UNIVERSITY OF WAIKATO

Hamilton
New Zealand

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

Rosmaiza Abdul Ghani, Michael P. Cameron
William Cochrane and Matthew Roskruge

Working Paper in Economics 1/20

February 2020

Corresponding Author

Rosmaiza Abdul Ghani
School of Accounting, Finance and Economics
University of Waikato
Private Bag 3105, Hamilton 3240, New Zealand
Email: rosmaizaghani@gmail.com

Michael P. Cameron
School of Accounting, Finance and Economics *and*
National Institute of Demographic and Economic Analysis
NIDEA
University of Waikato
Email: michael.cameron@waikato.ac.nz

William Cochrane
Faculty of Arts and Social Sciences *and*
National Institute of Demographic and Economic Analysis
University of Waikato
Email: billc@waikato.ac.nz

Matthew Roskruge
School of Economics and Finance
Massey University, Palmerston North, New Zealand
Email: m.roskruge@massey.ac.nz

Abstract

Studies on the causal impact of trade on migration are rare. Most previous studies have instead looked at the impact of migration on trade. The few empirical studies that have a causal interpretation have focused either on a single country, a single region, or within the members of a single trade agreement. This paper addresses the research question, does an increase in bilateral trade flows cause an increase in bilateral migration? We employ a novel instrumental variables strategy, using World Trade Organisation (WTO) affiliation and average tariff rates as instrumental variables within a gravity model framework. This approach mitigates against the endogeneity problem and allows us to extract the causal association between bilateral trade flows and bilateral migration flows. In the model, we employ data for 248 countries over the period 1990-2010. Our preferred estimator is the Poisson Pseudo-Maximum Likelihood Estimator, since it better handles the sparse nature of the data. Our findings suggest that trade is a statistically significant causal driver of migration. Based on our results, migration flows from country *i* to country *j* would increase by 11.3 percent if the corresponding trade flows increased by 10 percent.

Keywords

international trade
international migration
gravity model
causality

JEL Codes

F14, F22, O24

Acknowledgements

We are thankful for helpful suggestions from the participants at the 2019 Western Economic Association International (WEAI) Conference and seminar attendees at the University of Waikato, and to MARA University of Technology for financial support granted to the first author.

1. Introduction

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

Investigating this topic is important and timely. Trade flows have been expanding in response to globalization and the growth of developing countries. Migration flows are also affected by globalization. Both elements are important factors in providing opportunities, raising living standards and allowing society access to a greater variety of goods. However, recent political pressures have called into question the continuing desirability of both migration and trade flows, particularly those originating in certain parts of the world (Greenhill 2016). In 1990, 2.9 percent of the world population were migrants. This percentage had increased to 3.1 by 2010.[1] Meanwhile, annual world merchandise exports grew by seven percent on average from 1990 to 2005. Given the increases in both international trade and migration flows, understanding the impact of increased trade on migration is important for policy makers and planners seeking to ensure sustainable growth and to plan for future population pressures.

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

Following the protectionism of the inter-war period, in 1947 trade became more liberal when 23 countries agreed to be part of the first worldwide multilateral free trade agreement, the General Agreement on Tariffs and Trade (GATT), which transformed into the World Trade Organization (WTO) in 1995. The aim of this agreement was to increase international trade among members by removing or at least reducing any kind of trade protectionism. The WTO established a set of standards to guide member countries to participate in international trade. Nearly every country in the world is now a member of the WTO (164 members; see Appendix Table A1), and it has global impact. There are many benefits gained by a country joining the WTO. In general, all members must treat each other the same without any preferential trade

[1] United Nations Department of Economic and Social Affairs, Population Division 1, *International Migration Report* 2011.

benefits. The principal areas of activity of the WTO all focus on trade (WTO, 2011), including: trade negotiations; implementation and monitoring; dispute settlement; and building trade capacity. WTO is not directly involved in migration issues.

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

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

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

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

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

2. Literature Review

Many studies have focused on the correlation between both trade and migration and identifying whether they are complements (when the signs of both estimated coefficients are in the same direction), for example, Ghani, Cameron, Cochrane and Roskruge 2019, White 2007, Genç 2014) or substitutes (when the signs of both estimated coefficients are contradicted to each other) (for example, Wickramasekera 2002).

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

The closest study to our paper is Aguiar *et al.* (2007). Their study is based on the data of legal permanent resident flows to and from the U.S., using import trade costs as an instrument. They found that trade flows have a positive but insignificant impact on migration flows. Other studies have focused on the causal effect of migration on trade, rather than the effect of trade on migration. Steingress (2015) found that there was a causal relationship between immigration and imports, with a 10 percent increase in immigrants to the U.S. increasing intermediate imports from the immigrants' origin country by 1.5 percent. They used the allocation of refugee immigration spaces by the government as an instrument.

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

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

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

3: Data and Methods

3.1 Data Descriptions

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

Data on bilateral trade flows were attained from the Center for International Data at the University of California–Davis.[2] The value of bilateral nominal trade flows are in US$1million (Baxter and Kouparitsas 2006, Feenstra, Lipsey Deng, Ma and Mo 2005). The source of these bilateral trade flows data is importer countries' reports. Importers are believed to have more incentive to accurately record all transactions than exporters due to their liability for tariffs and duties (Fouquin and Hugot 2016).

Abel and Sander (2014) have produced a newly assembled global dataset on bilateral migration flows that has yet to be fully exploited in this area of study. The dataset consists of country–level data for each five-year period from 1990 to 2010, constructed from the changes in migrant stocks. These data effectively represent the total absolute number of people who change their country of residence within each five-year period and were mainly developed based on place-of-birth answers to census questions, information obtained from population registers, and refugee statistics.[3]

Our regression models use gross domestic product (GDP) and population data from the United Nations Population Division,[4] being mid-year estimates of the total population

[2] http://cid.econ.ucdavis.edu. Constructed from United Nation Trade data by Robert Fenestra and Robert Lipsey.
[3] UNPD, *Trends in International Migrant Stock: Migrants by Destination and Origin*, 2013 revision
[4] https://esa.un.org/unpd/wpp/

(headcount) counting all residents of each country irrespective of legal status or nationality, as control variables. Other variables were obtained from the CEPII database, including bilateral distances and colonial heritage. Distance was measured as the geographical distance between capital cities in kilometres. The distances can be taken as an indicator of the cost of a trade flow or migration event because the greater the distance, the higher the cost will be (Marimoutou, Peguin and Peguin-Feissolle 2009). Common colonial heritage is also often used by economists (for example, Mayer, Head and Ries 2008, Ekkayokkaya, Foojinphan and Wolff 2017) to represent similarities in cultural, political or legal institutions. Additional dummy variables were created for adjacency and landlockedness. Adjacency means whether countries *i* and country *j* share a common border and has also been used by Baier and Bergstrand (2009). Meanwhile, landlocked countries face constraints to accessing world markets, which may affect trade or migration flows (Faye *et al.* 2004).

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

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

3.2 Methods

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

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

where all variables except dummy variables are in log form, *i* and *j* indicate origin and destination countries respectively, and *t* indicates years. Trde_{ijt} is bilateral trade, Mig_{ijt} is

bilateral migration, and X_{ijt} is a vector of control variables, while u_{ijt} is an idiosyncratic error term. The coefficient δ_1 captures the impact of trade flows on migration flows and is a causal impact in the case of our preferred IV model specification.

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

One of the most important ordinary least squares (OLS) assumptions, which also applies to PPML, is that the errors are uncorrelated with the dependent variables. This assumption is violated in the presence of endogeneity, in which case OLS produces biased and inconsistent parameter estimates. Unlike the OLS assumptions, we expect that:

$$E_{[uij,t|TRDEi]} \neq 0.$$

then the OLS estimate of δ_1 will be biased and inconsistent since trade and the error term are correlated, that is, trade is endogenous.

To deal with the potential endogeneity of bilateral trade flows in our model, we use GATT/WTO membership and average tariff rates as instruments for trade. Our preferred model is a combination of two-stage least squares (TSLS) and PPML model. TSLS is frequently used to identify causal effects and/or to address endogeneity (Zelekha and Bar-Efrat 2011, Campaniello 2014, Romer and Frankel 1999, De Vita, Trachanas and Luo 2018, Yu, de Jong and Lee 2012). The reason this method is used is that variation in the estimated values of the endogenous variable is limited to that occurring because of changes in the exogenous instruments. Instruments will only be correlated with *x* but cannot be correlated with *y* or the error term in the equation model.

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

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

3.3 Weakness Test and Overidentifying Test

To test the validity of the instrumental variables, a weak instrument test (Staiger and Stock 1997) was used to confirm that our instruments were not weak (F test = 137.45). Since we have only endogenous variable but two instrumental variables, our model is over-identified. We used the Sargan test for the overall relevance of the instruments (Baum *et al.* 2007). Under the null hypothesis that all instrumental variables are uncorrelated with the error terms, we failed to reject the null hypothesis (Sargan statistic=47.04, p= 0.6). Therefore, it is safe to conclude that all excluded instruments are relevant.

3.4 Limitation

There are two primary limitations to our study. First, to prove that an instrument is valid, we must test the correlation between the instruments and the error term. Since the error term is unknown, this test is impossible to conduct. However, we argue that our instruments are nevertheless valid because they are plausibly exogenous. Since WTO membership does not entail any special access between countries for migration purposes, WTO membership should not exert a direct impact on migration flows. Similarly, tariff rates are plausibly unrelated to migration flows, and indeed have been used as an instrument in prior research (Aguiar *et al.* 2007). The second limitation is that our dataset has a number of missing values. Since we are using global dataset with eleven variables, it is difficult to get complete data, especially for small countries like Tuvalu, Marshall Islands, or Montenegro, which just recently gained independence. However, we use the most complete data currently available, including a dataset on migration that is new and the most complete exploration of international migration flows (Abel and Sander 2014).

3.5 Robustness Tests

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

In Table A2 in the Appendix, Model 2.1a reports the first stage coefficients and Model 2.1b reports the second stage incidence rate ratio for the regression model with WTO as the only instrument for trade. Model 2.2a reports the first stage coefficients and Model 2.2b reports the second stage incidence rate ratio for the regression model with the tariff rate as the only instrument for trade. Model 2.3a reports the first stage coefficients and Model 2.3b reports the

second stage incidence rate ratio for the regression model that excludes data from China and the United States. It is possible that the US and China might have an outsized effect on the results given their contributions to world trade. Interestingly, when we dropped China and the United States from our dataset, our desired coefficients are qualitatively similar to the findings presented in Table 1.

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

3. Results and Discussion

Table 1 presents the results of each model. Model 1.1 shows the pooled OLS results, Model 1.2 shows results PPML without IVs while Models 1.3a and 1.3b, shows the regression results using instrumental variable in TSLS combined with PPML model.

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

PPML without taking into account any instrumental variables in the model, was also added in the regression table mainly for comparison to our preferred model. The focused result shows that trade and migration have positive causal impact, but the value is slightly bigger which shows that if trade flows from country *i* to country *j* increase by 10 percent, this causes migration to increase by 13.4 percent. This model might also be bias subject to endogeneity without applying potential excluded instruments.

For the PPML-TSLS model, in the first stage, significant coefficients for both instrumental variables were obtained and proved that both are relevant and correlated with the endogenous variable. The sign of WTO and average tariff are as expected. For WTO, as a country become a member of WTO, their trade will increase and for tariff, the more tariff is implemented, trade between countries will be reduced. In the second stage, the main outcome shows that if trade flows from country *i* to country *j* increase by 10 percent, this causes migration to increase by 11.3 percent.

Table 1: Regression Results with All Countries

Variables	Model 1.1 Pooled OLS Migration	Model 1.2 PPML without IV Migration	Model 1.3a Trade 1st stage	Model 1.3b PPML-TSLS Migration 2nd Stage
Trade	0.203***	1.344		1.130
	(0.006)	(1.227-1.472)		(1.096-1.142)
GDP Origin	-0.101***	0.627	0.999***	1.031
	(0.013)	(0.567 - 0.700)	(0.006)	(1.022-1.032)
GDP Destination	0.540***	1.546	1.322***	1.164
	(0.015)	(1.274 - 1.877)	(0.007)	(1.154-1.657)
Distance	-0.125***	0.919	-1.230***	0.740
	(0.036)	(0.896 - 0.942)	(0.011)	(0.733-0.741)
Population Origin	0.508***	1.147	-0.197***	1.105
	(0.012)	(1.137 - 1.156)	(0.007)	(1.095-1.106)
Population Destination	-0.226***	0.950	-0.304***	0.973
	(0.013)	(0.942 - 0.958)	(0.007)	(0.964-0.974)
Common Colonizer	0.737***	0.781	0.719***	1.269
	(0.034)	(0.541- 1.127)	(0.020)	(1.257-1.270)
Adjacency	0.636***	2.035	0.488***	1.168
	(0.051)	(1.313 - 3.153)	(0.034)	(1.157-1.170)
Landlocked Origin	0.091**	1.197	-0.599***	1.024
	(0.038)	(0.877- 1.633)	(0.021)	(1.015-1.025)
Landlocked Destination	0.084	0.911	-0.451***	0.952
	(0.037)	(0.658 - 1.276)	(0.021)	(0.943-0.953)
WTO			0.692***	
			(0.016)	
Average Tariff			-0.025***	
			(0.002)	
Multilateral Resistance	-0.731***	0.628		
	(0.042)	(0.434- 0.907)		
Observations	30,359	30,359		37,916
R-squared	0.38			
Pseudo R2		0.14		
F-test			137	
Sargan test			0.642	

Notes:. Models 1.1 and 1.3a report coefficients, with standard errors clustered by paired countries of origin and destination in parentheses. Models 1.2 and 1.3b report the exponentiated coefficients, with 95% confidence intervals in parentheses.

4. Conclusions

Previous studies have found that migration is positively correlated with trade. Fewer studies have established causality between them, and those studies have mostly focused on only a small subset of countries. In our paper, we established the causal impact of trade on migration using a large global dataset of bilateral trade and migration flows. We controlled for the endogeneity problem by using WTO memberships and average tariff rate as instruments for trade flows. We

found that trade has a positive causal impact on migration, with 10 percent increase in trade, migration will increase by 11.3 percent. Our results are robust to the exclusion of China and the U.S. from the dataset, and robust to the use of each instrument separately, or together.

The findings of this paper have important policy implications, in addition to being of theoretical and practical interest. Countries that implement trade barriers, through tariffs or non-tariff trade barriers, can expect inward migration from the countries affected by the trade barriers to decrease. Countries or policy makers that favor both reducing trade and reducing migration will probably find the outcome of this research helpful in arguing a case for trade barriers. On the other hand, if a country becomes more liberal in their policy towards imports, they can expect increased immigration from countries that benefit from more liberal market access. This suggests that countries or policy makers can to some extent influence the source of immigrants to their countries, through the judicious use of trade policy.

Exporting countries are also affected. If a country increases exports, then it can expect an increase in emigration, towards the destination countries where exports have increased. Export promotion is a common goal of developing countries, but our results suggest that increasing exports is not without cost to the domestic economy. Since increasing exports will cause an increase in emigration, the origin country could suffer from a shortage of labor (Docquier 2014). This is especially problematic in the case of high-skilled labor. On the other hand, the increased diaspora may lead to increases in remittances to the origin country. Moreover, return migrants to the origin country come with increased human capital, skills, knowledge and experience, and thus contribute relatively more to the economy. To evaluate the net impact of increasing exports on the economy of an exporting country requires not only taking account of the causal impact on increasing emigration that we have identified, but also a deeper understanding of the role of remittances and return migration. We leave that as an exercise for future research.

Our results are silent on the particular mechanisms that link trade to migration. Future research could usefully explore the theoretical and practical mechanisms through which an increase (decrease) in trade would lead to an increase (decrease) in migration flows. We note that these mechanisms may differ between exporting and importing countries. We have also not explicitly tested the impact of changing trade policy on any particular country's migration flows. Our results are based on cross-country analysis, so the experience of any particular country may differ. Nevertheless, excluding the two largest countries (in terms of trade flows) does not materially affect our estimates.

Migration and trade are important components of a country's policy regime. Our results establish a causal link between these two components, demonstrating that trade policy should not be enacted independent of immigration policy, and vice versa.

References

Abel, G. J., & Sander, N. (2014). Quantifying global international migration flows. *Science, 343*(6178), 1520–1522. doi:10.1126/science.1248676

Adam, C., & Cobham, D. (2007). *Modelling multilateral trade resistance in a gravity model with exchange rate regimes* (CDMA Conference Paper Series No. 0702). Centre for Dynamic Macroeconomic

Aguiar, A., Walmsley, T., & Abrevaya, J. (2007). Effects of bilateral trade on migration flows: The case of the United States.

Anderson, J. E., & van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *The American Economic Review*, *93*(1), 170–192.

Angrist, J. D., Pischke, J.-S., & Pischke, J. R.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*.

Baier, S. L., & Bergstrand, J. H. (2009). Estimating the effects of free trade agreements on international trade flows using matching econometrics. *Journal of International Economics*, *77*(1), 63–76.

Baxter, M., & Kouparitsas, M. A. (2006). *What determines bilateral trade flows?* (Working Paper No. 12188). National Bureau of Economic Research. doi:10.3386/w12188

Baum, C., Schaffer, M., & Stillman, S. (2007). Enhanced routines for instrumental variables/ generalized method of moments estimation and testing. *Stata Journal*, *7*(4), 465–506

Baxter, M., & Kouparitsas, M. A. (2006). *What Determines Bilateral Trade Flows?* (Working Paper No. 12188).doi:10.3386/w12188

Bound, J., Jaeger, D. A., & Baker, R. M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogeneous explanatory variable is weak. *Journal of the American Statistical Association*, *90*(430), 443–450. doi:10.2307/2291055

Cameron, A., & Miller, D. (2015). A Practitioner's guide to cluster-robust inference. *Journal of Human Resources*, *50*(2), 317–372.

Campaniello, N. (2014). The causal effect of trade on migration: Evidence from countries of the Euro-Mediterranean partnership. *Labour Economics*, *30*, 223–233. doi:10.1016/j.labeco

Chase-Dunn, C., Kawano, Y., & Brewer, B. D. (2000). Trade globalization since 1795: Waves of integration in the world-system. *American Sociological Review*, *65*(1), 77–95. doi:10.2307/2657290

Christian, P., & Barrett, C. (2017). Revisiting the effect of food aid on conflict: A methodological caution. *SSRN Electronic Journal*. doi:10.2139/ssrn.3025852

Collins, W. J., O'Rourke, K. H., & Williamson, J. (1997). *Were trade and factor mobility substitutes in history?* (Working Paper No. 6059). National Bureau of Economic Research. doi:10.3386/w6059

De Vita, G., Trachanas, E., & Luo, Y. (2018). Revisiting the bi-directional causality between debt and growth: Evidence from linear and nonlinear tests. *Journal of International Money and Finance*, *83*, 55–74. doi:10.1016/j.jimonfin

Docquier, F. (2014). The brain drain from developing countries. *IZA World of Labor*. doi.10.15185/izawol.31

Drzewoszewska, N. (2014). Searching for the appropriate measure of multilateral trade-resistance terms in the gravity model of bilateral trade flows. *Dynamic Econometric Models*, *14*, 29–49.

Ekkayokkaya, M., Foojinphan, P., & Wolff, C. C. P. (2017). Cross-border mergers and acquisitions: Evidence from the Indochina region. *Finance Research Letters*, *23*(C), 253–256.

Fagiolo, G., & Mastrorillo, M. (2014). Does human migration affect international trade? A complex-network perspective. *PLoS ONE*, *9*(5).

Federico, G., & Tena-Junguito, A. (2016). *A tale of two globalizations: Gains from trade and openness 1800–2010* (SSRN Scholarly Paper No. ID 2766419). Rochester, NY: Social Science Research Network.

Feenstra, R. C., Lipsey, R. E., Deng, H., Ma, A. C., & Mo, H. (2005). *World Trade Flows: 1962-2000* (Working Paper No. 11040). National Bureau of Economic Research. doi:10.3386/w11040

Felbermayr, G. J., & Jung, B. (2009). The pro-trade effect of the brain drain: Sorting out confounding factors. *Economics Letters*, *104*(2), 72–75. doi:10.1016/j.econlet

Fouquin, M., & Hugot, J. (2016). *Two centuries of bilateral trade and gravity data: 1827-2014* (Working Papers No. 2016–14). CEPII research center.

Fox, K. A. (1959). [Review of *Review of Economic Forecasts and Policy*, by H. Theil]. *The American Economic Review*, *49*(4), 711–716.

Genç, M. (2014). The impact of migration on trade. *IZA World of Labor*. doi.10.15185/izawol.82

Ghani, R.A., Cameron, M.P., Cochrane, W. & Roskruge,M.J. 2019. *A gravity model estimation of the bi-directional relationship between international trade and migration* (Working Papers in Economics 19/02), University of Waikato.

Gould, D. M. (1994). Immigrant links to the home country: Empirical implications for U.S. bilateral trade flows. *The Review of Economics and Statistics*, *76*(2), 302–316. doi:10.2307

Greenhill, K. M. (2016). Open arms behind barred doors: Fear, hypocrisy and policy schizophrenia in the European migration crisis. *European Law Journal*, *22*(3), 317–332. doi.10.1111/eulj.12179

Hanson, G. H. (2010). Chapter 66 - International migration and the developing world. In D. Rodrik & M. Rosenzweig (Eds.), *Handbook of Development Economics* (Vol. 5, pp. 4363–4414). Elsevier. doi:10.1016/B978-0-444-52944-2.00004-5

Hatzigeorgiou, A., & Lodefalk, M. (2015). Trade, migration and integration – evidence and policy implications. *The World Economy*, *38*(12), 2013–2048. doi:10.1111/twec.12236

Head, K., & Ries, J. (1998). Immigration and trade creation: Econometric evidence from Canada. *The Canadian Journal of Economics / Revue Canadienne d'Economique*, *31*(1), 47–62. doi:10.2307/136376

Hong, T. C., & Santhapparaj, A. S. (2006). Skilled labor immigration and external trade in Malaysia: A pooled data analysis. *Perspectives on Global Development & Technology*, *5*(4), 351–366. doi:10.1163/156915006779206088

Hsiao, C. (2014). *Analysis of panel data*. Cambridge University Press.

Kirby, M.W. (2001). Bargaining on Europe: Britain and the first common market, 1860–1892. *The American Historical Review*, *106*(1), 256–257. doi:10.1086/ahr/106.1.256-a

Law, D., Genç, M., & Bryant, J. (2013). Trade, diaspora and migration to New Zealand. *The World Economy*, *36*(5), 582–606. doi:10.1111/twec.12035

Marimoutou, V. Peguin, D. & Peguin-Feissolle, A. (2009). The 'distance-varying' gravity model in international economics: Is the distance an obstacle to trade? *Economics Bulletin*, *29*(2), 1139–1155.

Markusen, J.R. (1983). Factor movements and commodity trade as complements. *Journal of International Economics*, *14*(3), 341–356. doi:10.1016/0022-1996(83)90009-0

Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., & Taylor, J. E. (1993). Theories of international migration: A review and appraisal. *Population and Development Review*, *19*(3), 431–466. doi:10.2307/2938462

Mayer, T., Head, K., & Ries, J. (2008). *The erosion of colonial trade linkages after independence* (Working Papers No. 2008–27). CEPII research center.

Meschi, E., Taymaz, E., & Vivarelli, M. (2016). Globalization, technological change and labor demand: A firm-level analysis for Turkey. *Review of World Economics*, *152*(4), 655–680.doi: 10.1007/s10290-0160256-y

Mikusheva, A. (2013). Survey on statistical inferences in weakly-identified instrumental variable models. *Applied Econometrics*, *29*(1), 117–131.

Mundell, R. A. (1957). International trade and factor mobility. *The American Economic Review*, *47*(3), 321–335.

Mundra, K. (2005). Immigration and international trade: A semiparametric empirical investigation. *The Journal of International Trade and Economic Development*, *14*(1), 65–91. doi:10.1080/0963819042000333252

Nooruddin, I., & Simmons, J. W. (2009). Openness, uncertainty, and social spending: Implications for the globalization— welfare state debate. *International Studies Quarterly*, *53*(3), 841–866.

Ortega, F., & Peri, G. (2011). *The aggregate effects of trade and migration: Evidence from OECD countries* (SSRN Scholarly Paper No. ID 1806405). Rochester, NY: Social Science Research Network.

Peri, G., & Requena-Silvente, F. (2010). The trade creation effect of immigrants: evidence from the remarkable case of Spain. *The Canadian Journal of Economics / Revue Canadienne d'Economique*, *43*(4), 1433–1459.

Poot, J., Alimi, O., Cameron, M. P., & Maré, D. C. (2016). The gravity model of migration: The successful comeback of an ageing superstar in regional science. *Investigaciones Regionales—Journal of Regional Research*

Ravenstein, E. G. (1885). The laws of migration. *Journal of the Statistical Society of London*, *48*(2), 167–235. doi:10.2307/2979181

Razin, A., & Sadka, E. (1992). *International migration and international trade* (Working Paper No. 4230). National Bureau of Economic Research. doi:10.3386/w4230

Romer, D.H., & Frankel, J. A. (1999). Does Trade Cause Growth? *American Economic Review*, *89*(3), 379–399.

Serrano-Domingo, G., & Requena-Silvente, F. (2013). Re-examining the migration–trade link using province data: An application of the generalized propensity score. *Economic Modelling*, *32*, 247–261.

Sheng, Z. & Ma, J. (2011). An analysis of emerging China's economy and its influence on world economy.

Silva, J.S. & Tenreyro, S. (2005). *The log of gravity* (CEP Discussion Papers No. dp0701). Centre for Economic Performance, LSE.

Staiger, D., & Stock, J.H. (1997). Instrumental variables regression with weak instruments. *Econometrica*, *65*(3), 557–586. doi:10.2307/2171753

Steingress, W. (2015). *The causal impact of migration on US trade: Evidence from a natural experiment* (IZA Discussion Papers No. 9058). Institute for the Study of Labor (IZA).

Stock, J.H. (2015). Instrumental variables in statistics and econometrics. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences (Second Edition)* (pp. 205–209). Oxford: Elsevier. doi:10.1016/B978-0-08-097086-8.42037-4

Stock, J.H., & Watson, M. W. (2006). *Heteroskedasticity-robust standard errors for fixed effects panel data regression* (Working Paper No. 323). National Bureau of Economic Research. doi:10.3386/t0323

Stock, J.H., & Yogo, M. (2002). *Testing for weak instruments in linear iv regression* (Working Paper No. 284). National Bureau of Economic Research. doi:10.3386/t0284

Tinbergen, J. (1963). Shaping the world economy. *The International Executive*, *5*(1), 27–30. doi:10.1002/tie.5060050113

Wagner, D., Head, K., & Ries, J. (2002). Immigration and the trade of provinces. *Scottish Journal of Political Economy*, *49*(5), 507–525. doi:10.1111/1467-9485.00245

White, R. (2007). Immigrant-trade links, transplanted home bias and network effects. *Applied Economics*,*39*(7), 839–852. doi:10.1080/00036840500447849

Wickramasekera, P. (2002). *Asian labour migration: Issues and challenges in an era of globalization* Geneva:ILO

Yu, J., de Jong, R., & Lee, L. (2012). Estimation for spatial dynamic panel data with fixed effects: The case of spatial cointegration. *Journal of Econometrics*, *167*(1), 16–37. doi:10.1016/j.jeconom

Zelekha, Y. & Bar-Efrat, O. (2011). The link between exchange rate uncertainty and Israeli exports to the US: 2SLS and cointegration approaches. *Research in Economics*, *65*(2), 100–109.

Appendix

Table A1: Lists of Members of World Trade Organization (WTO) and their Accession Dates

Members of WTO	• Afghanistan — 29 July 2016 • Albania — 8 September 2000 • Angola — 23 November 1996 • Antigua and Barbuda — 1 January 1995 • Argentina — 1 January 1995 • Armenia — 5 February 2003 • Australia — 1 January 1995 • Austria — 1 January 1995 • Bahrain, Kingdom of — 1 January 1995 • Bangladesh — 1 January 1995 • Barbados — 1 January 1995 • Belgium — 1 January 1995 • Belize — 1 January 1995 • Benin — 22 February 1996 • Bolivia, Plurinational State of — 12 September 1995 • Botswana — 31 May 1995 • Brazil — 1 January 1995 • Brunei Darussalam — 1 January 1995 • Bulgaria — 1 December 1996 • Burkina Faso — 3 June 1995 • Burundi — 23 July 1995 • Cabo Verde — 23 July 2008 • Cambodia — 13 October 2004 • Cameroon — 13 December 1995 • Canada — 1 January 1995 • Central African Republic — 31 May 1995 • Chad — 19 October 1996 • Chile — 1 January 1995 • China — 11 December 2001 • Colombia — 30 April 1995 • Congo — 27 March 1997 • Costa Rica — 1 January 1995 • Côte d'Ivoire — 1 January 1995 • Croatia — 30 November 2000 • Cuba — 20 April 1995 • Cyprus — 30 July 1995 • Czech Republic — 1 January 1995 • Democratic Republic of the Congo — 1 January 1997 • Denmark — 1 January 1995 • Djibouti — 31 May 1995 • Dominica — 1 January 1995 • Dominican Republic — 9 March 1995 • Ecuador — 21 January 1996 • Egypt — 30 June 1995 • El Salvador — 7 May 1995 • Estonia — 13 November 1999	• Indonesia — 1 January 1995 • Ireland — 1 January 1995 • Israel — 21 April 1995 • Italy — 1 January 1995 • Jamaica — 9 March 1995 • Japan — 1 January 1995 • Jordan — 11 April 2000 • Kazakhstan — 30 November 2015 • Kenya — 1 January 1995 • Korea, Republic of — 1 January 1995 • Kuwait, State of — 1 January 1995 • Kyrgyz Republic — 20 December 1998 • Lao People's Democratic Republic — 2 February 2013 • Latvia — 10 February 1999 • Lesotho — 31 May 1995 • Liberia — 14 July 2016 • Liechtenstein — 1 September 1995 • Lithuania — 31 May 2001 • Luxembourg — 1 January 1995 • Macao, China — 1 January 1995 • Madagascar — 17 November 1995 • Malawi — 31 May 1995 • Malaysia — 1 January 1995 • Maldives — 31 May 1995 • Mali — 31 May 1995 • Malta — 1 January 1995 • Mauritania — 31 May 1995 • Mauritius — 1 January 1995 • Mexico — 1 January 1995 • Moldova, Republic of — 26 July 2001 • Mongolia — 29 January 1997 • Montenegro — 29 April 2012 • Morocco — 1 January 1995 • Mozambique — 26 August 1995 • Myanmar — 1 January 1995 • Namibia — 1 January 1995 • Nepal — 23 April 2004 • Oman — 9 November 2000 • Pakistan — 1 January 1995 • Panama — 6 September 1997 • Papua New Guinea — 9 June 1996 • Paraguay — 1 January 1995 • Peru — 1 January 1995 • Philippines — 1 January 1995 • Poland — 1 July 1995

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

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

Table A2: Regression Results of Robustness Tests

Model Number:	**(2.1a)**	**(2.1b)**	**(2.2a)**	**(2.2b)**	**(2.3a)**	**(2.3b)**
Variables	**Trade (1st Stage)**	**PPML-TSLS Migration (2nd Stage) irr**	**Trade (1st Stage)**	**PPML-TSLS Migration (2nd Stage) irr**	**Trade (1st Stage)**	**PPML-TSLS Migration (2nd Stage) irr**
Trade		1.014		1.052		1.410
		(1.008-1.020)		(1.020-1.085)		(1.376-1.460)
GDP Origin	1.002***	1.003	1.034***	0.991	0.976***	1.045
	(0.006)	(1.002-1.004)	(0.006)	(0.954-1.029)	(0.007)	(1.035-1.046)
GDP	1.348***	1.016	1.364***	1.124	1.311***	1.174
Destination	(0.006)	(1.015-1.017)	(0.007)	(1.083-1.167)	(0.007)	(1.164-1.176)
Distance	-1.236***	0.969	-1.190***	0.775	-1.293***	0.777
	(0.011)	(0.968-0.970	(0.010)	(0.753-0.798)	(0.011)	(0.760-0.778)
Population	-0.198***	1.011	-0.220***	1.105	-0.196***	1.092
Origin	(0.007)	(1.009-1.013)	(0.007)	(1.095-1.114)	(0.007)	(1.082-1.093)
Population	-0.347***	0.997	-0.340***	0.970	-0.315***	0.972
Destination	(0.007)	(0.996-0.998)	(0.008)	(0.963-0.977)	(0.008)	(0.963-0.973)
Common	0.709***	1.025	0.819***	1.175	0.670***	1.226
Colonizer	(0.020)	(1.024-1.027)	(0.020)	(1.112-1.242)	(0.021)	(1.215-1.227)
Adjacency	0.488***	1.016	0.489***	1.211	0.455***	1.184
	(0.034)	(1.014-1.018)	(0.035)	(1.161.263)	(0.036)	(1.173-1.186)
Landlocked	-0.599***	1.002	-0.635***	1.103	-0.591***	1.015
Origin	(0.021)	(1.001-1.004)	(0.021)	(1.044-1.165)	(0.021)	(1.006-1.016)
Landlocked	-0.420***	0.995	-0.474***	1.026	-0.417***	0.961
Destination	(0.021)	(0.993-0.997)	-0.635***	(0.976-1.079)	(0.021)	(0.952-0.962)
WTO	0.664***				0.752***	
	(0.016)				(0.016)	
Average Tariff			-0.018***		-0.026***	
			(0.002)		(0.002)	
Observations		37,916		37,916		35,874
F-Test IV	17.44		124.81			
Sargan test					0.3348	

Notes

Model 2.1a reports the first stage coefficients and Model 2.1b reports the second stage incidence rate ratio for the regression model with WTO as the only instrument for trade.

Model 2.2a reports the first stage coefficients and Model 2.2b reports the second stage incidence rate ratio for the regression model with tariff rate as the only instrument for trade. Model 2.3a reports the first stage coefficients.

Model 2.3b reports the second stage incidence rate ratio for the regression model excluding data from China and the United States.

Standard errors clustered by paired countries of origin and destination in parentheses for coefficients. For the exponentiated coefficients, 95% confidence intervals are reported in parentheses.