are calculated by dividing the general import charges by the customs value. Import prices (measured at the source) are calculated by dividing the customs value by the quantity traded. Ignoring missing observations, the remaining data set constitutes 425,812 observations, consisting of 822 goods and 177 countries between 1996 and 2013.

We combine the trade data set with the gravity variable data borrowed from Glick and Rose (2016). In particular, Glick and Rose (2016) obtain data regarding distance, common borders, colonial relationships and common languages from the CIA's World Factbook, whereas they obtain data about regional/free trade agreements (FTAs) from the World Trade Organization. It is important to emphasize that the data about FTAs change across years, also; e.g., the dummy variable of FTA takes a value of one after the U.S. starts having an FTA with Australia in 2005, whereas the same dummy takes a value of zero before 2005.

Before continuing with the estimation results, we would like to provide some descriptive statistics about the combined version of our data sets. The effects of distance are shown in Figure 3.1, where we distinguish between distant and nearby countries. As is evident, the shares of U.S. imports are pretty much the same, and they are stable over time. However, the duties/tariffs decrease significantly over time for both nearby and distant countries. Although transportation costs have also been steady up until 2010 or so, they have decreased in recent years, for both nearby and distant countries.

The effects of having a land border are shown in Figure 3.2, where they also represent the North American Free Trade Agreement (NAFTA) countries (i.e., Canada and Mexico) for the U.S. Although the shares of trade are stable over time, both duties and transportation costs have been reduced, for both NAFTA countries (for which such trade costs were already low in 1996) and other trade partners (for which the reduction in percentage terms has been greater). Having a colonial relationship does not seem to have a large impact on U.S. imports due to the low trade shares, as shown in Figure 3.3, where both duties/tariffs and transportation costs follow similar patterns across the trade partners over time.

FTAs of the U.S. correspond to higher shares of trade over time according to Figure 3.4, where both duties/tariffs and transportation costs have increased between the U.S. and its FTA partner countries. Although such trends may seem puzzling, there is nothing interesting about them, since they are mostly due to new FTAs established in the early 2000s. Since the new FTA partner countries are either far away (e.g., Singapore and Australia) or initially have high duties/tariffs, we observe such increasing trends in trade costs starting from early 2000s.

Finally, as shown in Figure 3.5, the U.S. has imported relatively less over time from the countries with which it shares a language. Although there is evidence for decreasing duties/tariffs, independent of having a common language, duties/tariffs has always been lower in magnitude for the countries that share a language with the U.S. during our sample period. There is no significant effect of sharing a language on transportation costs, however.

3.4 Estimation Results

This section interprets the estimation results of our model using a 3SLS estimator. We mainly focus on the effects of trade elasticity of the gravity variables: common borders, common languages, colonial ties, free trade agreements, and (log) distance. Each gravity variable will consider the cases in both random and dyadic preferences. We depict the estimation results in figures to show their pattern over time. Thereafter, we also connect the estimation results to the relevant discussions in the existing literature. Finally, the gravity channel decomposition is provided for both random and dyadic preferences.

3.4.1 Trade Elasticity of the Gravity Variables

As one of the most important gravity variables in gravity studies, distance and distance elasticity are discussed first. The estimations for the coefficient of log distance are available for the regressions based on log duties/tariffs (as shown in Equation (3.14)) and log transportation costs (as shown in Equation (3.15)) for the case of random variables, whereas they are also available for the regressions based on preferences (as shown in Equation (3.18)) for the case of dyadic preferences. The coefficient estimates over the years are given in Figure 3.6, with the corresponding details. Specifically, for both cases of random and dyadic preferences, the effects of distance on transportation costs and duties/tariffs are consistent with the expectations based on their positive signs (since trade costs are expected to increase with distance) and magnitude; e.g., the average distance elasticity of observed trade costs, which is about 0.005, corresponds to distance effects on trade of approximately 7% ($\approx 1000^{0.005\times 2}$) for a distance of approximately one thousand miles (when multiplied by a trade elasticity of about 2), which is consistent with our expectations based on the actual data on duties/tariffs and transportation costs. Moreover, we consider the estimations for the distance elasticity of dyadic preferences in Figure 3.6. As is evident, after controlling for distance effects due to duties/tariffs and transportation costs, the effects of distance on trade due to preferences is positive during the 1990s, which is against most of the studies in the literature using distance as a proxy for such observed trade costs. However, this result is consistent with some other studies in the literature such as by Yilmazkuday (2016b) who also focus on the effects of distance through the preference of consumers toward exotic products coming from distant countries. The distance elasticity estimates become mostly insignificant over time (starting from 2005), potentially due to free trade agreements such as NAFTA showing its effects (gradually starting from 1994) when the U.S. might have started importing more products from nearby NAFTA countries. And the comparative trade volume to other remote countries outside NAFTA become insignificant in the estimation.

For the U.S., the effects of having a common border can also be considered as investigating the pure effects of NAFTA over time. The coefficient estimates of having a common border are given in Figure 3.7, where we again distinguish between the two cases of preferences. Independent of the preference type, as is evident, the effects of having a common border on transportation costs are significant and negative starting from the early 2000s, suggesting that transportation costs have become cheaper over the years, potentially due to the introduction of NAFTA back in 1994 after which transportation networks might have improved (as consistent with studies such as by Woudsma, 1999, and Hesse and Rodrigue, 2004). In terms of the magnitude, since we have log transportation costs on the estimated Equation (3.15), the average coefficient of about -0.05 corresponds to the U.S. having about 5% lower transportation costs with NAFTA countries compared to other trade partners, after controlling for all other factors. Moreover, there is evidence for decreasing common-border effects on duties/tariffs with NAFTA countries until 2004 (after which the effects become insignificant). This is exactly what one would expect due to the details of NAFTA that eliminate duties/tariffs starting in 1994 and continuing for ten years (with a few tariffs continuing to 15 years) as discussed by many studies (e.g., Romalis, 2007, and Hakobyan and McLaren, 2016). Regarding the magnitude of the effects, NAFTA has reduced duties/tariffs from about 3% to nothing during our sample period. The effects through dyadic preferences dominate one more time in terms of their magnitude (compared to the effects on observed trade costs) in Figure 7. As is evident, the U.S. has strengthened its already-existing preference toward NAFTA products over time, even after controlling for all other factors (captured by other gravity variables). In particular, back in 1996, the U.S. used to have a preference for NAFTA products by about 2, which has increased to about 2.5 over the years. Regarding the intuition of these numbers, they suggest that the U.S. has imported about double the amount of products coming from NAFTA countries compared to other trade partners, after controlling for all other factors. This result, which can be called *adjacency bias* or *common-border bias*, acts just like the *home-bias* in trade as discussed in several studies such as by Obstfeld and Rogoff (2001) as a puzzle that has been shown to be solved by considering the existence of trade costs. Compared to these studies, this paper shows that such trade costs mostly manifest through dyadic preferences (rather than transportation costs or duties/tariffs) when one considers the broader definition of trade costs by Anderson and van Wincoop (2004), which we introduced above.

Strong historical trade ties are important to understand the reasons behind certain trade patterns (see Anderson and van Wincoop, 2004). The empirical literature based on gravity studies has attempted to capture such effects partly by considering the historical colonial relationships between countries. As we show in Figure 8, the effects of having a colonial relationship on transportation costs and duties/tariffs are considered stable over time, although there are some evidences for increasing trade costs. It is implied that trade costs between the U.S. and the countries with which it has historical ties have increased compared to the trade costs between the U.S. and other trade partners. Nevertheless, the essential part of the picture appears when the effects of having a colonial relationship on dyadic preferences are investigated.

In particular, such effects were captured by a coefficient of 1.98 back in 1996, and this coefficient has decreased to 1.24 in 2012, suggesting that, after controlling for other factors, the U.S. has preferred importing more from countries with which it has historical colonial relationships with. However, these effects have been reduced significantly in recent years. In other words, after controlling for all other factors, colonial ties have lost some of their importance for U.S. imports.

Although we covered the effects of NAFTA above, the U.S. has regional/free trade agreements (FTAs) with 20 different countries in total. From a policy perspective, it is essential to understand the pure effects of these FTAs to shape the future global trade policy of the U.S. Since we have only one dummy variable for FTAs in our regressions (as standard in empirical gravity studies), the results here should be considered as the effects of FTAs on average across trade partners of the U.S. The estimation results presented in Figure 9 for transportation costs and duties/tariffs mostly reflect the descriptive statistics regarding FTAs (shown in Figure 3.4). In particular, since the U.S. started having FTAs in the early 2000s with either distant countries (e.g., Singapore and Australia) or FTA partner countries that initially had high duties/tariffs, the effects of having an FTA on both transportation costs and duties/tariffs started increasing in the early 2000s. Our results in Figure 3.9 also show that the effects of FTAs on transportation costs and duties/tariffs are almost entirely the mirror image of the results on common-border (NAFTA) effects (in Figure 3.3) along the horizontal axis. Therefore, while transportation costs and duties/tariffs have decreased over time between the U.S. and Canada and between the U.S. and Mexico in relative terms, the same measured trade costs have increased over time between the U.S. and other trade partners with FTAs, again in relative terms. This result implies that NAFTA has dominated all other FTAs due to its effect of decreasing both transportation costs and duties/tariffs. When we consider the dyadic preferences of the U.S. for products coming from FTA partner countries, it is evident that such preferences have been weakened dramatically during our sample period. This is again the mirror image of the results regarding the effects of NAFTA along the horizontal axis, suggesting that NAFTA has dominated all other FTAs not only due to its reducing impact on measured trade costs but also due to the shifts that it has created in the U.S. imports demand through preferences (e.g., adjacency bias or common-border bias).

Having a common language can facilitate communication between trade partners by reducing language barriers for trade. Our corresponding results are given in Figure 3.10, where the effects of language are stable over time. While having a common language coincides with slightly positive (and sometimes insignificant) effects on transportation costs, it coincides with negative and significant effects on duties/tariffs. Therefore, having a common language reduces trade costs mostly through duties/tariffs rather than transportation costs, where negotiation of tariff rates might have been affected historically or recently through FTAs. In terms of the magnitude, the higher effects of having a common language appear again when we consider the effects on dyadic preferences of the U.S. In particular, after controlling for all other factors, the U.S. has preferred importing relatively more products from the countries that it shares a language with, and these effects are fairly stable over time, as also shown in Figure 3.6.

3.4.2 Decomposition of Gravity Channels

Although we covered the magnitude of the effects through each gravity variable in the previous section, we did not discuss the sources of variation across channels, in particular, among the three gravity channels, namely, duties/tariffs (DC), transportation-costs (TC), and dyadic-preferences (PC). Which gravity channel contributes most to the overall effects of gravity variables on trade? What is the contribution of each gravity variable to a given gravity channel? What is the contribution of each gravity channel for a given gravity variable? We attempt to answer these questions by employing variance decomposition analyses across time and space (i.e., by pooling all source countries and years) and also by distinguishing between the cases of random and dyadic preferences.

Random Preferences

In the case of random preferences, we start with investigating the contribution of each gravity channel to the overall effects of gravity variables on trade. We achieve this through a variance decomposition analysis by taking the covariance of both sides in Equation (3.17) (i.e., the fitted values of estimated gravity effects) with respect to the left hand side variable of $\widehat{G}_{t,i}$ as follows:

$$cov\left(\widehat{G}_{t,i},\widehat{G}_{t,i}\right) = cov\left((1-\eta_t)\,\widehat{G}^{D}_{t,i},\widehat{G}_{t,i}\right) + cov\left((1-\eta_t)\,\widehat{G}^{T}_{t,i},\widehat{G}_{t,i}\right)$$

which can be rewritten in percentage terms as follows by using $cov\left(\widehat{G}_{t,i},\widehat{G}_{t,i}\right) = var\left(\widehat{G}_{t,i}\right)$:

$$100\% = \underbrace{\frac{cov\left((1-\eta_t)\,\widehat{G}^{D}_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}}_{\text{Gravity Effects (\%) through Duties/Tariffs (DC)}} + \underbrace{\frac{cov\left((1-\eta_t)\,\widehat{G}^{T}_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}}_{\text{Gravity Effects (\%) through Transportation Costs (TC)}}$$

where $cov(\cdot)$ and $var(\cdot)$ are the operators of covariance and variance, respectively, and all variables are pooled across source countries i and time t. The corresponding results are given in Table 1, where duties/tariffs contribute about 30.55%, whereas transportation costs contribute about 69.45% to the overall effects of gravity variables on trade. Therefore, when we ignore dyadic preferences, gravity variables are mostly effective through transportation costs rather than duties/tariffs.

Next, we investigate the contribution of each gravity variable to these gravity channels (in the absence of dyadic preferences). Such results, which are also reported in Table 3.1, are obtained by using the very same variance decomposition analysis, this time by considering the fitted values of all gravity variables within each gravity channel. As is evident, distance is the dominant gravity variable for both duties/tariffs and transportation costs; the contributions of other variables are relatively insignificant, except for the (expected) contribution of FTAs to duties/tariffs, which is approximately 7.19%.

In the case of random preferences, we also investigate the contribution of each given gravity variable through alternative gravity channels; the corresponding results are reported in Table 3.2. As is evident, the effects of distance, common borders, colonial relationships, and common languages are mostly through transportation costs, whereas only the effects of FTAs are through duties/tariffs.

Next, we investigate whether these results hold in the case of dyadic preferences, also.

Dyadic Preferences

In the case of dyadic preferences, for the purpose of investigating the contribution of each gravity channel to the overall effects of gravity variables on trade, we perform a variance decomposition analysis by using the very same methodology as above to obtain the following :

$$100\% = \underbrace{\frac{cov\left((1-\eta_t)\,\widehat{G}^D_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}}_{\text{Gravity Effects (\%) through Duties/Tariffs}} + \underbrace{\frac{cov\left((1-\eta_t)\,\widehat{G}^T_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}}_{\text{Gravity Effects (\%) through Transportation Costs}} + \underbrace{\frac{cov\left(G^U_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}}_{\text{Gravity Effects (\%) through Preferences}}$$

The corresponding results are given in Table 3.1, where the channel of *dyadic-preferences* dominate the other two channels. Therefore, we can safely claim that almost all gravity effects on trade are through the channel of *dyadic-preferences*, which is introduced in this paper, rather than the standard channels of duties/tariffs or transportation costs.

When we investigate the contribution of each gravity variable to each of these gravity channels, we observe that distance is again the dominant gravity variable due to its contribution to duties/tariffs and transportation costs. Nevertheless, the situation differs for the contribution of each gravity variable on the additional channel of dyadic preferences, where having a common border contributes most (approximately 45.12%), followed by distance (approximately 32.23%), colonial relationships (approximately 13.98%), FTAs (approximately 6.91%), and language (approximately 1.76%). Therefore, the channel of dyadic-preferences is the dominant gravity channel on trade, with (common) borders contributing most to it.

When we investigate the contribution of each given gravity variable through alternative gravity channels, the corresponding results are also presented in Table 3.2. As is evident, all gravity variables are effective through the channel of dyadic preferences rather than duties/tariffs or transportation costs.

In summary, if one ignores the existence of dyadic preferences, s/he may easily think that the effects of gravity variables are through the measured trade costs; however, as we show in this paper, the consideration of dyadic preferences dramatically changes the decomposition of gravity effects into their components.

3.5 Conclusions

Gravity variables such as distance, common borders, colonial ties, free trade agreements, and language have been extensively used in empirical studies to capture the effects of trade costs. By using actual data on transportation costs and duties/tariffs obtained from U.S. imports, this paper decomposes the overall effects of gravity variables on trade through three gravity channels: duties/tariffs (DC), transportation-costs (TC), and dyadic preferences (PC). When PC is ignored, as is typical in the literature, we show that nearly all gravity effects are due to distance, in which 29 percent are through DC and 71 percent through TC. However, the additional channel of PC is introduced and shown to dominate other channels, with common borders contributing approximately 45 percent, distance approximately 32 percent, colonial ties approximately percent, free trade agreements approximately 7 percent, and common language approximately 2 percent.

The results are robust to the specification of trade costs (e.g., multiplicative versus additive trade costs) since we use actual data on transportation costs and duties/tariffs to construct multiplicative trade costs. The results are also robust to the consideration of any local distribution costs (that are shown to account for approximately half of overall trade costs in Anderson and van Wincoop, 2004), since we already use trade data measured at both the source and destination docks. Accordingly, whenever we proxy dyadic preferences by gravity variables in our regressions, it is implied that they capture all other indirect costs of trade, such as time to ship (as in Hummels and Schaur, 2013), search costs (as in Rauch, 1999), and information barriers (as in Portes and Rey, 2005), although the source-country related costs (such as contracting costs as in Evans, (2001) or insecurity as in Anderson and Marcouiller, (2002)) are supposedly captured through data on source prices.

Significant policy implications follow. In particular, policy tools such as duties/tariffs or investment in transportation technologies are implied to have an insufficient impact on trade, as advocated in studies such as Harley (1988) and Irwin and ORourke (2011). It is rather globalization itself that should be promoted to shift the preferences of destination countries toward partner country products. Ultimately, consumers determine their preferences based on their perceptions of the products rather than pure evidence of quality.

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Table 3.1: Contribution of Each Gravity Channel to Overall Gravity Effects

	Random Preferences			Dyadic Preferences			
	Duties/Tariffs (DC)	Transportation Costs (TC)	Total	Duties/Tariffs (DC)	Transportation Costs (TC)	Dyadic Preferences (PC)	Total
% Contribution of Gravity Channels	30.55%	69.45%	100.00%	0.48%	2.44%	97.08%	100.00%
	% Contribution of Individual Variables to Each Gravity Channel:						
Distance	92.16%	98.61%	97.00%	92.15%	97.74%	34.34%	32.23%
Common Border	0.30%	1.96%	1.54%	0.29%	2.82%	42.57%	45.12%
Colonial Tie	0.01%	0.08%	0.04%	-0.04%	0.06%	14.28%	13.98%
FTA	7.19%	0.31%	2.07%	7.22%	0.18%	6.90%	6.91%
Common Language	0.34%	-0.96%	-0.65%	0.38%	-0.80%	1.91%	1.76%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Notes: This table shows the contribution of each gravity channel to the overall gravity effects. The effects due to each gravity channel is further decomposed into the effects due to individual variables.

Table 3.2: Contribution of Individual Variables to Overall Gravity Effects

	Random Preferences			Dyadic Preferences			
% Contribution of Individual Variables to Overall Gravity Effects	Duties/Tariffs (DC)	Transportation Costs (TC)	Total	Duties/Tariffs (DC)	Transportation Costs (TC)	Dyadic Preferences (PC)	Total
Distance	29.43%	70.57%	100.00%	0.40%	3.40%	96.20%	100.00%
Common Border	13.54%	86.46%	100.00%	-0.41%	2.71%	97.70%	100.00%
Colonial Tie	-7.30%	107.30%	100.00%	-0.31%	1.28%	99.03%	100.00%
FTA	75.00%	25.00%	100.00%	2.55%	2.63%	94.82%	100.00%
Common Language	39.22%	60.78%	100.00%	-1.80%	2.15%	99.65%	100.00%

Notes: This table shows the contribution of each gravity variable to the overall gravity effects.

Figure 3.1: Descriptive Statistics: Effects of Distance

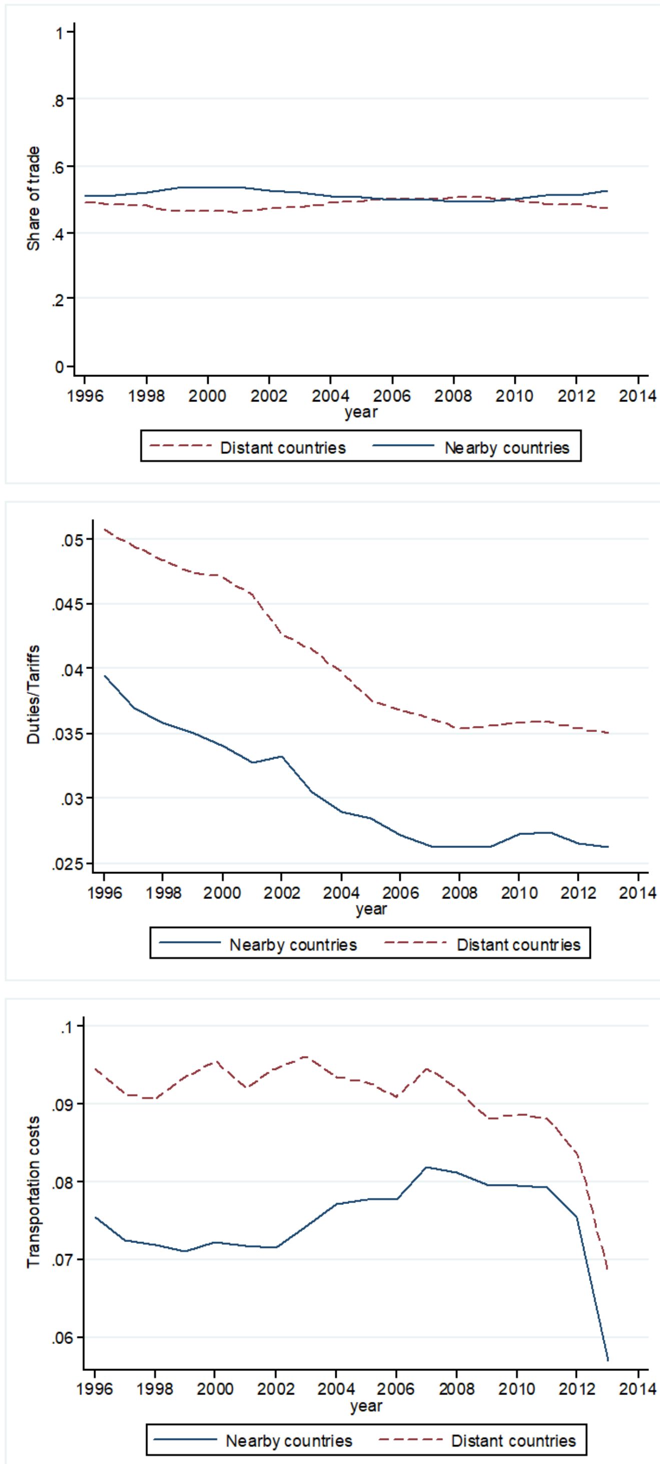


Figure 3.2: Descriptive Statistics: Effects of Having a Common Border (NAFTA)

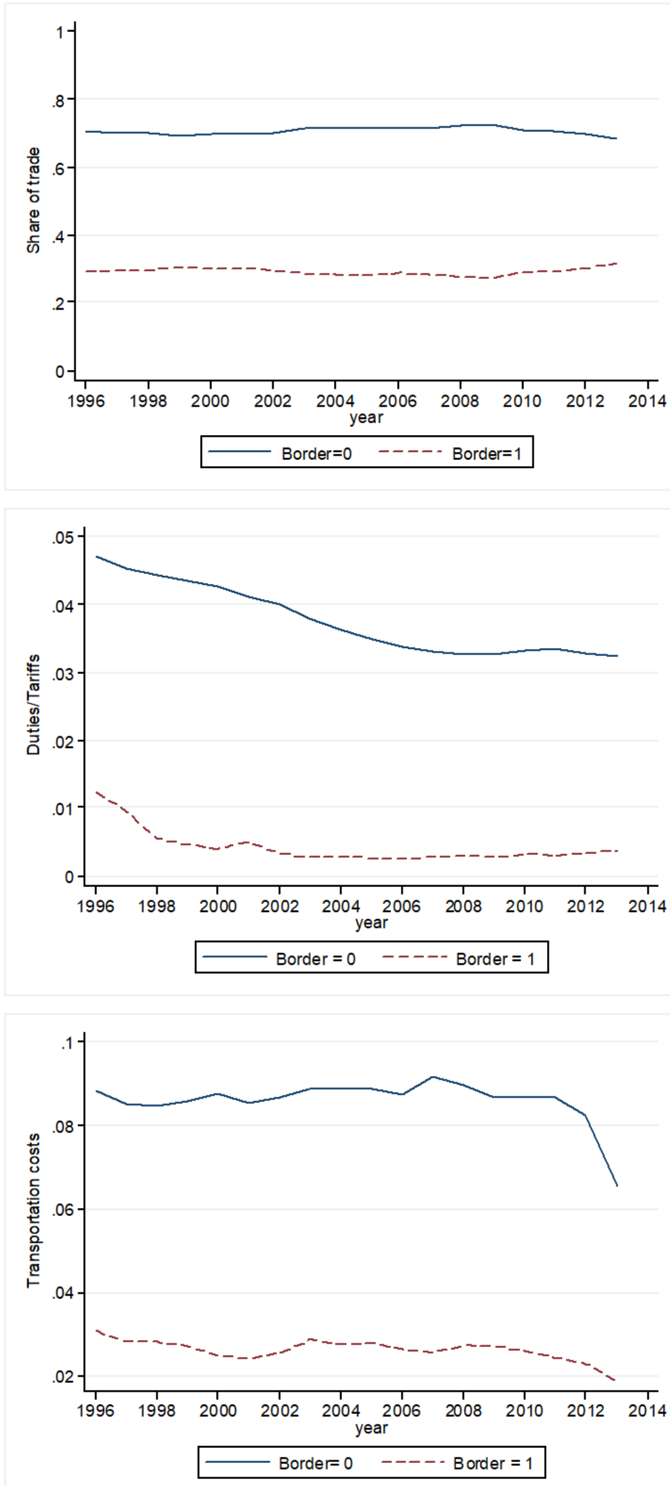


Figure 3.3: Descriptive Statistics: Effects of Having a Colonial Relationship

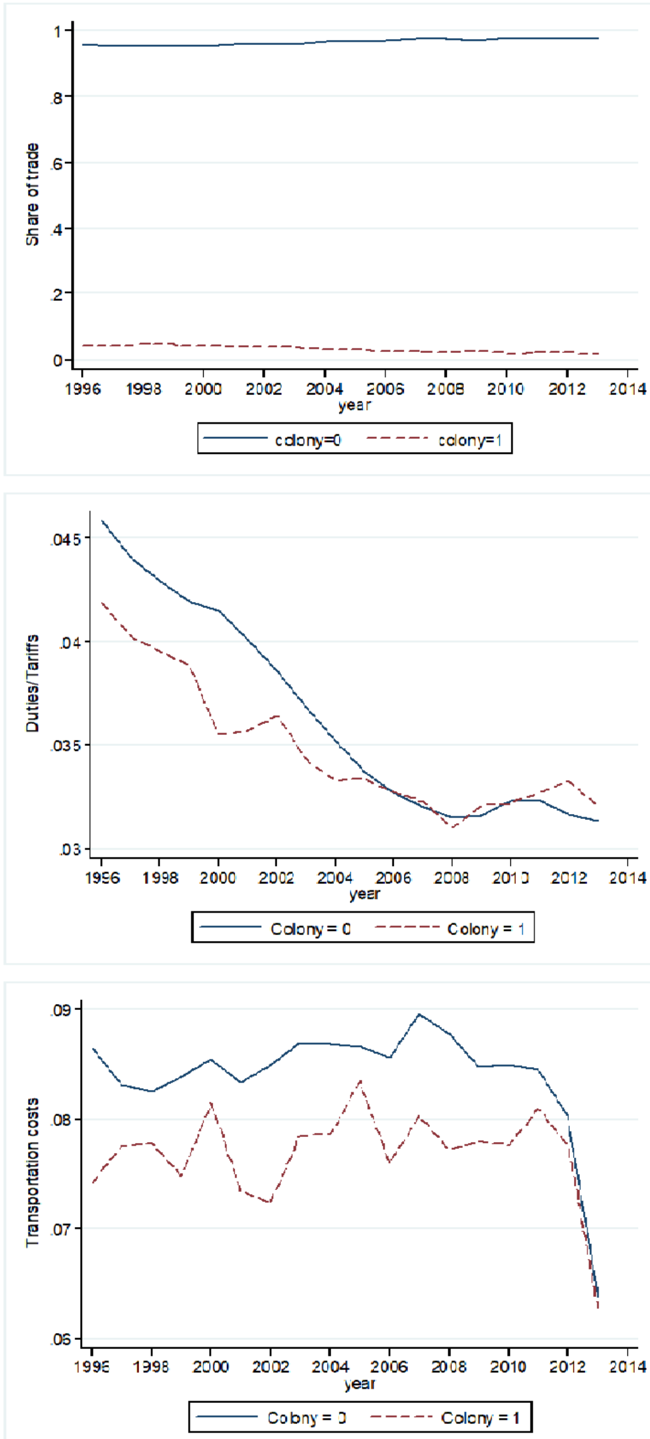


Figure 3.4: Descriptive Statistics: Effects of Having a Free Trade Agreement

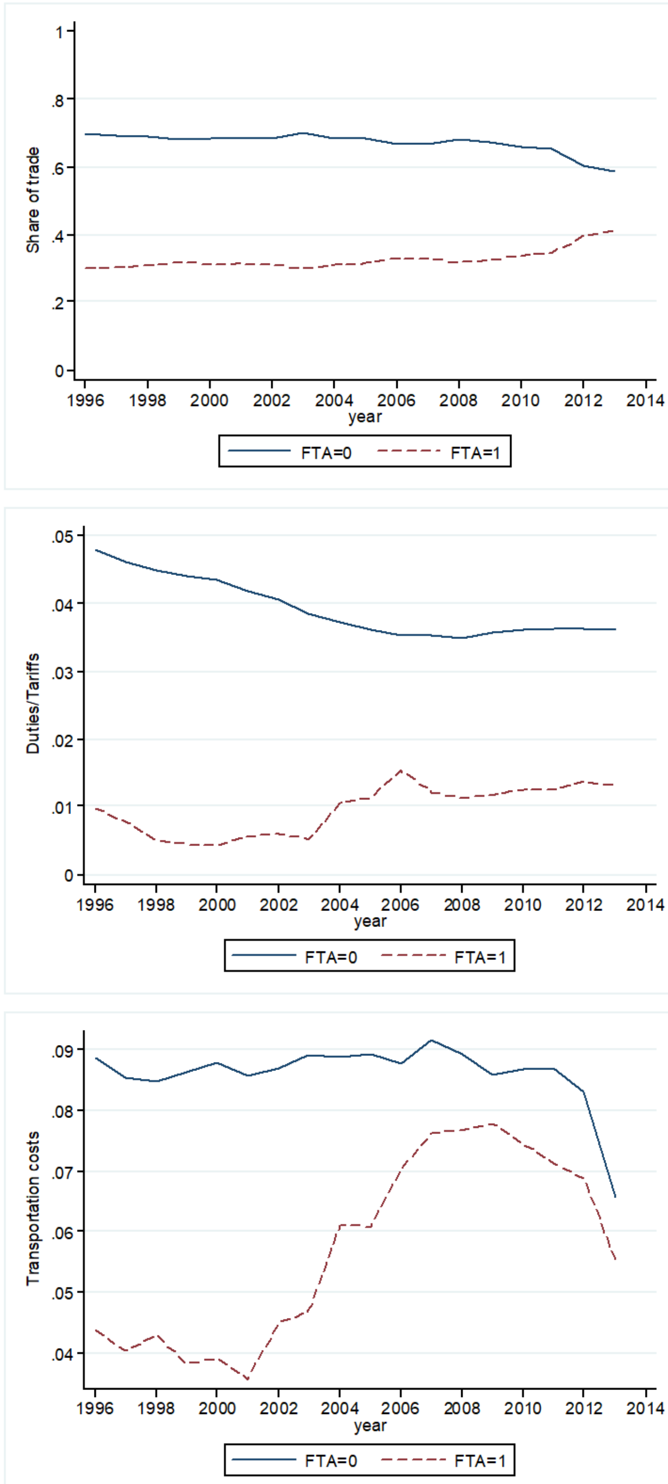


Figure 3.5: Descriptive Statistics: Effects of Having a Common Language

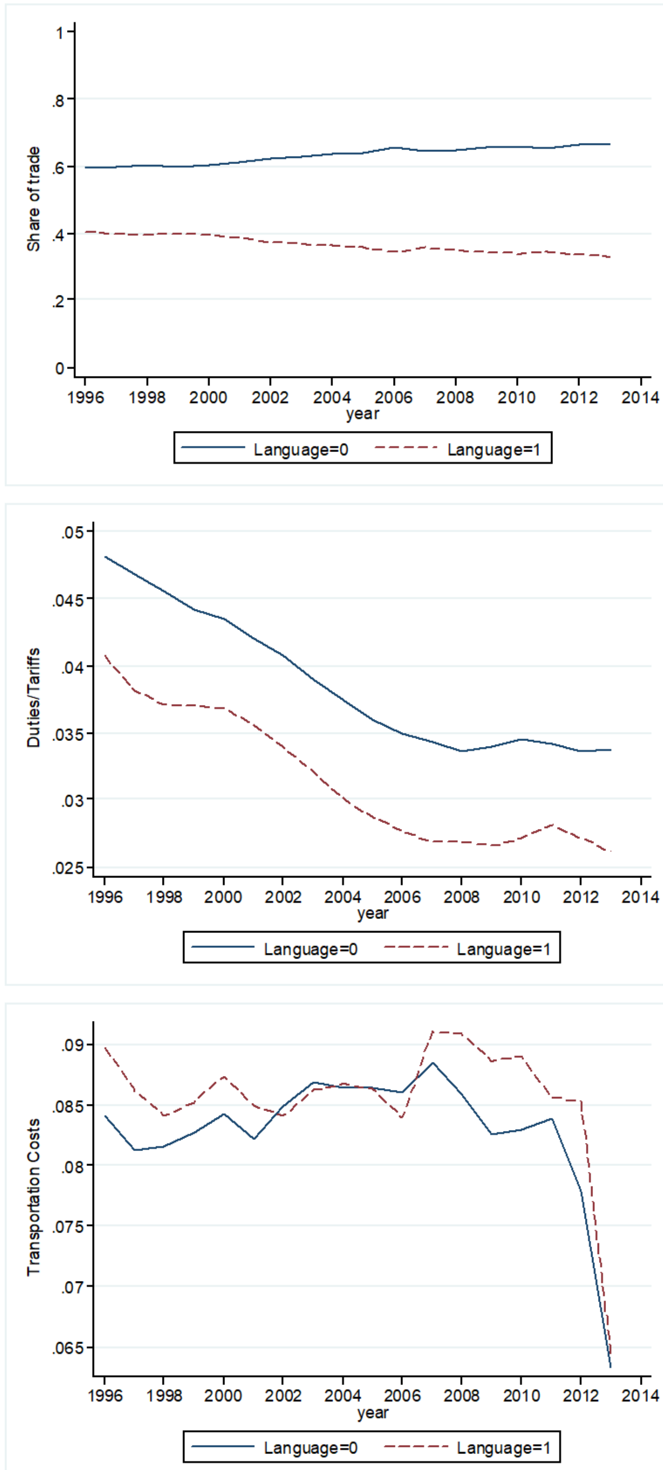


Figure 3.6: Estimates of Distance Elasticity between 1996-2013

Random Preferences **Dyadic Preferences**

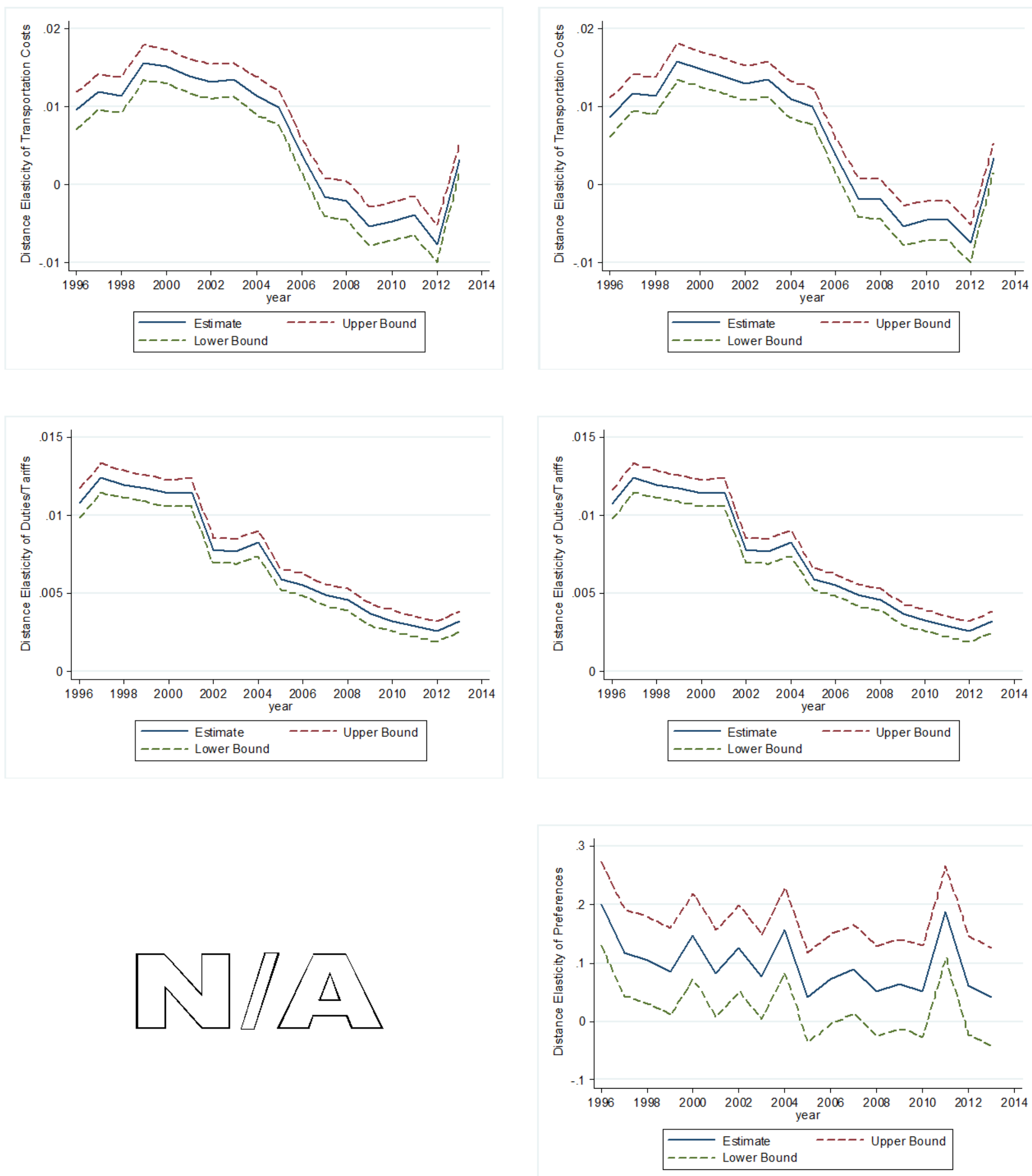


Figure 3.7: Common-Border Coefficient Estimates between 1996-2013

Random Preferences **Dyadic Preferences**

Figure 3.8: Colonial-Relationship Coefficient Estimates between 1996-2013

Random Preferences **Dyadic Preferences**

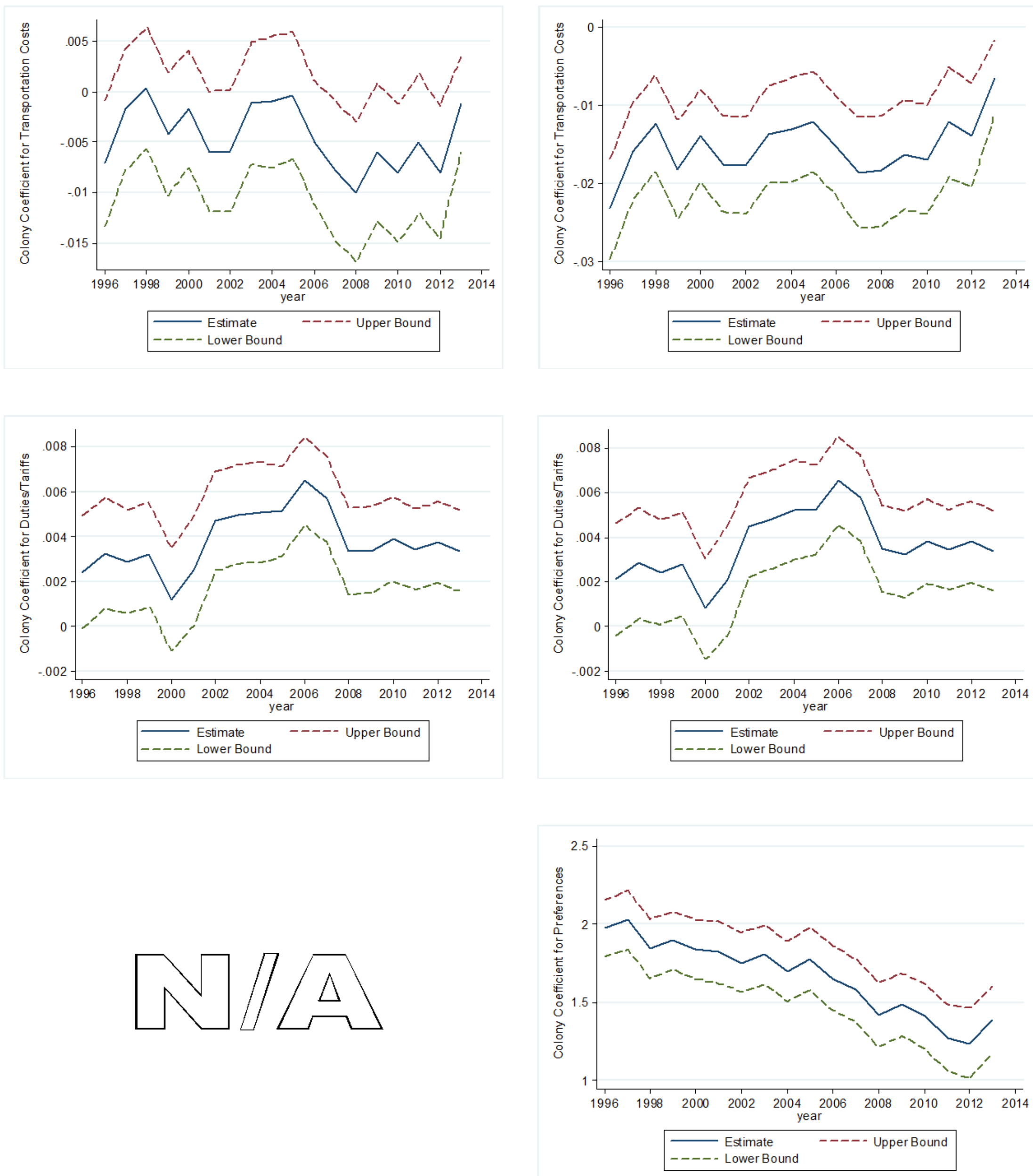


Figure 3.9: Regional/Free-Trade-Agreement Coefficient Estimates between 1996-2013

Random Preferences **Dyadic Preferences**

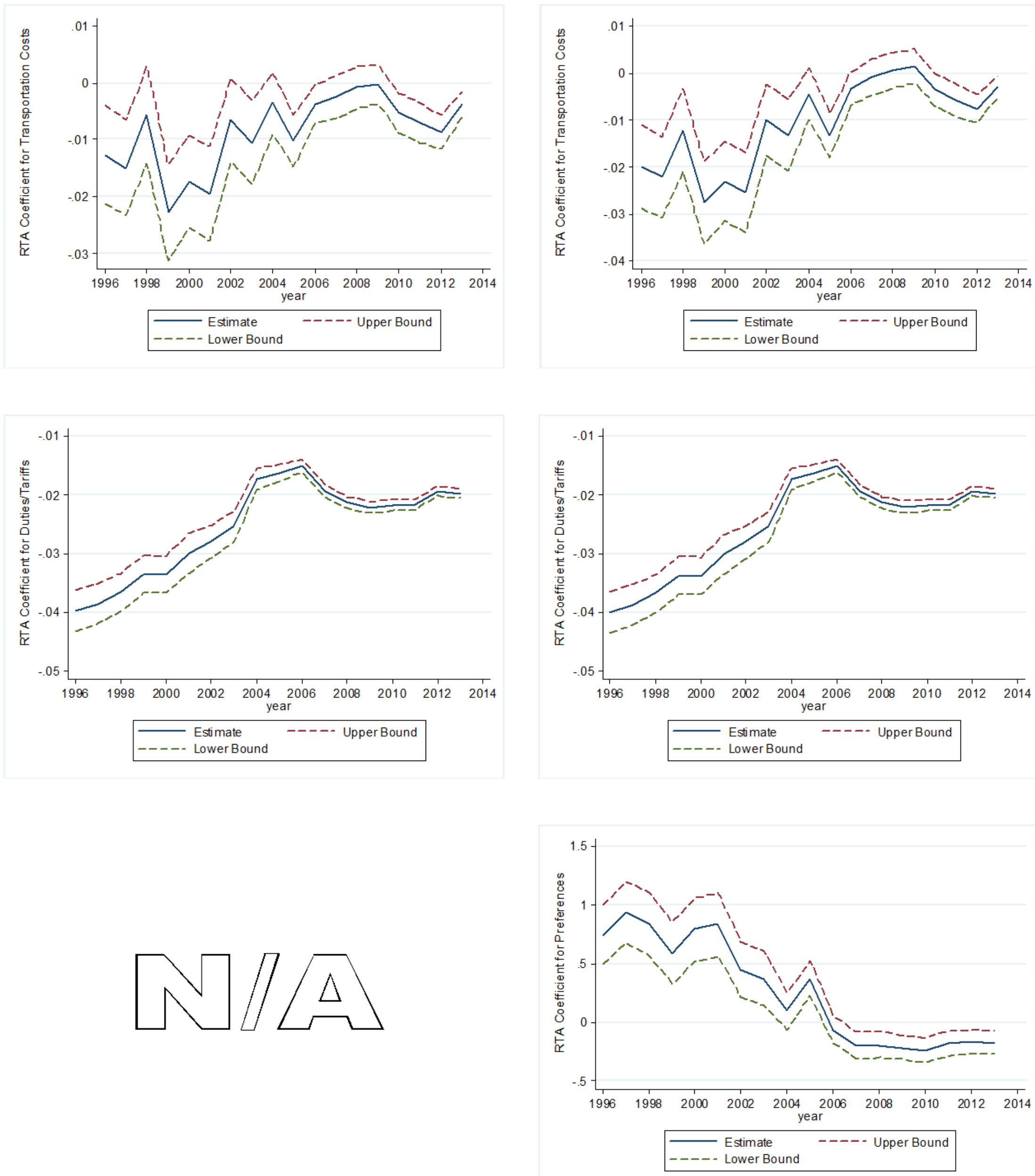
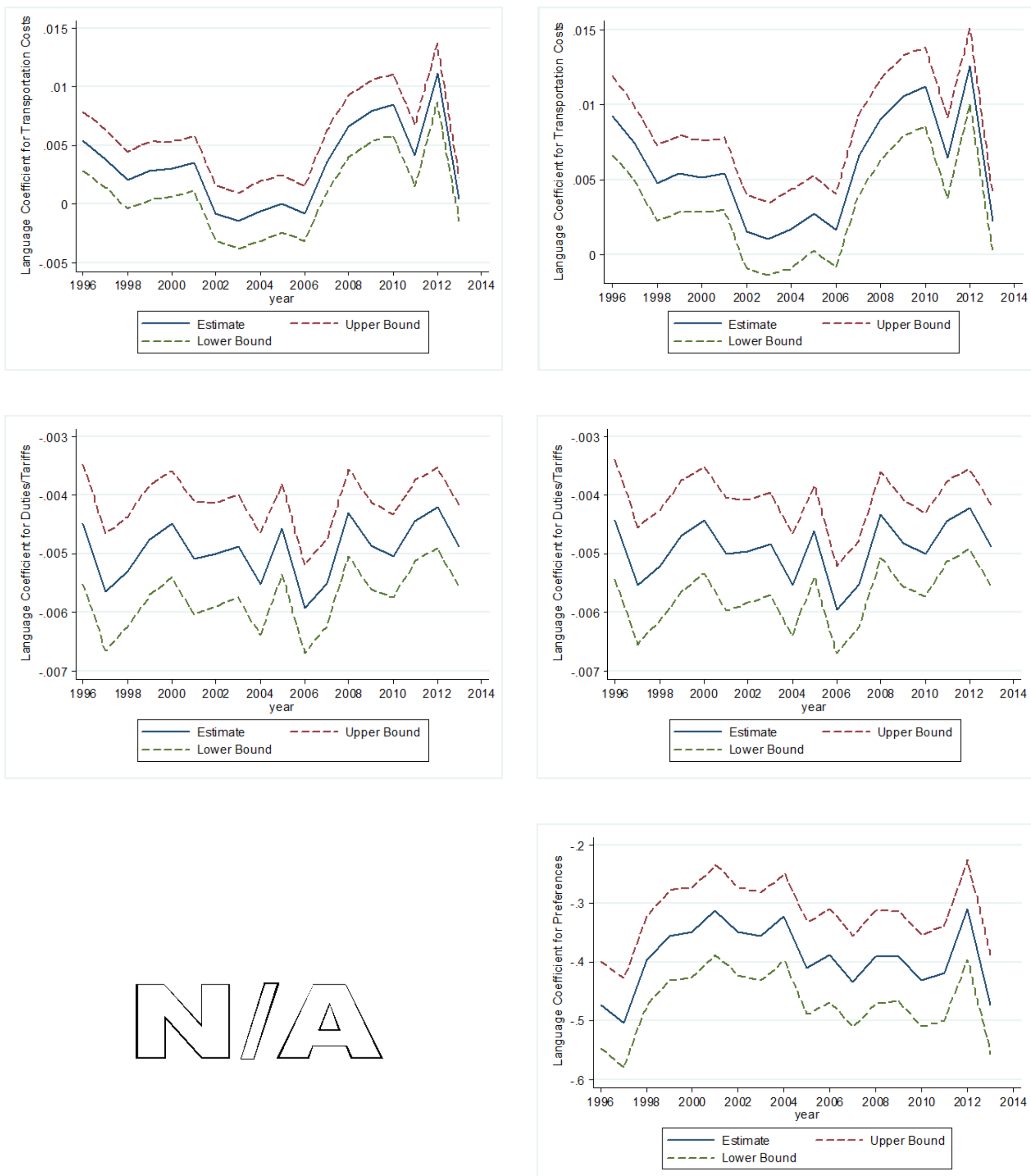


Figure 3.10: Common-Language Coefficient Estimates between 1996-2013

Random Preferences | **Dyadic Preferences**



CHAPTER 4

INSTITUTIONAL QUALITY AND MIGRATION FLOWS

4.1 Introduction

Similar to international trade, international migration is also a key component of modern globalization. The number of international migrants worldwide has reached 258 million in 2017. It was 220 million in 2010, and 173 million in 2000 according to the United Nations International Migration Report (2017). As documented by the OECD International Migration Outlook (2017), 4.7 million permanent immigrants resided in the OECD countries in 2015. The number is expected to grow rapidly in the next few years. United States, Germany, United Kingdom, Canada, and France have been the top five OECD countries with permanent inflow of foreigners in recent years. Meanwhile, the migration inflow pattern in the OECD countries has changed drastically. Before the 1980s, labor-intensive migration took over the majority of the migration inflow. In recent years, family-based immigrants and asylum-seekers from developing and underdeveloped countries have become the main source of the overall migration inflow (Chiswick and Hatton, 2003).

International migration and globalization have become unavoidable trends. Studies suggest that the patterns and reasons for global migration have changed in recent years (Karemera et al., 2000). What exactly power the migration movement? Traditional gravity analysis is able to explain the initiation of migration by highlighting migration costs and demographic factors. However, in the era in which we live, migration is driven by complicated social and economic motivations. Docquier and Rapoport (2012) express a concern that migration mainly flows from developing and underdeveloped countries to developed countries and thus causes brain-drain effects on the human capital stock of underdeveloped countries.

It seems that the institutional quality of a country affects the human capital flow and has different effects in the destination and source countries. Different migration studies (Docquier and Rapoport, 2012; Dreher et al., 2011; Dimant et al., 2013; Fitzgerald et al., 2014; Hatton and Williamson, 2003; Mayda, 2010) focus on only one or some aspects of the institutional quality for a country, such as political instability, social and economic issues, conflicts, and corruption. This paper contributes to the existing literature by constructing a set of institutional quality indexes to consider all the possible socioeconomic and political conditions.

Governments need to provide guidance as to about how the migration decision is made, and how to understand migration and use it for the country's own advantage. Immigration policies can highly impact the labor markets, economic development, and domestic markets on in both destination OECD countries and source countries. To explain the determinants of migration flows, the literature emphasizes that traditional gravity variables, such as the distance between destination and source countries, are key factors that determine the migration flows. Geographical distance is the most common proxy for migration costs in studies such as Borjas (2000), Hatton and Williamson (2003), and Fitzgerald et al. (2014). Other common gravity variables are also used in the most migration studies as proxies for cultural barriers in migration, such as common borders, common languages, and colonial ties.

In addition to the common proxies for migration costs, the literature emphasizes that wage differences between the destination and source countries may determine the migration decisions, also (Borjas, 1994; Borjas, 2000; Chiswick, 1986; Chiswick, 2000; Massey et al., 1999). Most recent studies pay attention to social networks that potentially connect family and friends. Therefore, immigration stocks are one of the most important explanatory variables in studies such as Fitzgerald et al. (2014), Karemera et al. (2000), Mayda (2009), and Pedersen et al. (2008).

In recent years, migration studies have focused on the specific factors that affect migration decisions in the destination or source countries. Pull factors are those destination-specific characteristics that attract potential emigrants from certain source countries. These studies concern socioeconomic and demographic factors and political institutional conditions in destination countries that affect the migration decisions of potential immigrants. Push factors are those source-country-specific characteristics that dissuade citizens residing in source countries from migrate out. Mainly political conditions, especially political instabilities in source countries, are main pushing factors that drive migration flows (Fitzgerald et al., 2014; Mayda, 2009; Pedersen et al., 2008).

This paper is motivated by recent advanced studies emphasizing pull and push factors of migration flows. By using an updated OECD immigration inflow data from 1984 to 2015, and a set of novel institutional quality indexes, this paper explores the effects of institutional quality on the immigration rate. The indexes come from The International Country Risk Guide (ICRG), which comprises 22 factors in political, economic, and financial categories to portray the overall risk of an institution. Among these indexes, we mainly focus on pull effects of socioeconomic conditions, which come from destination countries, and pushing effects from source countries, including foreign debt, government stability, budget, internal conflicts, and corruption conditions.

These institutional quality indexes describe both the destination and source country characteristics in details. The existing literature suggests that main pulling effects come from income advantages and employment conditions in the destination country. Specifically, Pedersen et al. (2008) conclude that they find an effect of employment on migration inflow in destination countries but no such impact in source countries. However, regarding the push factors, Karemera et al. (2010) suggest that domestic political conditions are the main factors that determine emigration outflows. Mayda (2009) also notes the existence of the asymmetrical pull and push factors, where income level and employment conditions in source countries have insignificant effects on emigration outflows. On the other hand, political issues and potential government risks will drive potential emigration outflows. Therefore, this paper mainly uses the destination country socioeconomic condition index to proximate the pulling effects and uses five other institutional quality indexes to describe political and government risks to proxy push factors from source countries.

The estimation results in this paper are in conformity with previous studies. Higher institutional quality in the destination countries increases the immigration rate. Specifically, higher employment rate and market confidence and a lower poverty level (socioeconomic condition) draw attention from potential immigrants. On the other hand, lower institutional quality in source countries decreases potential emigration outflows. The results provide the governments some guidance regarding their immigration policies and economic development. The most important thing for developing and underdeveloped countries is to retain their labor forces and citizens. For example, corruption risks affect the potential emigration outflow. As noted by Dimant et al. (2013), corruption control would be an important policy tool to prevent domestic brain drain, where the country in need for development can keep the talents. Nevertheless, institutional quality is important for countries to maintain their populations and labor forces. The key goals to prevent emigration outflows are to keep the government and political structure stable, cease domestic conflicts, control corruption, and manage the budget and debt for economic development.

The rest of the paper is organized as follows. Section 2 provides the empirical estimation methodologies with random effects and fixed effects estimators. The variable selection is also described in this section. Section 3 introduces the data source and constructs data according to the empirical model. Section 4 summarizes the empirical results, together with many robustness checks. Section 5 concludes.

4.2 Empirical Methodology

The common framework of the migration models is motivated by the idea that individuals will maximize their utility by choosing which country to live in. Their behaviors regarding where to move depend on three key components: the characteristics of the potential migrants, source-country-specific pushing effects, and destination-country-specific pulling effects (Borjas, 1987; Borjas, 1989; Karemera et al., 2000; Mayda, 2010; Zavodny, 1997).

The standard theoretical migration models, however, do not restrain or define the proxy variables for the three components. Therefore, the generalized migration model has the following form:

$$m_{ijt} = \beta_1 I_{ijt} + \beta_2 S_{it} + \beta_3 D_{jt} + u_{ijt} \tag{4.1}$$

where m_{ijt} is the number of immigrants moving from the source country i to the destination country j at time t. I_{ijt} is a vector of factors that describe the net gain of migrants if they decide to move from source country i to destination country j at time t. Pedersen et al. (2008) also separate I_{ijt} into two parts. One denotes the network effects of the potential immigrants from the destination country. The obvious proxy variable is the immigration stocks from the source county to the destination country. The other one represents the migration costs incurred when moving from source country i to destination country j. S_{it} and D_{jt} are vectors of pushing and pulling factors in the source country i and destination country j that affect the decisions of potential migrants whether to choose to move or stay. u_{ijt} is a white noise with zero mean and variance σ.

For the empirical analysis, the literature proposes different variables to indicate the three components of the migration function (see Borjas, 1989; Fitzgerald et al., 2014; Gastil, 1978; Greenwood, 1975; Hatton and Williamson, 2003; Mayda, 2010). As summarized by Karemera et al. (2000), a complete migration gravity model contains three groups of variables: traditional gravity variables, such as distance, common languages, common borders, and colonial ties, which account for the costs of migration. Variables related to the economic and political conditions in the source country push the potential emigrants to leave, whereas variables related to the economic and political conditions in the destination country pull the potential immigrants to arrive. In this paper, we try to examine the effects of institutional quality on migration flows. Accordingly, our empirical specification of the migration model has the following form:

$$\begin{aligned}\frac{m_{ijt}}{P_{it}} = \beta_0 + \beta_1 \frac{STOCK_{ijt}}{P_{it}} + \beta_2 \frac{GDPperCapita_{jt}}{GDPperCapita_{it}} + \beta_3 ldist_{ij} + \beta_4 border_{ij} + \beta_5 colony_{ij} \\ + \beta_6 comlang_{ij} + \beta_7 SocioeconomicConditions_{jt} + \beta_8 ForeignDebt_{it} \\ + \beta_9 BudgetBalance_{it} + \beta_{10} GovernmentStability_{it} + \beta_{11} InternalConflicts_{it} \\ + \beta_{12} Corruption_{it} + u_{ijt}\end{aligned} \tag{4.2}$$

where the new dependent variable $\frac{m_{ijt}}{P_{it}}$ is the emigration rate. We normalize the migration flows by the population of the source country i. This is consistent with the model derived by Borjas (1999), and Clark et al. (2007), in which the emigration rate is used to compare the relative sizes of the migration flows with the existence of heterogeneous source country sizes. The immigration stock variable to proxy the existing network effects is also divided by the population size of the source country. $\frac{GDPperCapita_{jt}}{GDPperCapita_{it}}$ shows the inequality in GDP per capita from the destination country j and source country i. $ldist_{ij}$ is the natural logarithm of the great circle distance between the source and destination countries. $border_{ij}$ is a dummy variable that takes the value of 1 if the source and destination countries share a land border. $colony_{ij}$ is a dummy variable that equals 1 when the source and destination countries had colonial ties in the past. $comlang_{ij}$ is also a dummy variable that takes the value of 1 if the source and destination countries use a common language. All four standard dummy variables approximate the migration costs to move from source country i to destination country j. $SocioeconomicConditions_{jt}$ is an institution quality index showing the socioeconomic condition of destination country j. $ForeignDebt_{it}$, $BudgetBalance_{it}$, $GovernmentStability_{it}$, $InternalConflicts_{it}$, and $Corruption_{it}$ are a vector of institutional quality to show the foreign debt condition, government budget availability, internal conflicts, and the corruption level of the government in source country i. u_{ijt} is an error term with zero mean and a constant variance σ.

In this paper, we use the country-time specific institutional quality indexes in equation (4.1) to explain the push and pull effects from the source country and destination country. It is unavoidable for us to solve the endogeneity issue of the regression, since there are reverse-causality concerns, where not only the difference of the GDP per capita in two countries affects the decision of potential immigrants and draws immigrants to the destination country but also more immigrants flow can impact labor market structural and GDP in the destination country. Another plausible problem is over/underestimating the model with too many/few independent variables. To solve the endogeneity issue, we include multiple fixed effects, combined with lagging one year for all time-varying independent variables to account for the time lag when the immigrants make decisions.

4.3 Data

In this section, we will construct the data by combining immigration flow, immigration stock, itemized population inflows, institutional quality indexes, and other country-pair specific variables from different sources. All the immigration data comes from the International Migration Statistics (IMS) database for the OECD countries. This data is the extension of the widely used OECD immigration data used in some recent studies [1]. This paper uses data of immigrants inflow from 134 source countries to 33 OECD countries in the period from 1984 to 2015. It is important to note that the data collection is conducted by each county separately, and the definition of migrants is different across countries [2], thus, the immigration inflow data are not perfectly comparable across OECD countries. Therefore, by controlling the heterogeneity at the destination-country level, the effects of institution quality can still be compared with our data over time. The collections of immigration inflow data from each OECD country are also different with respect to the availability of the time periods and the source countries. For example, the United States started to document the immigration inflow from the United Kingdom in 1984. Meanwhile, it only has immigration inflow data for Austria and Denmark available starting in 1997. Some OECD countries have already started to document immigration data specifying the country of origin since the 1960s, whereas many small-sized traditional

[1] Pedersen et al. (2008) use immigration inflow and stock data obtained from 26 destination OECD countries during the period 1989-2000. Mayda (2010) uses a similar data that provides bilateral immigration inflow into 14 core OECD countries in the period 1980-1995. While Fitzgerald et al. (2014) specifically include labor inflow into 18 OECD countries from over 170 source countries from the period 1980-2006.

[2] Majority of the OECD countries categorize and define immigrants by their country of birth. Some define it based on the nationality and citizenship of the immigrants (such as France and Austria).

low migration-impacted OECD countries have only started it since 1995, such as Austria.

Compared to existing studies using OECD immigration inflow, our data has several extensions and advantages. As mentioned above with more destination OECD countries included in the data, and extending the available years to 2015, our data set contains 54,722 observations on immigration inflow. The majority of the studies use the immigration inflow data even though there are concerns about comparability due to the complicity of definitions. Fitzgerald et al. (2014) use labor migrants data to exam the political considerations in shaping migration decisions of the potential labor migrants. We provide extra variables to allow us to entirely understand the migration behaviors. In addition to the immigration inflow and immigration stock yearly data, we also include worker inflow, seasonal worker inflow, and foreign student inflow yearly data. Within the discussion of the institution quality, it not only affects the general immigration inflows, but also impacts certain groups of immigrants, such as workers who see financial security of an institution more important than the political openness.

Our data also includes a set of standard independent variables commonly used in migration studies. The population and GDP per capita values for the destination country j and source country i come from World Bank Open Data Catalog[3]. Four standard gravity variables ($ldist_{ij}$, $border_{ij}$, $colony_{ij}$, and $comlang_{ij}$) are from Reuven and Rose (2016).

To explain the immigration rate from institutional quality, we apply the country risk data obtained from the International Country Risk Guide (ICRG). The specific variable that we use to explain the pulling effects from the destination countries is $SocioeconomicConditions$. The reason is that majority of the OECD destination

[3]https://data.worldbank.org/

countries share similar political and economic attributes, where they tend to have low external and internal conflicts, low military impact in politics, and low religion tensions. On the economic side, OECD countries have stable financial systems and mature economic growth rates. The attributes that set all the OECD countries apart are their different domestic unemployment rates and working conditions, consumer market structures and poverty levels. The socioeconomic conditions calculate the risk of a country exactly with these three sub-components: unemployment, consumer confidence, and property.

The institutional quality used to explain the pushing effects from the original countries are considered in terms of both political risks and economic risks. The $ForeignDebt$ variable indicates the foreign debt as a percentage of GDP in destination countries, the variable *BudgetBalance* calculates the estimated central government budget balance and grants for a given year as a percentage of the estimated GDP in destination countries. These two indexes indicate the economic risks of a country where the potential emigrants worry about the domestic economical conditions and the capability that their government can improve the living and working conditions of its citizens. The variables *GovernmentStability*, $Internalconflicts$, and *Corruption* indicate political risks for the potential institute to loose its potential emigrants. Specifically, *GovernmentStability* assesses the unity, legislative strength, and the popularity among citizens of the government. $Internalconflicts$ assesses whether an country is dealing with civil war/coup threat, terrorism/political violence, and civil disorders. *Corruption* measures the degree of corruption within the political system of the country.

As we introduced the institutional quality variables above, it is obvious to consider that potential emigrants will change their decisions of whether to stay or leave their home countries since the variables reflect a country's economic and political conditions, where less stabilized and more corrupt governments tend to encourage potential emigrants to move outside of their home countries. Moreover, when potential immigrants make the decision of where to relocate, they look for better socioeconomic conditions of a potential destination country, where the labor market thrives and the consumers are confident.

4.4 Empirical Results

4.4.1 Benchmark

Table 4.4 reports the benchmark results. With the dependent variable being the natural logarithm of the emigration rate (inflow foreign population from source country i to destination country j divided by the population of source country i) and using the random effects Generalized Least Squares (GLS) estimator, the estimates are shown to be consistent with the predictions and previous literature.

First, the control variables of the baseline models in column 1 and column 2 consist of the rate of immigration stock, GDP per capita ratio, and common gravity variables that are widely used in the immigration literature, such as the log geographic distance, land borders, colonial ties, and common languages. The results show that the immigration rate is positively related to the (log) percentage of existing immigration stocks at destination country to the source country population. Specifically, every 1 percent increase in the immigration stock rate increases by approximately 0.8 percent the immigration rate to the destination country. This denotes the network effects of the immigration rate, where the existing immigration stock in the destination country provides useful information and helps potential immigrants overcome language barriers, asymmetric information on the labor market.

All of these are reasonable to draw attentions from the potential immigrants and cause increases in the immigration rate. Moreover, even though the network effects from the existing immigration stock are prominent and positive, the increasing rate of immigration (0.8 percent) is still smaller than the increasing rate of immigration stock (1 percent).

The model also obtains similar results where the (log) GDP per capita differences between destination and source countries affect the immigration rate positively. Specifically, every 1 percent increase in GDP per capita ratio between destination country and source country will lead to an approximately 1 percent increase in immigration rate. Considering the case that GDP per capita in the destination country increases by 1 percent, whereas the GDP per capita in the source country is unchanged, there will be a 1 percent increase in the immigration rate. The bigger the GDP per capita gap between destination and source countries is, the higher income the destination country generally has, or the lower the income the source country has. In either case, potential immigrants have incentives to move to the destination country. Comparing columns 3 and 6, the coefficients in front of the control variables do not have significant changes, except for $lnGDPperHeadRatio$. As the evidence in column 6, in which case all control variables are included to avoid any omitted variables bias, the coefficient value of $lnGDPperHeadRatio$ remains significant but decreases to 0.632 from 1.067.

For the common gravity variables, we explore the effects of the geographic (distance and common borders) and cultural (colonial ties and common language) variables on the costs incurred during the migration. As expected, the geographical distance has a negative relationship with the immigration rate, and both colonial ties and common language have positive effects on the immigration rate. Common borders do not have significant effects on the immigration rate in any baseline model. More specifically, a 1 percent increase in the geographical distance between the destination and source country causes a decrease in the immigration rate of approximately 0.075 percent. Keeping all other factors equal, by doubling the distance between the destination and source country, there will be a 7.5 percent increase in potential emigrants from the source country who choose to move to the destination country. Colonial ties and common language between the source country and the destination country will improve the immigration rate by approximately 20 percent and 14.5 percent. Moreover, the significant effects of colonial ties and common language on immigration rate in Table 1 are consistent with different models. This result is inconsistent with the findings of Mayda (2010), where common language and colonial ties do not appear to play any significant role in determining the immigration rate.

In columns 3 through 6, one destination-country institution quality index and five source-country institutional quality indexes are added one by one to the baseline model. These coefficients of added independent variables are aligned with the expectation. Specifically, the coefficient of $SocioeconomicConditions$ is 0.0898 and statistically significant at the 1% level. Since the institutional quality index describes the socioeconomic pressures in the destination country measured in the scale from 0 to 12, this estimation result implies that a 1 point increase in $SocioeconomicConditions$ in the destination country is associated with an almost 9 percent increase in the immigration rate.

All the five source-country institutional quality indexes have negative effects on the immigration rate. Due to the fact that these push factors from the source country should affect the decision-making of potential emigrants, higher institutional quality in the source country would decrease the emigration rate. As shown in column 6, with all control variables, the coefficient of $ForeignDebt$ is approximately -0.02, which means a 1 point increase in $ForeignDebt$ index [4] from the source country is associated with around 2 percent decrease in immigration rate. Similarly, 1 point increase in $BudgetBalance$ index[5] from the source country is associated with around 0.9 percent decrease in the immigration rate. 1 point increase in $GovernmentStability$ index[6] from the source country is associated with around 1.4 percent decrease in the immigration rate. 1 point increase in $InternalConflicts$ index[7] is associated with around 2.2 percent decrease in the immigration rate. Last but not least, 1 point increase in $Corruption$ index[8] is associated with around 2.3 percent decrease in the immigration rate.

4.4.2 Robustness

Generally, endogeneity is the first problem in panel analyses. Especially in three-dimensional data, both unobserved destination-country and source-country

[4] $ForeignDebt$ measures the foreign debt services as a percentage of GDP. The value of the $ForeignDebt$ index is on a scale from 0 to 10. The bigger the index, the higher the institutional quality the country has.

[5] $BudgetBalance$ measures the central government budget balance (including grants) for a given year as the percentage of the estimates GDP. The value for the $BudgetBalance$ index ranges from 0 to 10. The bigger the index the higher the institutional quality the country has.

[6] $GovernmentStability$ measures the ability of the government to carry out declared programs and stay in office. It also consists of three assessment: government unity, legislative strength, and popularity. The value for the $GovernmentStability$ index ranges from 0 to 12. The bigger the index, the higher the institutional quality a country has.

[7] $InternalConflicts$ measures political violence in the country and the potential impact of it on governance. The value for the $InternalConflicts$ index ranges from 0 to 12. The bigger the index, the higher the institutional quality the country has.

[8] $Corruption$ measures financial corruption within country's political system. The value for the $Corruption$ index ranges from 0 to 6. The bigger the index, the higher the institutional quality the country has.

specific effects could cause a biased estimation. There are several concerns regarding the omitted variable problem. First, to determine the cause of migration (immigration rate), we look at the potential pull factors from the destination country. $SocioeconomicConditions$ may have a positive effect on the immigration rate. However, it is unclear whether a potential immigrant would be more willing to relocate to a destination country with better socioeconomic conditions or whether they are attracted by some other attributes that a destination country has because of good socioeconomic conditions. For the same reason, the push factors of institutional quality from source country might be a possible reason to push potential emigrants to relocate to other countries. It is also possible that other unobserved push factors lead to relocation of potential emigrants. To solve the omitted variables issue, Table 5 introduces several groups of dummy variables to control for different combinations of fixed effects.

Table 4.5 is based on the model in column 6 of Table 4.4 which includes all control variables. The destination-country fixed effects and source-country fixed effects are introduced in column 1 to account for the unobserved destination and source country specific effects. Compared with the random effects model in the column 6 of Table 4.4, there is no sign change in the coefficients, and all the coefficients are significant except for $border$ and $BudgetBalance$. The coefficients of $ln(immigration\ stock/source\ population)$, $ldist$, $colony$, and $comlang$ are unchanged. The coefficient of $lnGDPperHeadRatio$ increases from 0.632 to 0.998, which means the effect of GDP per capita differences on immigration rate is bigger. Regarding the institutional quality indexes, we notice that the pulling effects are increased with the coefficient changes from 0.0898 to 0.0966. However, source-country institutional quality indexes have less pushing effects in general after the fixed effects of destination and source countries are introduced.

Column 2 of Table 4.5 introduces another set of dummy variables as time fixed effects. In addition to the unobserved destination-country and the source-country specific effects, the time-varying unobserved effects are also considered in this model. The coefficients in the entire column 2 are unchanged compared to the random effects model. In the next column, we consider the omitted bias comes from the unobserved country-pair specific effects. The purpose of this set of dummy variables is to perfectly replace the gravity/dyadic variables in the model. Therefore, the gravity variables are omitted in columns 3, 4, and 5, in which country-pair fixed effects are included. Since country-pair specific attributes that affect the immigration rate are explained using country-pair fixed effects, the country-time specific institutional qualities will do a better job at explaining the immigration rate. Column 4 also includes time fixed effects in addition to the country-pair fixed effects. Column 5 incorporates time, destination-country, source-country, and country-pair fixed effects. We can see that the network effects from the immigration stock have not changed compared with the random effect model with the coefficient of 0.806. The GDP per capita difference from the destination and source country still has strong effects on immigration rate, also, with a coefficient of 0.831. For the pull and push factors, both models in the column 4 and 5 are the same, where socioeconomic conditions in the destination country affect the immigration rate positively, whereas the foreign debt rate and the budget balance, government stability, internal conflicts, and corruption level of the source country have negative effects on the immigration rate.

Table 4.6 considers the reverse causality issue for this panel analysis. This is also an unavoidable problem when we consider the estimation results. For example, the coefficient of the immigration stock rate is expected to be positive in the estimation, because the model predict that positive shocks on immigration stock will increase the network effects between the potential immigrants and the immigration stocks from the same source country. However, this positive relationship between immigration stock rate and immigration rate may represent the causation of these two variables in the opposite direction, where simply more immigration will increase the immigration stock rate in the destination country. Another example would be the pull effects of the socioeconomic condition in the destination country. A better socioeconomic environment means a better labor market and higher market confidence. These attributes all draw immigrants' attention and bring them in. However, it is plausible to argue that the incoming immigrants represent a strongly motivated labor force and high purchasing power, and therefore help to build up the strong socioeconomic conditions in the destination country.

Due to the reverse causality issue, it is possible for underestimation to occur. In Table 4.6, we use lagged values for all control variables [9] to explain immigration rate. It is more realistic to claim that the institutional qualities last period will have impacts on the migration decision this period, since people make decisions based on past information and experiences. However, the immigration decision in this period will have no effect on past institutional qualities.

As shown in columns 1 to 5, we run the regressions from Table 4.5 with the same fixed effects. The results of the new estimations have unchanged signs for all coefficients and are significant. *border* has a significant and negative effect on the immigration rate, compared with having an insignificant effect in old models. Specifically, having a land border between destination and source country will lead to a 15.2 percent decrease in the immigration rate. A plausible explanation is that most countries that share borders with an OECD country are also developed coun-

[9] Notice that the lagged value for gravity/dyadic variables such as *ldist*, *border*, *colonry*, and *comlang* are unchanged because they are not time-related variables.

tries or OECD countries themselves. In these cases, the immigration rate would be higher if the source country were a developing country, where institutional quality tends to be lower. The effects of *colony* and *comlang* are significantly larger than in Table 4.5. Having a colonial tie increases the immigration rate by 51.3 percent, and sharing a common language increases the immigration rate by almost 31 percent.

The coefficients of immigration stock rate and GDP per capita differences are significantly smaller compared with the estimation in Table 5. For the institutional quality indexes, socioeconomic condition as a pull factor from the destination country has a larger impact on the immigration rate, with a coefficient change from 0.089 to 0.101. The push effects also have larger effects on the immigration rate for all source country institutional quality indexes.

4.4.3 Further Robustness

Alternative Migration Data

One of the innovation in this paper is the alternative migration data we use to explain the importance of institutional quality on migration decision making. After examining the effects of institutional qualities on immigration rate, we look closely into how the different institutional qualities will affect migration decisions for different demographics.

Table 4.7 reports the effects of institutional qualities on the inflow of foreign workers. The most important difference for the inflow of foreign workers is that they rely less on network effects. However, their decisions about whether to move to a destination country reply strongly on economic reasons. Specifically, according to the coefficients of GDP per capita difference, workers are more than twice as sensitive to GDP per capita differences between the destination and source country. A 1 percent increase in GDP per capita difference leads to an approximately 2 percent increase in the inflow of foreign workers. Moreover, the pull effects from destination-country socioeconomic conditions are 5 times larger for inflow foreign workers compared with overall immigrants. On the other hand, push factors from the source country play lesser roles in emigrants' decision-making. Only $ForeignDebt$, $GovernmentStability$, and $InternalConflicts$ have weak but significant effects on foreign workers' relocation decisions. In addition, the standard gravity variables affect foreign workers' reallocation costs more. Having colonial ties and a common language play larger roles in deciding whether workers choose to relocate.

Table 4.8 introduces the effects of institutional qualities on seasonal foreign workers. The estimation shows that most of the coefficients are insignificant. Pull factors from destination country have no influence on the seasonal foreign workers' decision-making. However, their domestic economic conditions have weak but positive effects on seasonal workers migrating out for temporary seasonal jobs. Gravity variables are the only predominant factors that affect seasonal workers. Colonial ties increase the seasonal worker inflow to the destination country by 140 percent. It is more than double the size compared to other non-colonial relationship countries. However, common language decreases the seasonal workers inflow by almost 70 percent using our data set.

Another group of special categories of immigrants is inflow foreign students. They migrate to take advantages of the destination-country's education systems and future job opportunities. Table 4.9 presents estimations of how institutional qualities affect inflow foreign students. As expected, the network effects from the existing immigration stock in the destination country have weak but positive effects on foreign students' decision-making regarding whether to obtain their educations there. The GDP per capita difference does not increase the inflow of foreign students, since the purpose for the students to move to the destination country is to consume education. The richer the source country compared with the OECD destination country, the greater the purchasing power the potential outflow students have. Moreover, the pull effects from destination country play an important role in the students' attraction. However, the push effects from the source country have no significant effects on the students' decision-making.

Nonlinearity in Network Effects

Social network effects are employed by Fitzgerald et al. (2014) to explain the gravity of international migration. They argue that by distinguishing whether there are existing immigration stocks, they can determine the factors that affect original immigration behaviors and the changes in those factors when there are increasing immigration stocks. The importance of social networks to reduce the costs and risks associated with migration depends on the amount of immigration stocks. All the pulling and pushing factors also behave differently in the effects of migration decisions.

Table 4.10 considers the nonlinear effects of social networks on the immigration rate. Column 1 shows the estimation with the pooled immigration stock rate. We compare it with the set of models from columns 2 to 6 using immigration stock rate in the different percentiles. In column 2, when there are small immigration stocks, the social network effects are relatively small. The immigration stock rate itself has weaker effects on the immigration rate compared to the pooled sample. In addition, the GDP per capita difference is not a concern for the potential immigrants. Meanwhile, geographic distance and common land borders are the most important factors affecting the immigration rate. This conclusion is consistent with Fitzgerald et al. (2014). In addition, the pull effects are significant and positive, which means that socioeconomic conditions in the destination country are still important in migrants' decision-making. Push effects do not affect immigration when the network effects are small.

While the existing immigration stock increases, the immigration rate is increased. At the same time, the effects of geographic distance and land border on immigration rate diminish, which means the social networks can prominently reduce the migration costs and offset the costs from geographical barriers. Regarding the institutional quality, the pulling effects of socioeconomic conditions affect the immigration rate positively and significantly regardless of existing immigration stocks and network effects. All the pushing effects from institutional quality indexes in source country have no effect on immigration decisions, especially when there are less existing immigration stocks and social network effects.

OECD VS. Non-OECD Countries

Table 4.11 compares how the immigration from different source countries would be affected differently by control variables, especially the network effects and institutional quality indexes. By splitting source countries into OECD and non-OECD countries, we run all possible benchmark models, lagged-value models, and fixed effects models. The first three columns present the immigration rates from the OECD source countries. The final three columns report the immigration rates from non-OECD countries.

Due to the similarity among most OECD countries, the potential immigrants from OECD source countries rely less on the existing network effects from the immigration stocks compared to the potential immigrants from non-OECD countries. Standard gravity variables also affect the immigration rate more strongly for potential immigrants from non-OECD source countries.

Finally, the institutional quality indexes that describe pull and push factors also affect immigration rate slightly differently. Specifically, socioeconomic conditions in the destination country affect migration decisions less for potential immigrants from OECD source countries, also. For push factors, we notice that potential immigrants from OECD source counties are more affected by their own domestic economic conditions, such as foreign debt conditions and government budget balance conditions. However, political related institutional qualities affect the immigration rate more in non-OECD source countries, such as government stability and internal conflicts.

4.5 Conclusion

This paper uses an updated source-country-specific immigration inflow data set from 33 OECD destination countries between 1984 and 2015 to examine the gravity model of migration. Combining institutional quality indexes from the International Country Risk Guide (ICRG), this paper demonstrates the importance of institutional quality in both the destination and source countries for determining migration flows.

The modified empirical model summarizes the findings of previous studies. The common gravity variables as proxies for the migration costs affect migration flow negatively, such as geographic distance, common border, colonial tie, and common language. The results of the estimations also show that one of the most important factors is network effects from existing immigration stocks in the destination country. These network effects provide information to potential immigrants from family and friends who reside in the destination countries. As predicted, it reduces the migration costs and increases the chance for potential immigrants to land jobs and settle after relocation.

Finally, the innovation of this paper is to incorporate unique institutional quality measurements into the explanation of the pull and push factors in the model. This is the first study to fully integrate both economic and political, pull and push factors with institutional quality indexes to explain the patterns of migration flow. The results are aligned with the literature, in which institutional quality matters for the determination of migration. Better socioeconomic condition in the destination countries (pull factor), worse debt and budget conditions, lower stability of the government, more internal conflicts and corruption in the source countries yield higher immigration inflow from source to destination countries.

The policy implications are specifically important for developing and underdeveloped countries to keep their labor farce and citizens, and prevent brain-drain effects which could potentially damage the labor market and economic growth of those countries in the long run.

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Table 4.1: Summary statistics and data sources

	Count	Mean	Std.Dev	Min	Max
lninpopperpop	54722	-11.75264	2.428593	-23.9397	-3.72645
lninworkerperpop	24937	-12.89048	2.2603	-19.47161	-4.626491
lninseasonworkerperpop	4896	-13.41259	3.140172	-21.03897	-4.87396
lnforeignstudentsperpop	6557	-14.08104	2.385284	-21.03389	-4.136038
lnstockperpop	42251	-9.933965	2.732961	-22.69102	-1.73629
lngdpratio	119630	1.236518	.2511128	.7419261	2.349159
Land Border Dummy	135003	.0241476	.1535079	0	1
Dummy for pairs ever in Colonial Relationship	135003	.0243698	.1541951	0	1
1 for Common Language	135003	.1096865	.3124997	0	1
Log of Distance	135003	8.076017	.8748306	4.13298	9.416901
SocioeconomicConditions	125946	7.638018	1.655893	2	11
Debt Service as a % of XGS	118862	8.115373	1.7416	0	13.29167
Budget Balance	127606	5.70373	1.797101	0	10
GovernmentStability1	127576	7.596499	2.0745	.6666667	12
InternalConflicts1	126871	8.82185	2.446831	0	12
Corruption1	126871	2.968217	1.326876	0	6

Table 4.2: List of OECD countries:

Australia	Austria	Belgium	Canada	Chile	Czech Republic
Denmark	Estonia	Finland	France	Germany	Greece
Hungary	Iceland	Ireland	Israel	Italy	Japan
Latvia	Mexico	Netherlands	New Zealand	Norway	Poland
Portugal	Slovak Republic	Slovenia	South Korea	Spain	Sweden
Switzerland	Turkey	United Kingdom	United States		

Table 4.3: List of non-OECD source countries:

Albania	Algeria	Angola	Argentina	Armenia
Azerbaijan	Bahamas	Bahrain	Bangladesh	Belarus
Bolivia	Botswana	Brazil	Brunei	Bulgaria
Burkina Faso	Cameroon	China	Colombia	Costa Rica
Cote d'Ivoire	Croatia	Cuba	Cyprus	Dominican Republic
Ecuador	Egypt	El Salvador	Ethiopia	Gabon
Ghana	Guatemala	Guinea	Guyana	Haiti
Honduras	Hong Kong, China	India	Indonesia	Iran
Iraq	Jamaica	Jordan	Kazakhstan	Kenya
Kuwait	Lebanon	Liberia	Libya	Lithuania
Madagascar	Malawi	Malaysia	Mali	Malta
Moldova	Mongolia	Morocco	Mozambique	Myanmar
Namibia	Nicaragua	Niger	Nigeria	Oman
Pakistan	Panama	Papua New Guinea	Paraguay	Peru
Philippines	Qatar	Romania	Russia	Saudi Arabia
Senegal	Serbia	Sierra Leone	Singapore	Somalia
South Africa	Sri Lanka	Sudan	Suriname	Syria
Tanzania	Thailand	Togo	Trinidad and Tobago	Tunisia
Uganda	Ukraine	United Arab Emirates	Uruguay	Venezuela
Vietnam	Yemen	Zambia	Zimbabwe	

Table 4.4: Benchmark: The determines of inflow foreign population (pooled sample)

	Dependent variable: Log of emigration rate					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(immigrant stock/source population)	0.805***	0.799***	0.800***	0.796***	0.797***	0.795***
	(0.0110)	(0.0113)	(0.0113)	(0.0118)	(0.0117)	(0.0118)
lnGDPperHead Ratio (Destination/Source)	1.067***	1.050***	0.900***	0.791***	0.666**	0.632**
	(0.267)	(0.267)	(0.266)	(0.275)	(0.267)	(0.273)
ldist	-0.0675**	-0.0753**	-0.0763**	-0.0855***	-0.0833***	-0.0880***
	(0.0284)	(0.0303)	(0.0303)	(0.0309)	(0.0309)	(0.0309)
border		-0.0975	-0.0960	-0.105	-0.106	-0.107
		(0.0795)	(0.0792)	(0.0802)	(0.0802)	(0.0803)
colony		0.210***	0.202***	0.204***	0.201***	0.204***
		(0.0662)	(0.0662)	(0.0666)	(0.0668)	(0.0669)
comlang		0.145***	0.145***	0.147***	0.147***	0.148***
		(0.0425)	(0.0426)	(0.0427)	(0.0428)	(0.0428)
SocioeconomicConditions			0.0873***	0.0890***	0.0887***	0.0898***
(Destination)			(0.00739)	(0.00734)	(0.00731)	(0.00731)
ForeignDebt				-0.0197***		-0.0203***
(Source)				(0.00472)		(0.00472)
BudgetBalance				-0.0129***		-0.00850**
(Source)				(0.00411)		(0.00403)
GovernmentStability					-0.0146***	-0.0139***
(Source)					(0.00413)	(0.00407)
InternalConflicts					-0.0280***	-0.0216***
(Source)					(0.00583)	(0.00586)
Corruption					-0.0242**	-0.0226**
(Source)					(0.0110)	(0.0109)
_cons	-4.283***	-4.291***	-4.846***	-4.485***	-4.043***	-3.915***
	(0.430)	(0.432)	(0.431)	(0.441)	(0.443)	(0.447)
N	32757	32757	32733	32250	32420	32247
r2	0.931	0.932	0.933	0.933	0.933	0.933

Notes: The dependent variable is the natural logarithm of emigration rate (inflow foreign population from country i (source country) to country j (destination country) divided by the population in country i) in year t. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. All models include a vector of time, destination, and source country fixed effects. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 4.5: Robustness 1: The determines of inflow foreign population with fixed effects

	Log of emigration rate				
	(1)	(2)	(3)	(4)	(5)
ln(immigrant stock/source population)	0.797***	0.795***	0.809***	0.806***	0.806***
	(0.0117)	(0.0118)	(0.0173)	(0.0181)	(0.0181)
lnGDPperHead Ratio (Destination/Source)	0.998***	0.632**	1.196***	0.813***	0.813***
	(0.248)	(0.273)	(0.271)	(0.293)	(0.293)
ldist	-0.0890***	-0.0880***			
	(0.0310)	(0.0309)			
border	-0.105	-0.107			
	(0.0803)	(0.0803)			
colony	0.205***	0.204***			
	(0.0673)	(0.0669)			
comlang	0.146***	0.148***			
	(0.0429)	(0.0428)			
SocioeconomicConditions	0.0966***	0.0898***	0.0960***	0.0895***	0.0895***
(Destination)	(0.00597)	(0.00731)	(0.00597)	(0.00730)	(0.00730)
ForeignDebt	-0.0180***	-0.0203***	-0.0171***	-0.0194***	-0.0194***
(Source)	(0.00452)	(0.00472)	(0.00459)	(0.00480)	(0.00480)
BudgetBalance	0.0000737	-0.00850**	0.000358	-0.00814**	-0.00814**
(Source)	(0.00361)	(0.00403)	(0.00362)	(0.00405)	(0.00405)
GovernmentStability	-0.0106***	-0.0139***	-0.0107***	-0.0139***	-0.0139***
(Source)	(0.00348)	(0.00407)	(0.00352)	(0.00409)	(0.00409)
InternalConflicts	-0.0168***	-0.0216***	-0.0181***	-0.0228***	-0.0228***
(Source)	(0.00552)	(0.00586)	(0.00553)	(0.00588)	(0.00588)
Corruption	-0.0254**	-0.0226**	-0.0252**	-0.0224**	-0.0224**
(Source)	(0.0104)	(0.0109)	(0.0105)	(0.0109)	(0.0109)
_cons	-4.407***	-3.915***	-5.572***	-4.944***	-4.944***
	(0.386)	(0.447)	(0.327)	(0.428)	(0.428)
N	32247	32247	32247	32247	32247
r2	0.932	0.933	0.862	0.874	0.874
Time Fixed Effects	No	Yes	No	Yes	Yes
Destination Fixed Effects	Yes	Yes	No	No	Yes
Source Fixed Effects	Yes	Yes	No	No	Yes
Country-pair Fixed Effects	No	No	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of emigration rate (inflow foreign population from country i (source country) to country j (destination country) divided by the population in country i) in year t. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) includes a vector of source-country, and destination-country fixed effects. Model(2) includes a vector of time, source-country, and destination-country fixed effects. Model (3) includes a vector of country-pair fixed effects. Model(4) includes a vector of time, and country-pair fixed effects. Model (5) includes a vector of time, source-country, destination-country, and country-pair fixed effects.

Table 4.6: Robustness 2: The determines of inflow foreign population at $t-1$

	Log of emigration rate				
	(1)	(2)	(3)	(4)	(5)
ln(immigrant stock/source population) $(t-1)$	0.616***	0.617***	0.523***	0.511***	0.511***
	(0.0119)	(0.0118)	(0.0179)	(0.0185)	(0.0185)
lnGDPperHead Ratio (Destination/Source) $(t-1)$	0.838***	0.598*	0.405	0.390	0.390
	(0.275)	(0.309)	(0.294)	(0.330)	(0.330)
ldist	-0.382***	-0.377***			
	(0.0341)	(0.0340)			
border	-0.152*	-0.152*			
	(0.0876)	(0.0876)			
colony	0.513***	0.503***			
	(0.0871)	(0.0864)			
comlang	0.308***	0.308***			
	(0.0492)	(0.0490)			
SocioeconomicConditions $(t-1)$	0.101***	0.101***	0.105***	0.101***	0.101***
(Destination)	(0.00632)	(0.00795)	(0.00637)	(0.00788)	(0.00788)
ForeignDebt $(t-1)$	-0.0207***	-0.0231***	-0.0189***	-0.0255***	-0.0255***
(Source)	(0.00515)	(0.00536)	(0.00526)	(0.00551)	(0.00551)
BudgetBalance $(t-1)$	-0.000516	-0.0110**	-0.000907	-0.0104**	-0.0104**
(Source)	(0.00394)	(0.00454)	(0.00394)	(0.00454)	(0.00454)
GovernmentStability $(t-1)$	-0.0155***	-0.0162***	-0.0206***	-0.0162***	-0.0162***
(Source)	(0.00377)	(0.00464)	(0.00377)	(0.00465)	(0.00465)
InternalConflicts $(t-1)$	-0.0300***	-0.0308***	-0.0323***	-0.0330***	-0.0330***
(Source)	(0.00602)	(0.00639)	(0.00618)	(0.00665)	(0.00665)
Corruption $(t-1)$	-0.0442***	-0.0415***	-0.0530***	-0.0474***	-0.0474***
(Source)	(0.0115)	(0.0122)	(0.0115)	(0.0123)	(0.0123)
_cons	-2.532***	-2.225***	-7.099***	-7.102***	-7.102***
	(0.429)	(0.462)	(0.373)	(0.464)	(0.464)
N	30234	30234	30234	30234	30234
r2	0.917	0.918	0.848	0.848	0.848
Time Fixed Effects	No	Yes	No	Yes	Yes
Destination Fixed Effects	Yes	Yes	No	No	Yes
Source Fixed Effects	Yes	Yes	No	No	Yes
Country-pair Fixed Effects	No	No	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of emigration rate (inflow foreign population from country i (source country) to country j (destination country) divided by the population in country i) in year t. The values of all the independent variables are measured in year $t-1$. lnstockforeign (t-1) measures the natural logarithm of foreign population stock in year $t-1$. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) includes a vector of source-country, and destination-country fixed effects. Model(2) includes a vector of time, source-country, and destination-country fixed effects. Model (3) includes a vector of country-pair fixed effects. Model(4) includes a vector of time, and country-pair fixed effects. Model (5) includes a vector of time, source-country, destination-country, and country-pair fixed effects.

Table 4.7: Further Robustness 1: The determines of inflow foreign workers with fixed effects

	log (inflow foreign workers / source country population)				
	(1)	(2)	(3)	(4)	(5)
ln(immigrant stock/source population)	0.523***	0.547***	0.419***	0.438***	0.438***
	(0.0297)	(0.0311)	(0.0493)	(0.0551)	(0.0551)
lnGDPperHead Ratio (Destination/Source)	2.394***	1.565*	2.157**	1.913*	1.913*
	(0.866)	(0.920)	(0.940)	(0.997)	(0.997)
ldist	-0.176**	-0.137*			
	(0.0792)	(0.0803)			
border	-0.604*	-0.614*			
	(0.347)	(0.345)			
colony	0.700***	0.668***			
	(0.211)	(0.210)			
comlang	0.587***	0.568***			
	(0.112)	(0.112)			
SocioeconomicConditions	0.443***	0.456***	0.435***	0.452***	0.452***
(Destination)	(0.0299)	(0.0307)	(0.0297)	(0.0308)	(0.0308)
ForeignDebt	-0.0402***	-0.0260	-0.0396**	-0.0296*	-0.0296*
(Source)	(0.0156)	(0.0160)	(0.0155)	(0.0160)	(0.0160)
BudgetBalance	-0.0193**	-0.0105	-0.0228**	-0.0108	-0.0108
(Source)	(0.00931)	(0.0115)	(0.00933)	(0.0116)	(0.0116)
GovernmentStability	-0.00299	-0.0204*	-0.0102	-0.0196*	-0.0196*
(Source)	(0.0112)	(0.0116)	(0.0113)	(0.0116)	(0.0116)
InternalConflicts	-0.0379	-0.0415	-0.0414*	-0.0445*	-0.0445*
(Source)	(0.0238)	(0.0253)	(0.0239)	(0.0254)	(0.0254)
Corruption	0.0800**	0.0542	0.0831**	0.0538	0.0538
(Source)	(0.0390)	(0.0415)	(0.0394)	(0.0420)	(0.0420)
_cons	-12.40***	-11.37***	-14.53***	-13.92***	-13.92***
	(1.196)	(1.259)	(1.241)	(1.446)	(1.446)
N	13692	13692	13692	13692	13692
r2	0.756	0.760	0.286	0.309	0.309
Time Fixed Effects	No	Yes	No	Yes	Yes
Destination Fixed Effects	Yes	Yes	No	No	Yes
Source Fixed Effects	Yes	Yes	No	No	Yes
Country-pair Fixed Effects	No	No	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of inflow foreign workers from country i (source country) to country j (destination country) divided by the population in country i in year t. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) includes a vector of source-country, and destination-country fixed effects. Model(2) includes a vector of time, source-country, and destination-country fixed effects. Model (3) includes a vector of country-pair fixed effects. Model(4) includes a vector of time, and country-pair fixed effects. Model (5) includes a vector of time, source-country, destination-country, and country-pair fixed effects.

Table 4.8: Further Robustness 2: The determines of inflow seasonal foreign workers with fixed effects

	log (inflow seasonal foreign workers / source country population)				
	(1)	(2)	(3)	(4)	(5)
ln(immigrant stock/source population)	0.270**	0.248**	0.0693	-0.0341	-0.0341
	(0.121)	(0.114)	(0.242)	(0.235)	(0.235)
lnGDPperHead Ratio (Destination/Source)	5.433*	0.705	5.138	0.161	0.161
	(2.960)	(3.056)	(3.120)	(3.329)	(3.329)
ldist	-1.091***	-1.125***			
	(0.260)	(0.250)			
border	0.506	0.553			
	(0.472)	(0.480)			
colony	1.413***	1.489***			
	(0.470)	(0.467)			
comlang	-0.683*	-0.686*			
	(0.358)	(0.358)			
SocioeconomicConditions	0.118**	0.0237	0.141***	0.0402	0.0402
(Destination)	(0.0505)	(0.0519)	(0.0476)	(0.0509)	(0.0509)
ForeignDebt	0.0567	0.0803**	0.0518	0.0698*	0.0698*
(Source)	(0.0382)	(0.0406)	(0.0366)	(0.0378)	(0.0378)
BudgetBalance	0.0801***	0.0561**	0.0764***	0.0524*	0.0524*
(Source)	(0.0268)	(0.0281)	(0.0278)	(0.0288)	(0.0288)
GovernmentStability	0.0438*	-0.00370	0.0408*	-0.00375	-0.00375
(Source)	(0.0240)	(0.0252)	(0.0237)	(0.0253)	(0.0253)
InternalConflicts	0.0430	-0.0378	0.0527	-0.0379	-0.0379
(Source)	(0.0494)	(0.0512)	(0.0503)	(0.0517)	(0.0517)
Corruption	0.106	0.215***	0.0936	0.211***	0.211***
(Source)	(0.0758)	(0.0818)	(0.0735)	(0.0800)	(0.0800)
_cons	-12.36***	-6.033	-22.75***	-16.03***	-16.03***
	(3.554)	(3.736)	(4.411)	(4.747)	(4.747)
N	3211	3211	3211	3211	3211
r2	0.737	0.740	0.00000430	0.0176	0.0176
Time Fixed Effects	No	Yes	No	Yes	Yes
Destination Fixed Effects	Yes	Yes	No	No	Yes
Source Fixed Effects	Yes	Yes	No	No	Yes
Country-pair Fixed Effects	No	No	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of inflow seasonal foreign workers from country i (source country) to country j (destination country divided by the population in country i) in year t. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) includes a vector of source-country, and destination-country fixed effects. Model(2) includes a vector of time, source-country, and destination-country fixed effects. Model (3) includes a vector of country-pair fixed effects. Model(4) includes a vector of time, and country-pair fixed effects. Model (5) includes a vector of time, source-country, destination-country, and country-pair fixed effects.

Table 4.9: Further Robustness 3: The determines of inflow foreign students with fixed effects

	log (inflow foreign students / source country population)				
	(1)	(2)	(3)	(4)	(5)
ln(immigrant stock/source population)	0.330***	0.300***	0.474***	0.402***	0.402***
	(0.0348)	(0.0328)	(0.0966)	(0.0973)	(0.0973)
lnGDPperHead Ratio (Destination/Source)	-5.624***	-2.406**	-5.544***	-2.472**	-2.472**
	(0.937)	(1.001)	(0.995)	(1.127)	(1.127)
ldist	-0.389***	-0.486***			
	(0.0982)	(0.0981)			
border	-0.521	-0.524			
	(0.423)	(0.424)			
colony	1.874***	1.920***			
	(0.270)	(0.271)			
comlang	0.316	0.355			
	(0.236)	(0.240)			
SocioeconomicConditions	0.147***	0.117***	0.129***	0.112***	0.112***
(Destination)	(0.0346)	(0.0371)	(0.0356)	(0.0372)	(0.0372)
ForeignDebt	0.0206	-0.00467	0.0172	-0.00528	-0.00528
(Source)	(0.0167)	(0.0171)	(0.0170)	(0.0173)	(0.0173)
BudgetBalance	0.0245	0.0111	0.0223	0.00493	0.00493
(Source)	(0.0149)	(0.0156)	(0.0149)	(0.0157)	(0.0157)
GovernmentStability	-0.0609***	-0.0125	-0.0599***	-0.0154	-0.0154
(Source)	(0.0173)	(0.0186)	(0.0180)	(0.0186)	(0.0186)
InternalConflicts	-0.0387*	-0.00000347	-0.0460**	-0.00342	-0.00342
(Source)	(0.0223)	(0.0198)	(0.0229)	(0.0199)	(0.0199)
Corruption	0.0237	0.0148	0.0243	0.0170	0.0170
(Source)	(0.0406)	(0.0423)	(0.0401)	(0.0420)	(0.0420)
_cons	-4.379***	-7.611***	-4.241***	-9.342***	-9.342***
	(1.200)	(1.249)	(1.496)	(1.710)	(1.710)
N	2892	2892	2892	2892	2892
r2	0.807	0.814	0.212	0.335	0.335
Time Fixed Effects	No	Yes	No	Yes	Yes
Destination Fixed Effects	Yes	Yes	No	No	Yes
Source Fixed Effects	Yes	Yes	No	No	Yes
Country-pair Fixed Effects	No	No	Yes	Yes	Yes

Notes: The dependent variable is the natural logarithm of inflow foreign students from country i (source country) to country j (destination country) divided by the population in country i in year t. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) includes a vector of source-country, and destination-country fixed effects. Model(2) includes a vector of time, source-country, and destination-country fixed effects. Model (3) includes a vector of country-pair fixed effects. Model(4) includes a vector of time, and country-pair fixed effects. Model (5) includes a vector of time, source-country, destination-country, and country-pair fixed effects.

Table 4.10: Further Robustness 4: Non-linearity in stock foreign population with random vce

		Setting ln(immigrant stock/source population) $(t-1)$ at				
	Pooled	$< 20\%$	$20\% - 40\%$	$40\% - 60\%$	$60\% - 80\%$	$> 80\%$
ln(immigrant stock/source population)	0.617***	0.244***	0.644***	0.762***	0.708***	0.576***
$(t-1)$	(0.0118)	(0.0226)	(0.0356)	(0.0399)	(0.0380)	(0.0359)
lnGDPperHead Ratio (Destination/Source)	0.598*	0.396	0.834	1.626**	0.546	1.025
$(t-1)$	(0.309)	(0.722)	(0.615)	(0.642)	(0.743)	(0.895)
ldist	-0.377***	-0.499***	-0.203***	-0.161***	-0.212***	-0.355***
	(0.0340)	(0.113)	(0.0674)	(0.0604)	(0.0563)	(0.0629)
border	-0.152*	0.872***	-0.835***	-0.00783	0.0632	-0.203*
	(0.0876)	(0.261)	(0.188)	(0.191)	(0.119)	(0.120)
colony	0.503***			0.368***	0.825***	0.169*
	(0.0864)			(0.115)	(0.245)	(0.0940)
comlang	0.308***	-0.148	0.114	-0.00424	0.179**	0.362***
	(0.0490)	(0.112)	(0.0997)	(0.0796)	(0.0828)	(0.0761)
SocioeconomicConditions $(t-1)$	0.101***	0.0946***	0.114***	0.0882***	0.0462***	0.135***
(Destination)	(0.00795)	(0.0243)	(0.0180)	(0.0147)	(0.0150)	(0.0152)
ForeignDebt $(t-1)$	-0.0231***	-0.0189	-0.0174	-0.0172**	-0.00165	-0.0319***
(Source)	(0.00536)	(0.0148)	(0.0111)	(0.00741)	(0.0124)	(0.0109)
BudgetBalance $(t-1)$	-0.0110**	0.0109	-0.00530	-0.00298	-0.0174**	-0.0287**
(Source)	(0.00454)	(0.0117)	(0.00898)	(0.00706)	(0.00857)	(0.0112)
GovernmentStability $(t-1)$	-0.0162***	-0.0247	-0.00951	0.00152	-0.0211**	-0.0199***
(Source)	(0.00464)	(0.0153)	(0.0105)	(0.00840)	(0.00911)	(0.00726)
InternalConflicts $(t-1)$	-0.0308***	0.0250	-0.0116	-0.0470***	-0.0161	-0.0417***
(Source)	(0.00639)	(0.0195)	(0.0145)	(0.0118)	(0.0120)	(0.0130)
Corruption $(t-1)$	-0.0415***	-0.0110	0.0105	-0.0355	-0.0549**	-0.0425*
(Source)	(0.0122)	(0.0366)	(0.0261)	(0.0237)	(0.0265)	(0.0219)
_cons	-2.225***		-5.586***	-3.471***	-3.184***	-3.614***
	(0.462)		(0.927)	(1.168)	(1.020)	(1.054)
N	30234	3919	6674	6284	6335	7022
r2	0.918	0.825	0.833	0.873	0.892	0.869

Notes: The dependent variable is the natural logarithm of emigration rate (inflow foreign population from country i (source country) to country j (destination country) divided by the population in country i) in year t. The values of all the independent variables are measured in year $t-1$. lnstockforeign (t-1) measures the natural logarithm of foreign population stock in year $t-1$. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. All models include a vector of time, destination-country, and source-country fixed effects. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1) is the replicate of column 2 in the last table. Model (2) - (6) considers non-linearity of stock foreign population, each interval represent a 20 percentile of the stock foreign population.

Table 4.11: Further Robustness 5: The determines of inflow foreign population from OECD origin, and non-OECD origin.

	Source: OECD			Source: Non-OECD		
	t	$t-1$	$t-1$	t	$t-1$	$t-1$
ln(immigrant stock/source population)	0.798***	0.645***	0.590***	0.789***	0.604***	0.477***
	(0.0216)	(0.0236)	(0.0341)	(0.0138)	(0.0135)	(0.0218)
lnGDPperHead Ratio (Destination/Source)	1.851	2.141	2.125	0.389	0.235	-0.121
	(1.180)	(1.360)	(1.409)	(0.304)	(0.342)	(0.363)
ldist	0.0553	-0.143***		-0.122***	-0.470***	
	(0.0531)	(0.0540)		(0.0413)	(0.0452)	
border	-0.00829	0.00555		0.0591	0.240	
	(0.0948)	(0.0963)		(0.146)	(0.162)	
colony	0.105	0.249		0.246***	0.594***	
	(0.130)	(0.162)		(0.0737)	(0.0994)	
comlang	0.0798	0.176**		0.174***	0.360***	
	(0.0736)	(0.0783)		(0.0472)	(0.0560)	
SocioeconomicConditions	0.0767***	0.0792***	0.0799***	0.0951***	0.112***	0.111***
(Destination)	(0.0113)	(0.0122)	(0.0122)	(0.00956)	(0.0104)	(0.0103)
ForeignDebt	-0.0247***	-0.0320***	-0.0359***	-0.0158**	-0.0184***	-0.0180**
(Source)	(0.00706)	(0.00815)	(0.00818)	(0.00631)	(0.00713)	(0.00737)
BudgetBalance	-0.0217***	-0.0309***	-0.0303***	-0.00244	0.00219	0.00184
(Source)	(0.00796)	(0.00833)	(0.00822)	(0.00468)	(0.00540)	(0.00547)
GovernmentStability	-0.00832	-0.0135*	-0.0132*	-0.0154***	-0.0140**	-0.0149**
(Source)	(0.00664)	(0.00768)	(0.00761)	(0.00522)	(0.00595)	(0.00600)
InternalConflicts	-0.0106	-0.0200	-0.0228*	-0.0192***	-0.0257***	-0.0278***
(Source)	(0.0122)	(0.0132)	(0.0132)	(0.00693)	(0.00759)	(0.00800)
Corruption	-0.0614***	-0.0900***	-0.0976***	-0.00635	-0.0221	-0.0255
(Source)	(0.0160)	(0.0181)	(0.0181)	(0.0146)	(0.0160)	(0.0161)
_cons	-7.069***	-6.078***	-7.176***	-3.657***	-2.236***	-7.235***
	(1.265)	(1.459)	(1.515)	(0.706)	(0.759)	(0.554)
N	10700	10170	10170	21547	20064	20064
r2	0.924	0.915	0.808	0.933	0.916	0.867
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Destination Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair Fixed Effects	No	No	Yes	No	No	Yes

Notes: The dependent variable is the natural logarithm of inflow foreign population from country i (source country) to country j (destination country) in year t. In model (2) (3) (5) (6), the values of all the independent variables are measured in year $t-1$. lnstockforeign (t-1) measures the natural logarithm of foreign population stock in year $t-1$. The data covers yearly foreign population inflow from 133 source countries (including OECD members) to 34 OECD countries in the 1984-2015 period. The estimation method is GLS estimation. Standard errors, clustered by country-pair, are in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively. Model (1)-(3) include only OECD source countries. Model (4)-(6) include only non-OECD source countries.

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