Three Essays on Trade Costs and National Borders

Nicholas Myers

Doctor of Philosophy
University of Edinburgh
2014

Abstract of Thesis

Individuals of the same country buy and sell from each other far more than they do with individuals of a different country. A cost is associated with exchanging goods and service across national boundaries. Economists have had difficulty, however, in reconciling the small observable trade frictions with the very large trade reducing effect of borders. In the first chapter of this thesis, we propose an explanation which explains a great deal of the border puzzle between the United States and Canada. Few observable trade frictions exist which prevent the buying and selling of goods across this border, yet Canadian provinces and American states trade far more with themselves than they do with each other. Using a novel data set on Facebook friendship connections between North American regions, we uncover a substantial home bias in social linkages between the United States and Canada. Simply put, Canadians and Americans do not know each other very well. Social networks are important for trade in that they reduce information costs and increase the efficacy of informal trust mechanisms. We find that including social linkages in a gravity model substantially mediates the effect of the US-Canada border on trade. In the second chapter of this thesis, we focus on how trade costs are formed. Workhorse models of international trade typically assume, for great simplicity, that trade costs are exogenous to trade. We present a model in which the act of trading affects the cost of trade and vice versa. We focus on the trade cost associated with informal trust mechanisms. A great deal of evidence exists which shows that *ceteris paribus*, countries that trust each other trade far more with each other. In our model, trust is a necessary condition for trade to exist, but trust can only be formed through

repeated interaction. This creates a supermodular game between would-be traders of the same country. Broadly speaking, two equilibria exist in this game. One with trust and trade, and one without trust and without trade. This framework highlights the importance of trade missions as a coordinating device. In the final chapter, based on a joint work, we assess the welfare implications of political separation. Because borders dramatically reduce trade, what happens when national borders are created when they once did not exist? The focus of this chapter is on the Basque Country in Spain, in which there is a strong pressure for full political separation. While it is certainly difficult to say what exactly would happen to the cost of trading between the Basque Country and the rest of Spain if political separation occurred, we use the cost of trade between Portugal and Spain as a benchmark. That is, we ask what the welfare implications would be if the cost of trade between the Basque Country and the rest of Spain were equal to the cost of trade between Portugal and Spain. We find that increasing trade costs in this manner would decrease the Basque Country's real income by more than 12%.

Declaration of Own Work

I declare that this thesis was written and composed by myself and is the result of my own work unless clearly stated and referenced. This thesis has not been submitted for any other degrees or professional qualifications. Chapter 3 of this thesis is based on a joint work with David Comerford and Sevi Mora Rodríguez. In addition to individual contributions to the ongoing joint work, this chapter represents a unique and significant contribution to the joint project.

Nicholas R. Myers

May 2014

Acknowledgements

I am heavily indebted to my supervisors Sevi Mora Rodríguez and Andy Snell for their support and guidance. Both of my supervisors have taken a great interest in my work and I have learned a great deal from them. My development as an economist was heavily influenced by their supervision.

I would also like to acknowledge many of my fellow PhD students for making my time here enjoyable and for providing stimulating discussion and advice. I particularly would like to thank James Best, Sean Brocklebank, Kimon Doulis, Burak Darbaz, Euan Limmack, and Andre Loureiro for providing helpful comments along the way. Furthermore, I would like to thank the PhD directors and administrative staff. I am very grateful to Ed Hopkins, Michèle Belot, Tim Worrall and once again Andy Snell for creating a very positive and supportive environment in which we could work. I am also grateful to the postgraduate administrators Marie Craft and Lesley Mayné.

To my incredible wife Irina and my parents Arvin and Linda

Contents

List of Tables

List of Figures

CHAPTER 1

Social Ties and the Border Puzzle

Abstract

Canadian provinces and American states do not trade with each other very much. Economists have long had difficulty in reconciling why there exists such a strong trade reducing effect of the border between these two countries when observable trade costs are so low. In this chapter, we provide evidence which suggests that much of this border effect can be described by a substantial home bias in social ties. Using novel data on Facebook friendship connections between North American regions, we document the fact that Canadians and Americans do not know each other nearly as much as they know themselves. The literature recognises that social connections are important for trade in that they improve trust and facilitate the flow of information. Once we account for these linkages in a standard gravity model, the trade reducing effect of the border falls by about 60% in our benchmark estimation. The border effect which remains after social ties are accounted for is roughly what one would expect given observable trade costs.

1.1. Introduction

National borders decrease trade by far more than standard theory predicts. This notion is most striking when one looks at trade patterns between the United States and Canada. For nearly two decades, there have been no formal tariff barriers preventing Canadians buying and selling from Americans, and *vice versa*. Furthermore, 80% of Canadians live within 100 miles of the United States, and in some cases, single towns straddles both countries. At first glance, one would certainly not expect for there to be a substantial home bias in economic interaction between these two countries. Despite the seeming innocuousness of this border, the seminal studies of Feenstra (2002) and Anderson and van Wincoop (2003) find that the border decreases trade by a factor of about 5 after accounting for relevant factors.

It is conceivable that due to culture differences, Americans and Canadians somehow intrinsically prefer interacting with themselves than with each other. While many borders around the world demarcate distinct ethnolinguistic and cultural groups (in which case borders are endogenous in the very long run), this is not so much the case for the border between the United States and Canada. The actual boundary between these two countries is, for the most part, an arbitrary result of political discourse.[1] When considering certain observable cultural attributes, Americans and Canadians are not much more similar with themselves than they are with each other. This point is illustrated in Table 1.1 below.[2] Despite these similarities, we show that Canadians and Americans do not know each other very well. The U.S.-Canada border reduces social linkages between individuals by a very large magnitude. We show this using data on Facebook friendship connections between more than 260 regions in the United States and Canada.

To illustrate how weak social linkages are between these two countries, consider Seattle, Toronto and Vancouver. The latter two cities are in Canada and the former is in the United States. The distance between Seattle and Toronto is 2,066 miles and the distance between Toronto and Vancouver is 2,088 miles. Despite being roughly equidistant, the probability that a randomly selected facebook user in Toronto is friends with a randomly selected facebook user in Vancouver is more than 12 times greater than the probability a user in Toronto is friends with a user

[1] Nearly 2,000 miles of this border is simply the 49th parellel.

[2] This is based on the probability of sharing a common relgion, language and European ancestry. Religious categories considered are Protestant, Catholic, Mormon, Jewish and Muslim. Linguistic caterories considered are English, Spanish and French. European ancestral categories considered are English, French, Scottish, Irish, German, Italian, Ukrainian, Dutch, Polish, Russian, Norwegian and Swedish.

Table 1.1

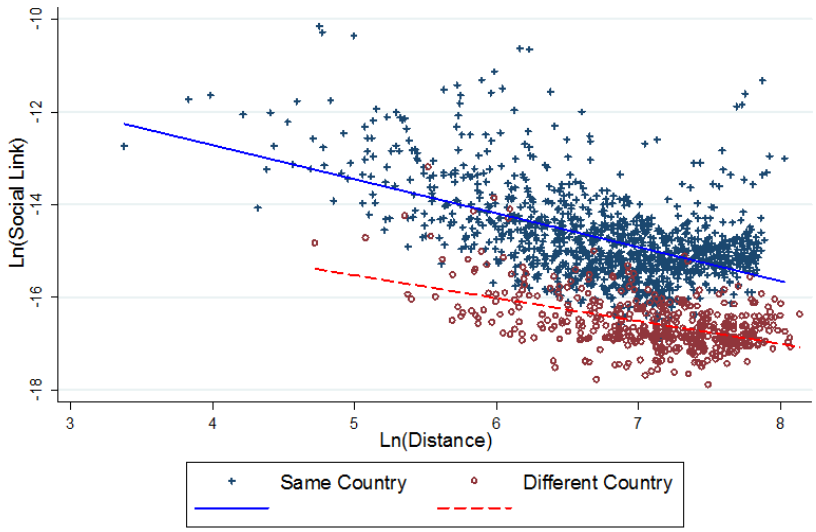
	CA-CA	US-US	CA-US
Religion	0.55	0.56	0.44
Language	0.62	0.75	0.65
European Ancestry	0.14	0.17	0.12

Probability a randomly selected individual from country i shares the same attribute as a randomly selected individual in country j. For example, the probability that both claim Scottish ancestry. Linguistic and ancestral data is from the National Household Survey 2011 and the American Community Survey 2011. Religious data is from the CIA world factbook. See footnote 2 for the list of attribute categories considered.

in Seattle. Furthermore, compare the link between Vancouver and Seattle with the link between Vancouver and Montreal, Canada. Vancouver and Seattle are a mere 119 miles apart and can reasonably be said to be part of the same metropolitan corridor. Vancouver and Montreal are 2293 miles apart. Residents of Vancouver and Seattle are predominantly English speaking, whereas residents of Montreal are predominantly French speaking. Despite all this, the probability of friendship between Montreal and Vancouver is more than 1.5 times greater than it is between Seattle and Vancouver. More generally speaking, according to our measure of social linkages between states and provinces which is discussed in detail in the data section, the average link between two states/provinces is more than ten times greater if the two states/provinces are on the same side of the border.

So why are Canada and the United States so far apart socially? While the border does not inhibit the flow of goods, it does inhibit the flow of people. Canadians move around in Canada and attend university in provinces away from home, but they very rarely move to or attend university in the United States. The reverse is also true. Helliwell (1997), for example, shows that the border reduces migration by a factor of about 100. It is important for our purposes to note, however, that this

Figure 1.1



author does not have data on migration from state i to province j, but only total migration from country i to province j. Graphically, we illustrate the border effect in social links in Figure 1.1 by plotting social links against distance.

The relationship between social networks (usually as proxied by migratory flows) and trade has garnered much interest in recent years and a positive link has been well established. The literature identifies three broad channels through which social networks are important for trade. The first channel is through the transmission of information. Setting up an export operation in a region outside one's own entails a sunk cost, part of which is comprised of learning about the local business environment and regulations. The cost of gathering this information is presumably much lower if one has friends, family or business acquaintances in the candidate region of import. On the other side of the market, information is also important to buyers. Information about the quality of a particular variety (or the awareness of its existence in the first place) is also likely transmitted through these networks.

The second channel through which these social ties are important for trade is through the facilitation of informal trust and community enforcement mechanisms.

Doing business at a great distance necessitates an element of trust as direct observation of distant agents is far more difficult. The presence of strong social ties will ease the monitoring of hidden behaviour. The presence of social connections is likely also important for the screening and selection of business partners. In other words, an individual from province i can only get somebody to 'vouch' that they are not a Machiavellian-type businessman to somebody in region j if there is some sort of connection between i and j. Furthermore, social ties are in a sense substitutes for the use of costly formal contracts or lawsuits. This topic is related to the focus of the next chapter. Collectively, we refer to the cost associated with low levels of trust and informational problems as the cost of unfamiliarity.

Finally, social connections might simply be reflective of common tastes. That is, Oregonians with strong social ties with Massachusetts might prefer Massachusetts produced varieties of goods. This could because many in Oregon have once lived in Massachusetts or perhaps the tastes of one individual are endogenous to the tastes of their friends. We argue, however, that this channel is not likely to be as important in the sample considered here. First, this paper considers trade in goods. It is difficult to imagine that an Oregonian has an intrinsically stronger preference for Massachusetts produced computers or livestock than would somebody from a state without strong ties (although Oregonians still buy more from Massachusetts because the unfamiliarity cost is lower). Second, we are considering regions that roughly share similar cultures, histories and media and it is hard to image that there is much variance in preferred consumption bundles across states and provinces. This channel is likely more important when considering trade between very different countries, such as Bolivia and Nigeria for example. This cannot be categorically ruled out, however, due to the nature of data considered.[3]

[3]This channel is identified by comparing the elasticity of imports and the elasticity of exports from i and j with respect to immigration from i to j. The idea is that exporting and importing should equally reflect the trust and informational components, but the excessively larger elasticity of imports with respect to immigration reflects the taste component. Our data on social ties is

Indeed as one would expect, there is a significantly positive relationship between social ties, as measured by Facebook connections, and trade. When estimating the gravity model presented in section 1.2 (trade conditional on distance, the border and exporter/importer fixed effects), a 10% increase in social linkages is associated with a 4.3% increase in exports. The relationship between social links and trade is very similar when talking trade between countries and trade within countries.[4] Given that the border reduces social links, and that social links are important for trade, it is natural to ask how much excessive *intra*national trade can be described by social ties. This question is the main goal of this paper, and in our benchmark estimation, we find that about 60% of the measured U.S.-Canada border effect on trade exists because the border reduces linkages and linkages reduce trade. Of course, the effect of the border is not eliminated after accounting for social ties. This is because there are trade barriers between Canada and the United States other than just unfamiliarity costs. These other costs might be border wait times, regulatory differences, exchange rate uncertainty or other forms 'red tape' associated with selling internationally. However, what is left of the border effect can be more easily reconciled.[5]

The contribution of our paper is two-fold. First, this is to our knowledge the first economics paper that has utilised data on Facebook linkages between regions.[6]

dyadic, and the link between i and j equals the link between j and i (and exports from i to j equals imports to j from i). We do not find this methodology entirely convincing. The same result would occur if informational asymmetry is a larger barrier to trade on the buyers' side of the market.

[4]Social ties increase trade by 7% points more for *inter*national trade. The relatively small difference is actually somewhat surprising. Theory suggests that informal mechanisms are more important when regions have different legal systems. This is evidence of the relative ease with which Canadians and Americans can utilise the other's legal system, as suggestive evidence shows.

[5]As will be discussed later, the border effect is entirely eliminated in some models. This is more difficult to justify.

[6]The data that we use has only recently been made available (the corresponding paper was published in 2012 and it appeared on the web not much earlier). As far as we can tell, this is the only data which is made available to researchers (the Facebook corporation is notoriously uncooperative with providing academics data) and those that cite this paper are typically graph theorists or computer scientists.

Social ties in the literature are most often proxied by bilateral mobility. However, we believe that Facebook friendships provides a better measure of social connections across space. Mapping mobility to social ties is difficult and a number of factors will not be accounted for. Issues such as return migration or whether to discount past migration (social ties persist, but decay over time) are not easily dealt with. Other possible factors important for social ties, such as student mobility or the presence of extended family are not picked up by migration statistics. The data we use is a direct measure of how much people in different regions know each other. However, this data is not without its own issues. It suffers from over-representation of some groups and there is no time series. We do believe, however, that the rich nature of this data set can be very useful to future researchers.[7]

Our second contribution is that a very large trade cost between the United States and Canada is identified. This trade cost can reconcile a sizeable portion of this historically very puzzling border effect. Without the data employed in this paper, trying to explain away the border effect between the United States and Canada through social connectivity would be either difficult or impossible. This is because we are quite confident that there are no available direct measures of cross-border migration, student mobility or bilateral telephone traffic between individual states and individual provinces which could be used as a proxy for social ties.

1.1.1. The Border Puzzle. The amount which two countries trade with each other is in amalgamation of the actual cost of trade with the elasticity of trade with respect to trade costs. In standard models, the elasticity of trade is a function of the relative substitutability of goods and the distribution of firms productivities (in the Krugman model with homogenous firms, it only depends on the elasticity

[7]The original authors also compiled data on linkages between individual U.K. cities, U.S. universities and over 100 countries. We are not permitted to redistribute this data ourselves, but we were able to obtain with surprisingly little difficulty. An interested research can visit www.geosocialmap.com to request it.

of substitution). If the elasticity of trade were infinite, for example, a trade cost equal to a fraction of a penny would eliminate all cross-border interaction. In other words, a sufficiently high trade cost or elasticity of trade could reconcile how little Americans and Canadians trade with each other.

The puzzle is illustrated using Anderson and van Wincoop (2003) and Feenstra (2002)'s border estimate of 5. This figure is the most pointed to estimate of the U.S.-Canada border effect. To illustrate why this number is puzzlingly high, it is necessary to have an idea of what the cost is of trading between the United States and Canada and what is the elasticity of trade. Yi (2010), relying mostly on data concerning transport and wholesale margins, estimates that the observable cost of shipping a good across the United States-Canada border (relative to selling it domestically) is equivalent to an *ad valorem* tariff of 14.8%. This figure is likely on the high side as it was estimated using 1990 data when formal trade barriers were still in the process of being removed. There is much uncertainty regarding the value of the elasticity of trade with respect to trade costs, and this is an issue on the frontier of trade research. Recent papers argue that the elasticity of trade is much lower than was previously thought. Simonovska and Waugh (2011), a paper which already has gathered much attention, estimates a trade elasticity between -2.54 and -4.42.

Denote τ_{Border} as the *ad valorem* tariff equivalent of crossing the U.S.-Canada border and $\varepsilon < 0$ as the elasticity of trade with respect to trade costs. Given a border effect of 5, it must be that that $5 = (1 + \tau_{Border})^{-\varepsilon}$, or $1.6 = -\varepsilon \ln(1+\tau_{Border})$. The upper bound of Simonovska and Waugh (2011)'s estimates would imply an *ad valorem* tariff equivalence of 44% whereas the lower bound implies a tariff of 88% (as opposed to the observable 14.8%). Given the trade cost estimates implied by Yi (2010), the U.S.-Canada border should reduce trade by a factor of 1.4 for the lower trade elasticity and 1.85 from the higher trade elasticity (as opposed to 5 found as estimated by Feenstra, 2002 and Anderson and van Wincoop, 2003). These irreconcilable figures lead Obstfeld and Rogoff (2000) to list the border puzzle as one of the "six major puzzles in international macroeconomics."

There are only three possible ways in which this can be reconciled. Either the elasticity of trade is in reality higher, trade costs are much larger than can be observed, or the border effect is not estimated properly. Regarding the first possibility, Yi (2010), Hillberry and Hummels (2008) and Rossi-Hansberg (2005), present models which deliver higher elasticities of trade with respect to trade barriers than would the more standard trade models. The intuition behind these three papers is the spatial and production decisions of firms. If vertically linked firms are located on the opposite side of the border, the border cost must be incurred multiple times. This incentivises firms in a particular industry to cluster and focus production on the same side of the border. Yi (2010), the only of the three which provides quantitative results for the U.S. and Canada, presents a calibrated model with multistage production that reduces the border effect by almost 2/5ths. This line of work is intuitively appealing and is a large contribution, however much of puzzle still remains. The explanatory power of this work hinges on what the initial parameter values are, about which there is much difficulty in measuring.

Justifying large unobservable trade costs between the United States and Canada is difficult because of the similarities in their legal systems, histories, cultures and languages. The most obvious unobservable trade cost relates to the fact that the Unites States and Canada are not members of a currency union. However, reasonable estimates of the trade creating effects of a common currency are modest and would only explain a small fraction of the border puzzle. Meta-analysis by Rose and Stanley (2005), for example, suggests that common currencies increase trade by between 30% and 90%. Moreover, the exchange rate volatility between the U.S. dollar and the Canadian dollar is relatively very small (Campbell, Medeiros, and

Viceira, 2010). The explanation put forth in this paper conceptually falls into this explanatory channel.

Finally, it has been recently argued that the gravity model should not be estimated using ordinary least squares, a practice which has been and arguably still is standard practice. It has been shown that the elasticities resulting from OLS estimation tend to be inflated. More detail will be provided about this in subsequent sections. However, in the context of the seminal estimates of the U.S.-Canada border, the net effect of the border estimate using more novel techniques is nearly unchanged when correcting for other issues. The estimates of Anderson and van Wincoop (2003) and Feenstra (2002) consider a restricted sample of states which trade with Canada the most in the first place. Matsuo and Isihe (2012) consider the full sample of American states. Their use of the more novel estimators greatly reduces the border effect when comparing their results with ordinary least squares, but when considering the full sample of states, the border estimate is nearly the same. That is, the canonical estimate of a border effect of 5 is simultaneously over and under estimated. Which effect outweighs the other is not general, of course.

The rest of this paper is organised as follows. In section 1.1.2, we survey some of the existing literature regarding the relationship between social networks and trade. Three papers very similar to this study are also discussed. In section 1.2, the methodological framework is established and data construction is discussed in section 1.3. In section 1.4, we present our results and section 1.5 concludes.

1.1.2. Related Literature. The migration-trade link has been heavily studied and perhaps the most identified channel justifying this relationship is through the creation of social networks. A comprehensive review of this literature will not be provided here, but two results will be illustrated.

Wagner, Head, and Ries (2002), for example, explore the link between trade and migration to individual Canadian provinces from the rest of the world. They find that a single immigrant from country i to province j increases imports from i to j by an average of $1,000. They also find that this relationship is most important for trade in differentiated goods. They argue that this supports the notion that the migrant-trade relationship exists because of informational channels. The idea behind this claim is that information is less important for producers of homogenous goods, in which there exists reference prices and a lower quality variability. The higher elasticity of trade with respect to migrants in differentiated sectors is a commonly identified result in the literature. Peri and Requena (2010) focus on the effect of migration to Spain from the rest of the world. They show that migrants increase the number of transactions, but do not appear to have an impact on the average value of a particular transaction (the extensive versus the intensive margins). This leads them to claim that migrant networks lower the fixed cost of trade. Perhaps the most obvious justification of this result is that migratory links lower fixed informational costs. Further studies on the link between migration and trade include Gould (1994) for the U.S., Tadesse and White (2013) for Africa, Bratti, De Benedictis, and Santoni (2011) for Italy, Felbermayr and Toubal (2011) for the OECD, Gen, Gheasi, Nijkamp, and Poot (2011) for a meta-analysis, and so forth.

Murat (2012) addresses the relationship between student alumni networks and trade. The hypothesised mechanism behind this relationship is that students who studied in a country other than their own maintain social ties there long after they leave. They show that a 10% increase in international students registered in the UK increases exports to the student's country of origin by 3%. The effect of students on trade exists long after the student is done with university. A few other studies have also explored the relationship between bilateral phone call traffic and trade. Blumenstock (2011), Perkins and Neumayer (2013), and Garín-Muñoz and Pérez-Amaral (1998) all find evidence of a significant relationship.

As discussed, the hypothesised channel through which social linkages matter is because of better information and increased trust. Some papers have directly tested the link between these channels and trade. Huang (2007), for example, argues that one reason geographically far-apart regions trade less is because information and familiarity decays with distance. They support this claim by arguing that more risk-averse countries, as measured by international survey data, trade less with distance partners. The idea here is that trade with countries where less information is available is more risky. As will be discussed in more detail in the next chapter, the relationship between trust and trade is highly robust. Guiso, Sapienza, and Zingales (2009) find that all else equal, a one standard deviation increase in trust leads to 10% increase in trade. Given all of this, the result that Facebook friendships are important for trade is well in line with the literature.

Using social networks to explain away a border effect in trade is not novel, although it has only been used to describe *intra*national border effects to our knowledge. Like international borders, subnational boundaries have been found to depress trade flows (although to a much lesser degree). Combes, Lafourcade, and Mayer (2005) show that trade within a particular French département is more than 6 times greater than is trade between two non-adjacent French "départements." These authors include proxies for social networks (stock of migrants born in i living in j) and business networks (common ownership of plants) and find that their estimate of the border effect falls by a factor of 3. Millimet and Osang (2007) have a very similar study for the United States, in which subnational borders also puzzlingly reduce trade. Incorporating bilateral migration into their gravity equation leads to a substantial reduction (but once again not an elimination) of the subnational border effect. This leads them to conclude that "network ties may be a key omitted variable in many empirical specifications of the gravity equation." Finally, Garmendia, Llano, Minondo, and Requena (2012) conduct a similar study for Spain. They find that incorporating business and social networks into a gravity model entirely eliminates the border effect between Spanish communities (although a small portion of it remains if their dependent variable is trade in quantity rather than trade in value).

1.2. Methodology

The first task of this paper is to address the determinants of social links and to discuss why they are so weak between Canada and the United States. We propose a number of candidate factors which might determine these linkages. The most obvious candidate is bilateral migration. An individual who migrates from one state to another does not sever ties with friends and family left behind. We also consider student mobility. A student from state i studying in state j is still considered a resident of i and is not counted in the migration data insofar as they return to the state of their residence once their studies are complete. There is a considerable amount of student mobility in the United States and Canada. In fall 2008, 16.5% of first-time postsecondary students in the U.S. enrolled in a postsecondary institution outside of the state in which they have residency. In Canada, nearly 10% of university students in total were enrolled at a university outside of their home province.[8] Next, physical distance between regions is also considered. Individuals only a few hundred miles apart are more likely to encounter each other in some way or to have common familial connections. Finally, we also incorporate three variables which capture linguistic, religious and ancestral similarities. These factors are typically passed on from parent to child and it is reasonable to hypothesise that the likelihood of having a relative in an ethno-linguistically similar state is higher.

As mentioned, there does not exist direct international data on migration and student mobility between individual Canadian provinces and American states. We

[8] U.S. figure is calculated from The Integrated Postsecondary Education Data System. Canada figure is calculated from Postsecondary Student Information System.

therefore focus on how these linkages are determined solely between American states. Making the reasonable assumption that friendships are not formed in an intrinsically different manner between states and provinces, the results can be used to suggest why social ties are so weak internationally based on data which does exist. One concern with respect to this exercise relates to the issue of reverse causality. If migration/student mobility causes social ties and at the same time social ties cause migration/student mobility, our estimate of the effects of migration/student mobility on social ties will be inflated. To account for the possibility that the direction of causality partly runs from social links to migration/student mobility and not exclusively in the other direction, past values of migration and past values of student mobility are used as instruments. While we cannot claim with certainty the degree of excludability of these instruments, the problematic component of social ties and migration is mitigated at least in part. Historic migration and student mobility and current migration and student mobility will be driven by the same factors which are exogenous to social ties. For example, Ohioans and Michiganians exhibit high employment-motivated bilateral migration both today and in the past because both economies demand similar sets of labour skills. Alternatively, students from Minnesota and North Dakota are driven to study in each other's states today and in the past because each can receive reduced tuition rates in each other's states. Lagged migration is often used as an instrument for the migration-trade link and the logic behind its validity is similar. For example, this instrument is also used in Garmendia, Llano, Minondo, and Requena (2012) and Combes, Lafourcade, and Mayer (2005).

Turning to the main goal of this paper, we use the standard theoretically motivated gravity model specification due to Anderson and van Wincoop (2003) and Feenstra (2002). Only a brief summary rather than a full derivation is provided here, but an excellent discussion is provided in Shepherd (2013). The underlying theory is quite straightforward. On the demand side are C.E.S. preferences and on the supply side are identical monopolistically competitive firms. General equilibrium is imposed by setting world income equal to world sales. The predicted exports from i to j are expressed as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y_W} \left(\frac{\tau_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \tag{1}$$

X_{ij} are exports from i to j and Y_i, Y_j and Y_W are the GDPs of i, j and the world respectively. $\sigma > 1$ is the constant elasticity of substitution between varieties. τ_{ij} is the *ad valorem* cost of sending a good from i to j. When estimating the border effect, trade costs are typically specified as $\tau_{ij} = (d_{ij})^{\beta_1} \exp(-\beta_2 Border_{ij})$ where d_{ij} is the physical distance between i and j and $Border_{ij}$ is an indicator which takes a value of one if a border is crossed in exporting from i to j and zero otherwise. P_j and Π_i are the multilateral resistance terms and this is the key distinction between this gravity equation and the so-called "naive" Newtonian based gravity models. P_j essentially captures the relative desirability of purchasing goods from i, and it is a function of the full gamut of prices facing individuals in j. Similarly, Π_i captures the relative desirability of exporting to j, which is a function of all the trade costs and regional incomes in the world. The basic principle is that i and j should trade more if they are both more isolated from the rest of the world and have fewer outside options. Anderson and van Wincoop (2003) take the logs of both sides of this expression and the estimatable amount of predicted trade is described in equation 2.

$$\ln \frac{X_{ij}}{Y_i Y_j} = -\ln Y_W + (1-\sigma)\left(\ln \tau_{ij} - \ln \Pi_i - \ln P_j\right) + u_{ij} \tag{2}$$

Estimation of the multilateral resistance terms is not straightforward, but Feenstra (2002) shows that the gravity model can be consistently estimated by replacing the multilateral resistance terms with importer and exporter fixed effects. The resulting gravity model (and what is most commonly used in practice) is as follows:

$$\ln \frac{X_{ij}}{Y_i Y_j} = \alpha + \beta_1 \ln d_{ij} - \beta_2 Border_{ij} + \gamma_i + \gamma_j + u_{ij} \tag{3}$$

γ_i and γ_j are exporter and importer fixed effects. GDPs are absorbed by the fixed effects but they are included above for exposition. Imposing unitary income elasticities or not does not affect the estimates of interest. The coefficient β_2 is the estimate of the border. Taking the exponent of this yields what is defined as the border effect in this paper. That is, $\exp(\beta_2)$ tells us the factor by which the border decreases trade, which is intertwined with the pure border cost and the elasticity of trade.

For the novel component of this paper, the estimates of the gravity model in equation 3 are compared with a gravity model in which social ties between i and j are included. The model we also estimate is

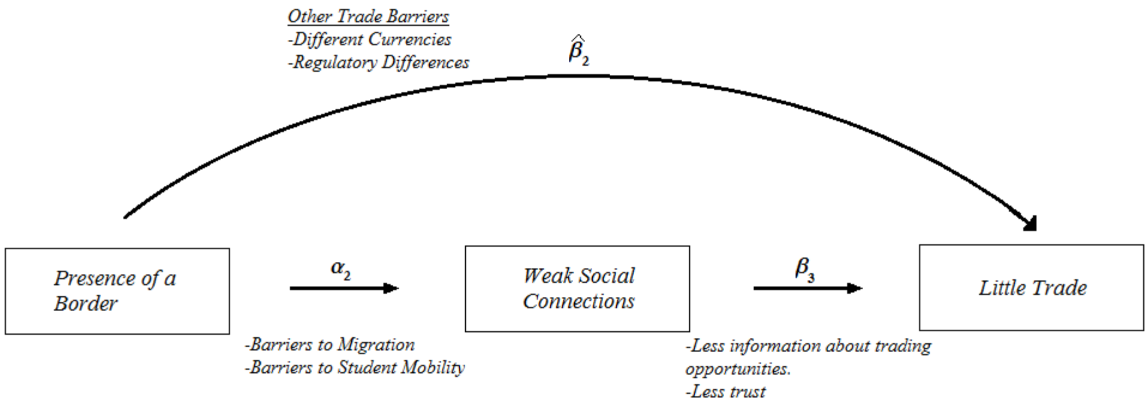
$$\ln \frac{X_{ij}}{Y_i Y_j} = \alpha + \beta_1 \ln d_{ij} - \widehat{\beta}_2 Border_{ij} + \beta_3 \ln l_{ij} + \gamma_i + \gamma_j + u_{ij} \tag{4}$$

where l_{ij} is the social link between i and j. In context of the Anderson and van Wincoop (2003) model, this is equivalent to specifying trade costs as $\tau_{ij} = (d_{ij})^{\beta_1} (l_{ij})^{\beta_3} \exp(-\hat{\beta}_2 Border_{ij})$. The main interest of this paper is to compare β_2 with $\widehat{\beta}_2$, the coefficient on $Border_{ij}$ before and after social ties are included. To be clear what this comparison is telling us, the following equation is also estimated:

$$\ln l_{ij} = \delta + \gamma_i + \gamma_j + \ln Y_i + \ln Y_j + \alpha_1 \ln d_{ij} - \alpha_2 Border_{ij} + u_{ij} \tag{5}$$

α_2 is the effect of the border on social ties. The argument in this paper is based on a chain of causality. From a purely mathematical standpoint, it must be the case

Figure 1.2



that $\alpha_2 * \beta_3 = \beta_2 - \widehat{\beta}_2$. For example, if the border decreases ties by 50% and social ties increase trade by 25%, the difference between the border coefficients with and without social ties will be .125. Because the coefficients on the border variable do not have much intuitive explanation as they stand, it is useful to take the exponential of both sides resulting in $\exp(\alpha_2 * \beta_3) = \exp\left(\beta_2 - \widehat{\beta}_2\right) = \frac{\exp(\beta_2)}{\exp(\widehat{\beta}_2)} = \Delta$. The value Δ is the factor by which the border falls after social linkages are accounted for. $1-1/\Delta$ is the percent of the border effect which exists because of the effect of the border on social ties followed by the effect of social ties on trade. $1/\Delta$ is the percent of the border effect which is not attributable to the social linkage channel. $1/\Delta$ includes the other trade diverting effects of the border. These concepts are illustrated in Figure 1.2.

As part of a robustness exercise, equation 4 is re-estimated as follows:

$$(6)\quad \ln\frac{X_{ij}}{Y_iY_j} = \alpha + \beta_1 \ln d_{ij} - \widehat{\beta}_2 Border_{ij} + \beta_3 \ln l_{ij} + \beta_4 Border_{ij} \times \ln l_{ij} + \gamma_i + \gamma_j + u_{ij}$$

By including the interaction term $Border_{ij} \times \ln l_{ij}$, we allow for a differential effect of social ties on trade within countries versus between countries. That is, perhaps social ties impact trade in a fundamentally different manner when talking about trade across international borders. The results of this robustness exercise can be found in Appendix 1.B. As can be seen in this appendix, an even larger drop in the estimated effect of the border on trade is found.

Of course, the argument outlined in Figure 1.2 begins to break down if a causal chain cannot be established or if correct estimates of each partial effect in each link of the chain cannot be obtained. In an ideal world, we would instrument social linkages with a variable that doesn't affect trade insofar as it does not affect these linkages. As the data on linkages between subnational units in different countries is rare, such an instrument is even rarer. As such, we are forced to rely on more *ad hoc* measures of addressing endogeneity. The first issue that might be faced is due to the omission of confounding factors. That is, it is conceivable that Quebec and New Brunswick both trade with each other and have strong links with each other solely because they are largely French and Catholic. That is, perhaps they have strong links because cultural similarity lowers the cost of bilateral migration and they trade because they have similar preferences. In this case, there is no direct relationship between social links and trade. To address this, a number of observable cultural variables are included in equations 3 and 4, and the change in the border effect is re-estimated. By including these variables, the effects of culture are no longer acting through the error term. We believe that cultural commonalities are the most obvious factors which might independently cause both trade and linkages. Culture is difficult to measure, however, and it is near impossible to pick up on the more subtle cultural commonalities. However, would any of the subtle cultural idiosyncrasies that cannot be accounted for have any effect on trade? We make an *a fortiori* argument that this should not be a large issue. If Δ is similar whether or not the most important cultural variables are included, it is difficult to argue that Δ would depend on the inclusion of variables which capture more minor cultural similarities.

The second potential issue is reverse causality. One could surmise, for example, that strong trade links lead to back and forth business motivated migration or that people become friends because they are in business together not the other way around. Nearly 70% of the variance in social links is shared with distance, bilateral migration and bilateral student mobility. Once reporter and partner fixed effects are included (which captures the notion that some places are more insular than others), this number rises to approximately 90%. While this is no more than suggestive, we believe we have a fairly good idea as to why social linkages exist. The natural next question is, are any of these variables individually caused by trade and not the other way around? As far as migration, the literature suggests that the possibility of reverse causality can safely be ignored. Numerous studies argue that the direction of causality is from migration to trade. See, for example, Gould (1994), Hatzigeorgiou (2010), Dunlevy and Hutchinson (1999) and others. If trade does not cause migration, it is difficult to imagine that it might cause student mobility. In the education literature on student mobility, trade has never to our knowledge been suggested as a determinant of a student's relocation decisions. Survey evidence by Prior et al. (2012), as one would expect, shows that student college choice decisions are predominantly driven by university reputation, future job prospects, tuition costs and various amenities provided by the university. Unfortunately, reverse causality cannot entirely be ruled out because no suitable instrument has yet been found. But, given that 90% of the variance in social ties is driven by factors which can arguably be said to be non-problematic, it is unlikely that our results could be too severely biased.[9]

The final, and most topical, issue is actually how to estimate the gravity equation. As discussed above, the norm has been, and for the most part still is, to take the log of the gravity equation and use ordinary least squares. The use of alternative

[9]There is still a significant partial correlation between social ties and exports even after controlling for migration, student mobility, distance, fixed effects, and other cultural variables. This implies there is a link between social ties and trade which exists above and beyond the determinants of social ties that we discuss. This does not imply reverse causality, but it also means we cannot rule it out entirely.

techniques is a heavily debated issue in current gravity model research. The use of OLS has been criticised by Santos Silva and Tenreyro (2006) who argue that the gravity model cannot be estimated in its log-log form if heteroskedasticity is present. Heteroskedasticity in trade models is common, and indeed is also found in the OLS estimation of equations 3 and 4 using our data. This is because the variance in trade is often much larger for distant trading partners or for economically large regions.

To illustrate why this is an issue, consider the gravity model presented above $X_{ij} = \frac{Y_i Y_j}{Y_W} \left(\frac{\tau_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \varepsilon_{ij}$ where ε_{ij} is an error term. Suppose that it is the case that the expected value of ε_{ij} is independent of the covariates in this expression, but the variance of is not. That is, $\sigma^2_{\varepsilon_{ij}} = f\left(Y_i, Y_j, Y_W, \tau_{ij}, \Pi_i, P_j\right)$. Suppose the logarithm of both sides is taken and we are left with $\ln \frac{X_{ij}}{Y_i Y_j} = -\ln Y_W + (1-\sigma)\left(\ln \tau_{ij} - \ln \Pi_i - \ln P_j\right) + \ln \varepsilon_{ij}$. The expected value of $\ln \varepsilon_{ij}$ depends on the variance of ε_{ij}. Because the variance of ε_{ij} is not independent of the explanatory variables, it stands that the conditional mean of $\ln \varepsilon_{ij}$ will also be a function of the explanatory variables. That is, $E\left(\ln \varepsilon_{ij} | Y_i, Y_j, Y_W, \tau_{ij}, \Pi_i, P_j\right) = f\left(Y_i, Y_j, Y_W, \tau_{ij}, \Pi_i, P_j\right)$. This leads to possible bias and inconsistency in ordinary least squares estimation. Martin and Pham (2008) discuss that when comparing OLS with estimators that correct for heteroskedasticity, estimates of the elasticities of interest are typically biased by 35% or more.

Santos Silva and Tenreyro (2006) suggest exponentiating the log-log gravity equation and using non-logged exports as the dependent variable. They then propose using a non-linear estimator, such as a Poisson Pseudo Maximum Likelihood (PPML) estimator. Martínez-Zarzoso (2013) systematically compares a number of different estimators which might be used to correct for this problem. This paper finds that in most cases, a Feasible Generalised Least Squares (FGLS) estimator on the standard log-log gravity model specification performs just as well as alternative estimators, and in often cases results in a smaller bias.[10] FGLS is used as our benchmark for two reasons. First, this is the methodology that performs the best in many cases according to Martínez-Zarzoso (2013). Second, the remaining border effect *after* controlling for social ties is the most reasonable under FGLS than it is under different estimators.[11]

The steps followed for the implementation of FGLS are based on the general methodology laid out by Wooldridge (2012, Ch. 8). First define $\nu_{ij} = \ln(\varepsilon_{ij})$ as a general error term (either the error term in equation 3 or equation 4). In order to correct for heteroskedasticty, we must first estimate how the variance ν_{ij} depends on the explanatory variables. In practice, this relationship is usually specified as $Var(\nu|x) = \sigma^2 \exp(\gamma_0 + \gamma_1 x_1 ...)$. An alternative specification of the skedastic function, such as $Var(\nu_{ij}|x) = \sigma^2(\gamma_0 + \gamma_1 x_1 ...)$ could yield negative estimated variances and weighted least squares could not be performed. The procedure entails estimating the residuals from equations 3 and 4. The fitted values of $\ln\left(\nu_{ij}^2\right) = \alpha + \beta_1 \ln d_{ij} - \widehat{\beta}_2 Border_{ij} + \{\beta_3 \ln l_{ij}\} + \gamma_i + \gamma_j + \eta_{ij}$ are obtained. The resulting weights that are used in weighted least squares are $\omega_{ij} = \left(\exp\left[\ \ln\left(\ \widehat{\nu}_{ij}^2\right)\ \right]\right)^{-\frac{1}{2}}$. It is important to note that the identity described above, $\alpha_2 * \beta_3 = \beta_2 - \widehat{\beta}_2$, will no longer exactly hold as it would with OLS. This is because the introduction of an additional variable (social ties) also changes the weights that are applied for weighted least squares. It will still be the case, however, that $\alpha_2 * \beta_3 \approx \beta_2 - \widehat{\beta}_2$. The conceptual validity of the border working through a chain is not compromised.

Because our benchmark estimates are done using the log-log gravity model specification, a small issue of zeroes exists because they will drop out after logs are taken. This is far more of an issue in other data sets, where nearly 50% of the global trade

---

[10]There is a great deal of interesting back and forth with respect to these issues. Santos Silva and Tenreyro recurrently argue that PPML is superior to the alternative estimators.

[11]When some estimators are used, the border effect after controlling for social ties is not statistically significant from zero. This is difficult to justify as there are border costs other than just weak social ties.

matrix is recorded as a zero. Only about a half of a percent of bilateral exports are zero in our sample, all of which relate to trade between American states and the two smallest Canadian provinces considered. The standard approach is used where $\ln(X_{ij})$ is replaced with $\ln(X_{ij}+1)$. After logs are taken, zero recorded trade flows are zero in the logged gravity model.

For robustness, an additional estimator is used. Santos Silva and Tenreyro (2006) argue for the use of PPML, but this estimator has been criticised because it assumes the conditional mean of exports is proportional to the conditional variance of exports. PPML is a special case of the Negative Binomial Pseudo Maximum Likelihood (NBPML) estimator, where NBPML does not require this assumption. However, NBPML is not scale invariant. That is, the elasticities of interest would change depending on whether exports are in thousands or millions. Bosquet and Boulhol (2013) propose a using the Negative Binomial Quasi-Generalised PML estimator with the GLM variance assumption (NBQGPML^{GLM}) to overcome the problem of scale dependence. A more detailed description of this estimator and the associated results using this estimation technique can be found in Appendix 1.B. The proof that this estimator is scale invariant can be found in Bosquet and Boulhol (2013).

Finally, by default, ordinary least squares is implemented on the Feenstra (2002) and Anderson and van Wincoop (2003)'s restricted sample (but for 2009 rather than 1993). Their sample considers 30, rather than 48 states, and they ignore zero trade flows.[12] This allows for the comparability of our results with the canonical estimates of the U.S.-Canada border effect.

[12] 30 states are used in these papers because Anderson and van Wincoop (2003) sought to compare their results with McCallum (1995) and Feenstra (2002) sought to compare results with Anderson and van Wincoop. It is not clear why McCallum originally used a restricted sample. It is also not clear from their papers that Feenstra (2002) and Anderson and van Wincoop (2003) drop zero trade flows. This is confirmed, however, by accessing Feenstra's data and code, which are available from his website.

It should be noted that our estimates of the border effect between the United States and Canada are not robust. As will be seen, different estimators can yield very different results with respect to the trade reducing effect of the border. This is not a problem idiosyncratic to this paper, but it is a problem facing most empirical gravity model research. However, we are principally interested in the *change* in the border effect. Our estimate of the change in the border effect is actually quite robust.

1.3. Data

Due to data restrictions, our analysis is based around the year 2009. Not all Canadian provinces and American states are included. In the United States, Alaska and Hawaii are not considered. Neither region shares a border with the rest of United States and a clear discontinuity in the effect of distance would be introduced. That is, a distance of 2000 miles over land means something completely different than 2000 miles over water. As far as Canada, the Yukon, Nunavut and the Northwest Territories are not included as there is no data on their social linkages. These omitted regions combined account for about half of a percent of the combined U.S.-Canada population. We are left with 48 states in the U.S. and 10 provinces in Canada. There are 3,306 i to j observations (1,653 dyads). 1,173 dyads are on the same side of the border and and 480 dyads are on the opposite side of the border.

1.3.1. Social Linkages (l_{ij}). Data on social linkages was provided to us by Kurant, Gjoka, Wang, Almquist, Butts, and Markopoulo (2012), who constructed this data in order to illustrate a graph sampling technique for topological estimation. This data is the result of extensive scraping of Facebook's publicly available information in 2009. From this data, we have friendship linkages between 266 North American regional networks (272 if Alaska and Hawaii were included). These regional networks are the self-reported locales of Facebook users, but Facebook has since phased them out.[13] The vast majority of the time, regional networks correspond to a particular city. The full list of regional networks used in this study can be found in appendix 1.A. The variable l_{ij} is the probability that a randomly selected user from network i is friends with a randomly selected user in network j. It is entirely possible that scale effects exist, depending on how one assumes these linkages are formed. However, even if scale effects are present, the results are entirely unaffected because they are captured by reporter and partner fixed effects.

Because trade data is measured between provinces/states, social linkages between individual cities must be mapped into social linkages between provinces and states. To do this, we use the population weighted average social link between all the networks in state/province i and state/province j.[14] Two potential concerns exist with this data. The first concern is geographic coverage. While the catchment areas of these regional networks are subjective (and presumably reach very far in regions where few choices of networks exist), not all areas of the United States and Canada would fall under one of the networks for which data exists. With very few exceptions, however, the principal cities in every state/province are represented. The second concern is demographic coverage. Even though the authors who collected this data took care in randomly sampling users from Facebook, the users of Facebook themselves are not representative of the population. That is, even though Facebook was quite ubiquitous by 2009, the users still tended to be younger and more affluent.[15] However, the difference between the true link and our measurement of social links between i and j is not systematically driven in one direction because of non-random

[13]As a result, there is no choice but to use the 2009 data.

[14]In some cases, it is difficult to measure the population of a particular network because its boundaries are inherently subjective. For example, one regional network is "Northern New Jersey." In such cases, we use the largest city in the regional network. The substituted cities can also be found in appendix 1.A. Nearly 9% of networks are problematic in this sense. Because all links between state/province i and j are so highly correlated, the weighting system is not important to the results.

[15]As of December 2009, there were 100 million facebook users in the United States and 14 million in Canada.

geographic and demographic sampling. As such, the estimated effect of social links on trade is attenuated and the results are *understated* because of this. For example, the true link between Alberta and Newfoundland is likely overstated because young individuals have recently migrated from Newfoundland to Alberta in droves to work in Northern Alberta's booming oil industry. Furthermore, the true link between Michigan and southern states is likely understated because historic migration from the south to work in Michigan's manufacturing plants has since all but stopped.

1.3.2. Physical Distance (d_{ij}). In order to estimate the distance between state/province i and j, we use the population weighted great circle distance between both i and j's five largest cities using the law of cosines.[16] Latitudes and longitudes were taken from www.latlong.net. All populations used are intercensal estimates taken from Statistics Canada and the U.S. Census Bureau. This is a slightly different approach from the standard papers on the U.S.-Canada border effect which usually measure the distance between i and j as the distance between state/province i and j's single focal point, such as centre or capital. As such, the elasticity of distance with respect to trade is better measured in this paper. Had we adopted the coarser and more conventional capital-capital distance measure, the estimated effect of distance on trade would be subject to greater attenuation bias. An identical strategy was also adopted by Requena and Llano (2010) for Spain.

1.3.3. Trade Flows (X_{ij}). The standard data sources and harmonisation techniques for compiling trade flows between regions is used. Trade between Canadian provinces is taken from Statistics Canada's input-output division (tables 386-0003 and 386-0002 for 2009 and 2007 respectively). Trade between Canadian provinces and American states is taken from Industry Canada which is based on customs data.

[16] $distance_{12} = R * \arccos(\sin(lat_1)\sin(lat_2) + \cos(lat_1)\cos(lat_2))\cos(long_2 - long_2)$. where R is the earth's average radius in miles

The input-output data is seen as superior as the end use is well known and these figures do not measure goods in transit. From the Industry Canada data, we calculate the percent of total exports/imports going to/coming from state i as a percentage of total exports/imports. We apply this percentage to total exports and total imports as reported in the input-output tables.

Data on US-US trade is far less clean and three issues exist. The first issue is that we do not have trade data for 2009, the only year for which there is data on linkages. The U.S. Census Bureau publishes this data only every 5 years in the Commodity Flow Survey (CFS) and 2007 is the nearest year that can be used. While it is not likely that trade relationships or social linkages have dramatically changed in just two years, we do make an effort to make these figures compatible. The second issue is that the CFS does not glean out goods simply in transit and a particular shipment crossing multiple state lines will be counted multiple times if it stops somewhere just to be warehoused. The magnitude of interstate trade is therefore severely overstated. We can infer total intranational trade in the United States by using gross output in goods-producing industries (agriculture, mining and manufacturing) minus exports in goods to the world. This tells us the gross value of goods actually produced and sold within the United States. Data on gross output (and state GDPs) is taken from the Bureau of Economic Analysis and exports to the world are taken from the IMF DOTS. The total value of shipments as reported by the CFS in 2007 was $11,684,872 million and intranational trade as inferred by output data is $4,890,390 million. We scale 2007 CFS data by a factor of .418, which is in the ballpark of the adjustment made by the seminal Anderson and van Wincoop (2003) paper using 1993 CFS data. The value of intranational trade in 2009 as inferred by output data is 81.4% that of 2007. While the measurement errors in US-US trade loom large, this is the only available data. However, as we are more concerned about the change in the border effect rather than the magnitude, this is potentially much less of an issue in our paper. Anderson and van Wincoop (2003) have a nice discussion about how the comparability of this data is at least reasonable. They claim this because the inclusion of US-US trade does not systematically affect their estimated trade elasticities.

The final issue is that there are 179 missing (not zero) trade values in the sample. These trade values are filled in with estimates from the U.S. Department of Transportation (FAF) who augment the CFS data with additional sources to reduce sample variability.

We estimate 2009 trade flows from the 2007 CFS data using the following methodology. The use of this method is based on the observation that trade relationships die hard and trade hysteresis is well documented. Supply chains between Oregon and Washington that existed in 2007, for example, will still exist in 2009. And, even though Oregon and Washington were both poorer in 2009, they would still trade much more with each other than they would with a state like Tennessee. We first estimate the elasticities of trade with respect to income and distance using the 2007 data. That is, we estimate $\ln X_{ij}^{2007} = \beta_0^{2007} + \beta_1^{2007} \ln Y_i^{2007} + \beta_2^{2007} \ln Y_j^{2007} + \beta_3^{2007} \ln d_{ij}$. We take the residual of this regression ε_{ij} which tells us that i and j traded $\exp(\varepsilon_{ij})$ times more or less than they should have as predicted by their incomes and distance. Preliminary 2009 trade flows are then calculated as $\ln X_{ij}^{2009} = \beta_0^{2007} + \beta_1^{2007} \ln Y_i^{2009} + \beta_2^{2007} \ln Y_j^{2009} + \beta_3^{2007} \ln d_{ij} + \varepsilon_{ij}^{2007}$. But, total intranational trade in the United States has fallen dramatically as reported by gross output data. We further adjust the 2009 trade data such that $\Sigma_{ij=1}^{n} X_{ij}^{2009} / \Sigma_{ij=1}^{n} \ X_{ij}^{2007} = 0.814$, the ratio of intranational trade in the two years.

We feel that for our purposes, this provides at least a reasonable estimate of 2009 trade flows. While the financial crisis of 2008 led to a drop in intra-state American trade, this drop is entirely accounted for because total intra-state trade is interpolated to match gross output for which we do have 2009 data. The only data that we interpolate is the *distribution* of intra-state trade for 2009. For Canada, at least, the correlation between $\ln(\frac{X_{ij}}{Y_i Y_j})$ in 2007 and 2009, the dependent variable in the main regression, is 0.97. That is, bilateral trade is a slow moving variable and we should not expect that the distribution of trade within the United States has changed very much. Perhaps most importantly, the change in the border effect is re-estimated using the un-estimated 2007 data (with the implicit assumption that social linkages have not changed much). The results are remarkably similar. This can be found in appendix 1.B.

1.3.4. Common Language ($ComLang_{ij}$). $ComLang_{ij}$ is the probability that a randomly selected individual from region i speaks the same primary language at home as randomly selected individual in region j conditional on both individuals belonging to one of the language groups considered. We consider only Spanish, French and English. As the overwhelming majority of every state and province speaks one of these three languages, the inclusion of any of the other several hundred languages has virtually an unnoticeable effect. The linguistic distribution by American State is taken from the American Community Survey 3 year estimates (2008 - 2010) and the linguistic distribution by Canadian Province for 2009 is inferred from 2006 and 2011 census data.[17]

1.3.5. Common European Origin ($ComEurope_{ij}$). To further capture cultural similarities/differences between regions, we consider the probability that a randomly selected individual in region i is of the same European ancestry as a randomly selected individual in region j, conditional on both individuals being a member of a group considered. Different European groups settled in different parts of North

[17]A detailed language breakdown is not available for regions in 2009. For the US data, we use survey data collected between 2008 and 2010. Data is not available for Wyoming so we use the ACS 5-year estimates in this case. For Canada, we infer the 2009 values by assuming a linear year-by-year change between 2006 and 2011. Because this is such a slow moving variable, any measurement errors should be neglible.

America and the culture brought can still be seen today.[18] The Irish tended to settle in Northeastern U.S., Italians tended to settle in the mid-Atlantic U.S., Scottish tended to settle in the maritimes of Canada, Scandinavians and Germans tended to settle in the North American plains region, and so forth. Ideally, we should consider non-European ancestries as well. However, as is rather frustrating, the distinction between ancestry and race is extremely vague in U.S. data. For example, respondents cannot declare to be of "Mexican" or "Chinese" ancestry and respondents cannot declare to be of "English" race, making a reasonable comparison not possible. Much of this oversight is picked up by the linguistic variable, however.

A second issue arises because many respondents, in both the U.S. and Canada, list "American" or "Canadian" as their ancestry. Presumably, this is largely due to individuals simply not knowing their ancestry. These ancestral group cannot considered. This is justifiable if one makes the assumption that the ancestral distribution in a particular region of those who claim to be American or Canadian is not much different than the ancestral distribution of those who know their ancestry. Data on ancestry for Canada is taken from the 2006 census and the 2011 National Household Survey, the 2009 values are inferred.[19][20] Data on U.S. ancestral origins is taken from the American Community Survey. Both data sources consider total ancestry reported, either as a single response or as one of many responses. We consider the European ancestral groups such that the top ten ancestral groups in both the U.S and Canada are represented. These groups are English, French, Scottish, Irish, German, Italian, Ukrainian, Dutch, Polish, Russian, Norwegian and Swedish.

[18] Compare, for example, the St. Patrick's day parade in largely Irish Boston with the St. Patrick's day parade in largely German Wichita. To cite another example, the regional dialect of the maritime region of Canada still has a distinct Scottish influence.

[19] Assuming a linear year-by-year change.

[20] In 2011, the NHS has replaced Canada's long form census questionnaire, which contains information on ethnicity and race.

1.3.6. Common Religion ($ComRel_{ij}$). The U.S. Census Bureau legally cannot ask about the religion of survey respondents, so we must turn to alternative sources. U.S. data is from the Pew Forum's U.S. Religious Landscape survey collected in 2007. Skipping every other census, religion was not asked in the 2006 Canadian census. Canadian data is from the 2011 NHS survey. Unlike in previous cases, we cannot infer 2009 data for the United States. As such, the data will be used as it is. Because religious affiliation is a very slow moving variable, using a non-2009 year is not very problematic and any attenuation should be very minor. Once again, only the major groups are considered because probabilities are not affected by including any of the many other minor groups. The religious affiliations considered are Protestant, Catholic, Mormon, Jewish and Muslim. As a comment about the collinearity between our cultural variables, each is picking up something that the other does not. For example, Utah and Maine are both predominantly of English ancestry, but they share very different religious affiliations. Conversely, Quebec and Massachusetts largely share a common religion but differ greatly in their ancestry and language. The size of the correlation between these variables (the highest being 0.5 between religion and ancestry) does not indicate the inclusion of all three variables simultaneously leads to a multicollinearity issue.

1.3.7. Migration (m_{ij}). As discussed, migration data is used in order to describe why social linkages exist between i and j. Because there is an issue of reverse causality, lagged migratory flows are used as an instrument. Migration flows between American States are taken from the American Community Survey (1-year estimates) for the years 2004-2009. For 2009, for example, this tells us the number of individuals residing in state i in 2009 who resided in state j in 2008. Data from the 2000 census is also used which tells us the current state of residence and the state of residence 5 years prior. Data at an annual frequency is not available before the new millennium. This variable is weighted by i and j's populations. m_{ij2000}

is total migration between i and j between the years 1995 and 2000 divided by the sum of i and j's population in 1995. Likewise, m_{ij2009} is total migration between i and j between 2004 and 2009 divided by the sum of their 2004 populations.

1.3.8. University Attendance ($School_{ij}$). Student mobility is also included as a possible driver of social links between regions. Data on student mobility is taken from the Integrated Postsecondary Education Data System (IPEDS). This is a very rich data set which has enrollment data on more than 7,000 postsecondary institutions (not just traditional 4-year universities). The time windows considered are 2005 to 2009 and 1992 to 2000. The year 2009, for example, refers to fall enrollment in the 2009-2010 academic year. Annual data is not available prior to 2000 so the window 1992-2000 only includes even years. $School_{ijYEAR}$ (where $Year = \{2000,\ 2009\}$) captures bilateral fall enrolment of first-time students divided by the sum of i and $j's$ population at the beginning of the window. Descriptive statistics are presented in Table 1.2.

	mean	*mean, same country*	*mean, different country*	*max, US-US*	*max, CA-CA*
l_{ij}	$6.30\times(10^{-7})$	$8.53\times(10^{-7})$	$8.34\times(10^{-8})$	$1.48\times(10^{-5})$ MT-WY	$3.91\times(10^{-5})$ NS-PE
d_{ij} (miles)	1149.72	1047.6	1399.26	2657.34 CA-ME	3064.35 BC-NL
X_{ij} (mill. CAD)	921.62	1127.42	418.71	25221.18 NJ to NY	20124.0 QC to ON
$ComRel_{ij}$	0.5	0.51	0.47	0.86 AR-AL	0.55 NB-QC
$ComLan_{ij}$	0.82	0.83	0.79	0.97 ND-WV	0.99 NL-SK
$ComEurope_{ij}$	0.16	0.17	0.13	0.27 IA-NB	0.22 NB-NL
m_{ij} 2000	0.0014	-	-	0.02 OR-WA	-
m_{ij} 2009	0.0021	-	-	0.03 OR-WA	-
$School_{ij}$ 2000	0.00013	-	-	0.003 MN-WI	-
$School_{ij}$ 2009	0.00014	-	-	0.003 MN-WI	-

	max, CA-US	*min, US-US*	*min, CA-CA*	*min, CA-US*	*Std. Dev.*
l_{ij}	$1.89\times(10^{-6})$ ME-NB	$4.67\times(10^{-8})$ ND-NJ	$3.2\times(10^{-7})$ QC-SK	$1.72\times(10^{-8})$ MT-QC	$2.07\times(10^{-6})$
d_{ij} (miles)	3411.55 CA-NL	29.21 NJ-NY	115.42 NS-PE	112.23 QC-VT	653.01
X_{ij} (mill. CAD)	23430.66 ON to MI	0.39 MT-RI	0.0001 BC to PE	0 multiple	1975.6
$ComRel_{ij}$	0.60 QC-RI	0.11 NJ-UT	0.33 BC-QC	0.10 QC-UT	0.012
$ComLang_{ij}$	0.99 NF-WV	0.56 CA-TX	0.11 NL-QC	0.08 CA-QC	0.17
$ComEurope_{ij}$	0.26 NL-UT	0.07 ND-RI	0.09 SK-QC	0.05 ND-QC	0.036
m_{ij} 2000	--	$7.97\times(10^{-6})$ ND-RI	--	--	0.0025
m_{ij} 2009	--	0, ND-RI & ND-NH	--	--	0.003
$School_{ij}$ 2000	--	0 DE-ND	--	--	0.0006
$School_{ij}$ 2009	--	$1.40\times(10^{-6})$ DE-ND	--	--	0.0005

Table 1.2

1.4. Results

1.4.1. Determinants of Social Links. In this section, the determination of social links is addressed based on U.S. data. The results of this can be found in Table 1.3. Because the distribution of the social ties variable is heavily skewed to the right, a logarithmic transformation of our dependent variable is necessary to establish something which resembles a linear relationship. The regression results where social ties are specified in levels can be found in appendix 1.B. Because the social ties variable represents a probability of friendship, the results can be interpreted are as follows: a one percentage increase in bilateral migration (a log-transformed independent variable) is associated with a 0.224% increase in the probability that a randomly selected user from i is friends with a randomly selected user from j. Alternatively, a one unit increase our common language variable (a non-log-transformed independent variable) is associated with a 0.264% increase in the probability that a randomly selected user from i is friends with a randomly selected user from j.

As discussed in section 1.3, the suitability of using past migration and student mobility as instruments for current migration and student mobility is arguably tenuous, but is the only known manner in which endogeneity can be addressed. This is partly due to the fact that migration and student mobility are highly persistent; the coefficient of correlation between $\ln m_{ij}2000$ and $\ln m_{ij}2009$ and between $\ln School_{ij}2000$ and $\ln School_{ij}2009$ is about 0.96 and 0.93 respectively. Without additional instruments, we cannot guarantee that the endogenous components of migration and student mobility are entirely filtered out through an IV regression. Despite their drawbacks, it should be clear that the use of lagged migration and student mobility should weakly reduce the potential problem of reverse causality.[21]

[21]As a corollary to the temporal persistence of student mobility and migration, it should be clear that these instruments are anything but weak as confirmed by a weak identification test on the first stage of two stage least squares estimation. The Kleibergen-Paap Wald F-statistic reported by Stata's ivreg2 command is equal to 248. Stock-Yogo (2005) critical value for a 10% maximum IV bias is 7.03.

Table 1.3

Dependent Variable: $ln(l_{ij})$	
Constant	-9.46***
	(0.266)
$ln(d_{ij})$	-0.156***
	(0.036)
$ln(m_{ij})$	0.224***
	(0.045)
$ln(School_{ij})$	0.305***
	(0.043)
$ComRel_{ij}$	-0.008
	(0.151)
$ComEurope_{ij}$	0.352
	(0.7)
$ComLang_{ij}$	0.264
	(0.212)
N	1125
Method	2SLS
R^2	0.66
RMSE	0.50

*Heteroskedasticity robust standard errors are in parenthesis. Because data are dyadic in this section, standard errors are not clustered by partner pair. *-significant at 10%, **-significant at 5%, ***-signficant at 1%.*

The results are more or less what would be expected. Places that are farther apart have significantly weaker social links and regions with a high degree of bilateral migration and student mobility exhibit significantly stronger social linkages. As can be seen in the subsequent section, common ancestry and common religion significantly affect linkages when mobility is not controlled for. However, these variables are not significant in the model presented here. This suggests that the channel through which cultural similarity matters for social ties is because cultural similarity leads to increased mobility. That is, cultural similarity in itself does not create social ties, but it increases social ties through alternative channels.

Given that distance, migration and student mobility significantly affect social ties, can the strong border effect in social linkages between the United States and

Canada be reconciled? First, it is clear that distance could only explain a negligible fraction of the difference in mean social ties within and between countries. Canada and the United States are not much farther apart from each other than they are from themselves. Distances between countries are just one-third greater than are distances within countries. The effect of the border on social ties (when not just comparing means) is still very large when distance is included as can be seen in columns 7, 8 and 9 in Table 1.4 in the subsequent section.

What about migration? As of 2011, according to the American Community Survey, more than 83 million Americans resided in a state in which they were not born. As of 2011, according to National Household Survey in Canada, only 316,165 individuals born in the United States lived in Canada. The latter figure is more than 260 times less than the former. Data on interprovincial migration flows from Statistics Canada shows that more than 2.8 million Canadians moved between provinces between the years 2000 and 2010. Data from the Department of Homeland Security shows that just 255,840 Canadians migrated to the United States during this time. As discussed above, Helliwell (1997) found that the border decreases migration by a factor of 100. This enormous border effect in migration is not surprising given the figures just discussed.

As far as student mobility, a rough calculation based on data from the Postsecondary Student Information Survey shows that Americans make up approximately half of a percent of total enrollment in Canadian Universities. The same source shows that close to 10% of total University enrollment is comprised of Canadians studying in a province other than their own. According to the Integrated Postsecondary Education Study, 513,000 first time American postsecondary students attended an American institution outside of their own state. Yet, according to UNESCO, only 29,000 postsecondary Canadian students enrolled in an American institution.

Given the remarkable lack of mobility between these countries, it is not surprising to see the magnitude of unfamiliarity between Americans and Canadians found in the data. If anything, one would expect that average intranational ties should be more than ten times greater than international ties. What could be behind this lack of mobility? As far as the movement of students, tuition fees at a particular university are often much lower for students of the same country. The cost of attending a Canadian university is approximately 3 times greater for international students than for Canadian students (Statistics Canada). Published tuition fees in the United States are typically not higher for out-of-state students than they are for international students. However, several states, either bilaterally or as members of a consortium, have bilateral tuition reciprocity agreements. To name one of many, the Western Undergraduate Exchange is an agreement between 15 western states in which accepted out-of-state students receive a tuition discount equal to 150% of the in-state rate. Furthermore, and perhaps more importantly, there are barriers to the bilateral recognition of professional qualifications. For example, those that attend law school in Canada are not trained to pass the American bar exam, or a teacher certified in Oregon can teach in Idaho but cannot teach in British Columbia with out passing additional hurdles.

The lack of migration is also as expected. There is no free mobility across the U.S.-Canada border. Due to increased security concerns, migratory policies in these countries are arguably more strict now than they have ever been. Migrants must go through costly visa application processes, after which their allowance to permanently stay is not guaranteed until citizenship can be obtained after several years. Often times, Canadian employers (particularly publicly funded institutions such as universities) will explicitly discriminate against non-Canadians in the hiring process. Moreover, even though both the United States and Canada are highly federal, there is a greater degree of regulatory homogeneity intranationally than internationally. For example, social security numbers are a prerequisite for obtaining a job in the United States in any state.

Finally, it is certainly possible that both types of mobility and social ties feed back into one another. Perhaps people opt to settle in locations where they have some form of social connection all else equal, but these connections are formed through mobility in the first place.

1.4.2. The Mediating Effects of Social Ties. The main results of this paper can be seen in Table 1.4. Column 1 presents our benchmark estimation with out any cultural variables or social ties and column 2 shows the estimation of the border effect after social ties are included. Columns 3 and 4 show the estimate of the border effect with and without social ties but with the cultural variables also included. Columns 5 and 6 show the OLS estimates of the border effect using the restricted data set of Anderson and van Wincoop (2003) and Feenstra (2002). Columns 7 and 8 show the effect of the border on social ties when cultural variables are not included and when they are included respectively. Column 9 illustrates the effect of the border on social ties in the restricted sample.

According to our benchmark estimate with feasible GLS, the estimated coefficient on the border is $Border_{ij} = 1.5$. This implies that the border reduces trade by a factor of $\exp(1.5) = 4.5$. Recall from the introduction that any border effect greater than 1.8, according to our back of the envelope calculation, is a puzzle in the sense that it cannot be reconciled with observable trade costs. The equivalent *ad valorem* tariff which would generate a border effect of 4.5 is between 40 and 80 percent depending on the elasticity of trade (as opposed to the observable tariff equivalence of 14.8% as calculated by Yi, 2010). As is no surprise, the border still is a puzzle in 2009.

Recall that Feenstra (2002) and Anderson van Wincoop (2003) estimated a border effect of about 5. Our result does not imply that the border was less a trade

Table 1.4

	Dependent Variable: $ln(X_{ij})$						Dependent Variable: $ln(l_{ij})$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	26.076***	30.377***	24.435***	29.991***	26.4***	31.567***	-10.798***	-12.754***	-11.029***
	(0.205)	(0.306)	(0.658)	(0.768)	(0.375)	(0.737)	(0.190)	(0.620)	(0.255)
$ln(d_{ij})$	-1.161***	-0.695***	-1.117***	-0.693***	-1.256***	-0.792***	-1.031***	-0.972***	-0.986***
	(0.024)	(0.030)	(0.024)	(0.031)	(0.052)	(0.074)	(0.020)	(0.022)	(0.029)
$Border_{ij}$	1.505***	0.520***	1.415***	0.490***	1.822***	0.651***	2.524***	2.393***	2.512***
	(0.063)	(0.089)	(0.071)	(0.088)	(0.091)	(0.174)	(0.042)	(0.046)	(0.046)
$ln(l_{ij})$	--	0.425***	--	0.423***	--	0.468***	--	--	--
		(0.024)		(0.025)		(0.059)			
$ComRel_{ij}$	--	--	0.446**	-0.063	--	--	--	0.601**	--
			(0.222)	(0.199)				(0.247)	
$ComEurope_{ij}$	--	--	3.083***	1.474**	--	--	--	3.476***	--
			(0.703)	(0.594)				(0.64)	
$ComLang_{ij}$	--	--	0.581	0.151	--	--	--	0.591	--
			(0.686)	(0.751)				(0.622)	
Method	FGLS	FGLS	FGLS	FGLS	OLS	OLS	OLS	OLS	OLS
Sample	Full	Full	Full	Full	Restricted	Restricted	Full	Full	Restricted
N	3306	3306	3306	3306	1555	1555	1653	1653	780
R^2	0.92	0.92	0.92	0.93	0.88	0.87	0.86	0.87	0.891
RMSE	0.51	0.47	0.51	0.47	0.87	0.90	0.46	0.46	0.45

*NB the constant for FGLS is a coefficient because after the transformation cons=cons*w where w is the weight. Fixed effects are not included for exposition, but are available by request however they are of limited use as they are referenced to an arbitrary category omission. Standard errors in columns 1-6 are clustered by dyad. 10%, **-significant at 5%, ***-signficant at 1%. Restricted sample indicates only the states and provinces used by McCallum (1995) are used.*

deterrent in 2009 than it was in 1993. When the border effect is re-estimated using the restricted sample and ordinary least squares, the estimate of the border effect is $\exp(1.82) = 6.19$ in 2009. This is substantially greater than the seminal estimates based on 1993 data. At first, this seems puzzling. The U.S. and Canada were only five years into their free trade agreement in 1993 and not all explicit trade barriers were formally removed yet. By any measure of bilateral trade intensity, however, the United States and Canada were not as close of trading partners in 2009 as they were in 1993. Canada and the U.S. exported 81.3% and 21.5% (respectively) to the other as a percentage of their total exports in 1993. In 2009, these figures dropped to 75.1% and 19.4%. Exports from one country to the other as a percentage of the exporter's GDP fell from 20.3% and 1.5% in Canada and the U.S. in 1993 to 17.7% and 1.47% in 2009. Further recall that OLS estimation of the log-log gravity model may yield misleading results. The comparison of the 2009 results and the 1993 results will also depend on the conditional distribution of the residuals in these two samples. The smaller estimate of the border effect using FGLS is expected. Santos Silva and Tenreyro (2006), and subsequent papers which use newer gravity model estimators, show the elasticity of trade with respect to the variables which proxy trade costs are inflated when heteroskedasticity is not accounted for.

The estimate of the border effect when cultural variables are included, as shown in column 3, is lower than when cultural variables are not included. The trade reducing effect of the border in this case is $\exp(1.42) = 4.12$. In column 3, it is shown that common ancestry and common religion are important for trade. Regions of the same country are slightly more similar in these two respects. The probability of being of the same European ancestry is 0.16 intranationally versus 0.13 internationally. The probability of adhering to the same religion is 0.5 intranationally and 0.47 internationally. Including variables which are important to trade in the gravity model will of course decrease the border effect if these factors become less similar when the border is crossed. This drop in border effect is the mediating effect of cultural similarity on trade. That is, cultural dissimilarity is a hidden, albeit small, cost of crossing the U.S.-Canada border.

Columns 7 through 9 illustrate the substantial border effect in social ties between the United States and Canada. Conditional on other factors, the border reduces social ties by a factor of nearly 11 when cultural similarity is accounted for and by 12 when not accounting for culture. There is no evidence that language has a significant impact on social ties above and beyond the effects of other covariates.

In all three cases considered, the inclusion of social ties substantially reduces the effect of the border on trade. The border effect which remains after social ties are included is the effect of the border which was not caused through the social tie channel. In the benchmark case without cultural variables, the border effect falls from $\exp(1.5) = 4.5$ to $\exp(.52) = 1.68$, which gives $\Delta = 2.68$. That is, the inclusion of social ties reduces the effect of the border on trade by a factor of 2.68. 63% of the trade reducing effect of the border can be explained by the effect of the border on social ties and the effect of social ties on trade. 37% of the border is left unexplained. This is the direct effect of the border on trade (as opposed to the indirect effect of the border which works through social ties). This could be due to border wait times, uncertainty over exchange rate fluctuations or other regulatory barriers.

The results are quite similar once the cultural variables are included. $\left(\beta_{border} - \widehat{\beta}_{border}\right) - \left(\beta'_{border} - \widehat{\beta}'_{border}\right) = 0.08$, where a hat denotes the inclusion of social links and $'$ denotes the inclusion of cultural similarity. The slightly smaller mediational effect of the social ties on the border is expected. Both trade and social ties are positively affected by common ancestries and common religions. The relationship between trade and social ties is reduced when accounting for these confounding factors. When social links are accounted for, the border effect falls from $\exp(1.42) = 4.12$ to $\exp(0.49) = 1.63$, which yields $\Delta = 2.53$. In this case, slightly over 60% of the border can be explained by social ties and 40% cannot. Qualitatively, the mediating effects of social ties on the border are quite stable when confounding factors are accounted for.

When using ordinary least squares on the restricted sample, the border effect falls from $\exp(1.82) = 6.19$ to $\exp(0.65) = 1.92$, implying a Δ of 3.22. Given the findings of recent research, even though this large drop helps our argument, favour should be given towards the FGLS estimates. It is useful to note for the sake of our argument here, however, that $\frac{\partial \ln l_{ij}}{\partial Border_{ij}} * \frac{\partial \ln X_{ij}}{\partial \ln l_{ij}} = \beta_{border} - \widehat{\beta}_{border}$.

The elasticity of trade with respect to distance also falls when including social ties. Analysis in the previous subsection shows that social ties decay with distance.

This is evidence that part of the reason why geographic distance matters is not just due to the pecuniary cost long-distance haulage. It is also due to the notion that the farther a good travels, the fewer are social linkages and the higher are the implicit costs of trading. The elasticity of trade with respect to distance falls by approximately 40% once social ties are accounted for.

If the results in this section are pushed to the extreme, it is interesting to point out that the remaining border effect in our benchmark estimation after including social ties is 1.68 and 1.63. This is the effect of the United States - Canada border which is not caused by unfamiliarity costs. These figures, fall precisely within the range of what the border effect should be given recent estimates of the elasticity of trade and the observable cost of crossing the border. The OLS estimates lie slightly above this range. As discussed in appendix 1.B, the use of an alternative technique actually implies that the border is no longer significant after social ties are accounted for. This is difficult to reconcile, however, as trade costs other than a lack of unfamiliarity between the United States and Canada do exist. The value of Δ implied by this estimator is between the value implied by OLS and FGLS.

1.5. Conclusion

The trade promoting effects of social connections between regions is well recognised in the literature. We do not claim that it is a surprise that social ties diminish when borders are crossed, even when we are talking about a border between two similar counties. We also do not claim that it is a surprise that this unfamiliarity can partly describe away the trade reducing effects of the border. What we do find surprising, however, is the magnitude with which the border creates unfamiliarity and subsequently how much excessive intranational trade can be described by social ties. Once social ties are accounted for in standard gravity equation estimation, the border effect falls by about 60% in our benchmark estimation. The use of other estimators imply the border effect falls by a similar magnitude.

Using more traditional estimation techniques, we show that the U.S.-Canada border was more a trade deterrent in 2009 than it was in 1993. As formal trade barriers were still being removed in 1993, one can reasonably surmise that explicit trade costs were lower in 2009 than they were in 1993. This observation gives support for our argument that the border puzzle is due to very large missing trade costs. If the border puzzle was driven by a large elasticity of trade with respect to trade costs, the effect of the border in 2009 should be much lower than it was in 1993.

The weaknesses of this study are principally caused by limitations in the data. A valid instrument which could account for the potential endogeneity of social ties would be very useful for strengthening the claims put forward. As we have discussed, such an instrument is at the very least difficult to come by. Alternatively, the use of a long panel with dyad specific fixed effects would also be a solution to this problem. However, there is only one year of data available. Finally, it would be useful to further explore the nature of the border effect on social ties. Our discussion of the causes of home bias in social connectivity was based around suggestion only. Without data on bilateral mobility between one individual state and another individual province, more concrete analysis would be difficult.

At the very least, this paper has put light a novel data set which would be very useful for future trade research. Many interesting questions could be addressed in a straightforward manner. For example, why does language matter for trade? The fixed cost of sourcing an interpreter and the marginal cost of multilingual packaging should not inhibit trade as much as it has been found to. Does language matter for trade because it leads to social unfamiliarity? This could easily be addressed using the data and methodologies put forward. This data set has information on social ties between more than 100 countries, and because there are currently more than 1 billion active Facebook users in the world, we hope to see it used more in the future.

Appendix 1.A

The list of cities used can be seen in Table 1.A. * Indicates that a substitute city was used in population weighting because of subjective boundaries. This was done to prevent absurdly large weightings to rural regions. For example, if one conservatively says that "Northern Jersey" is the three northern most counties of New Jersey, a "Northern Jersey" would be weighted 5 times more than Newark, the principle city of New Jersey in which every resident of Northern New Jersey could reasonably claim as their regional network. The substitutions are as follows: Northern Arizona - Flagstaff, Western Arizona-Yuma, Orange County - Anaheim, Silicon Valley - San Jose, Inland Empire - Riverside, Monterey Bay - Salinas, Ventura County - Oxnard, East Bay - Oakland, Central Coast - Santa Maria, Northern Colorado - Fort Collins, Western Colorado - Grand Junction, Southern GA - Albany, Eastern Idaho - Idaho Falls, Northern Indiana - South Bend, Cape Cod - Barnstable Town, South Jersey - Camden, North Jersey - Paterson, Jersey Shore - Atlantic City, Central Jersey - Trenton, Suffolk County - Lindenhurst, Westchester - Yonkers, Nassau County - Hempstead, Rio Grande Valley - Brownsville

Table 1.A

Mobile, AL	Savannah, GA	Hattiesburg, MS	Lima, OH	Victoria, TX	Saint John, NB
Dothan, AL	Athens, GA	Tupelo, MS	Youngstown, OH	El Paso, TX	St. John's, NF
Montgomery, AL	Atlanta, GA	St. Louis, MO	Akron, OH	Lubbock, TX	Halifax, NS
Western AZ., AZ*	Southern GA., GA*	Springfield, MO	Toledo, OH	Corpus Christi, TX	Ottawa, ON
Northern AZ., AZ*	Augusta, GA	Kansas City, MO	Cleveland, OH	Wichita Falls, TX	Barrie, ON
Phoenix, AZ	Eastern ID, ID*	Missoula, MT	Mansfield, OH	Houston, TX	Kingston, ON
Tucson, AZ	Boise, ID	Billings, MT	Cincinnati, OH	Amarillo, TX	Thunder Bay, ON
Fort Smith, AK	Rockford, IL	Great Falls, MT	Columbus, OH	San Angelo, TX	London, ON
Fayetteville, AK	Chicago, IL	Bozeman, MT	Dayton, OH	San Antonio, TX	Toronto, ON
Little Rock, AK	Peoria, IL	North Platte, NE	OK City, OK	Rio Grande Valley, TX*	Hamilton, ON
Jonesboro, AK	Lafayette, IN	Omaha, NE	Lawton, OK	St. George, UT	Sudbury, ON
Los Angeles, CA	Indianpolis, IN	Lincoln, NE	Tulsa, OK	Logan, UT	Kitchener, ON
Sacramento, CA	Bloomington, IN	Scottsbluff, NE	Medford, OR	Provo, UT	Charlottetown, PE
Orange County, CA*	Terre Haute, IN	Kearney, NE	Portland, OR	Salt Lake City, UT	QC City, QC
Silicon Valley, CA*	Fort Wayne, IN	Las Vegas, NV	Corvallis, OR	Ogden, UT	Montreal, QC
Santa Barbara, CA	Northern IN., IN*	Reno, NV	Eugene, OR	Burlington, VE	Saskatoon, SK
Bakersfield, CA	Evansville, IN	Carson City, NV	Salem, OR	Roanoke, VA	Regina, SK
Santa Cruz, CA	Waterloo, IA	Concord, NH	Bend, OR	Lynchburg, VA	
Inland Empire, CA*	Cedar Rapids, IA	Manchester, NH	Harrisburg, PA	Richmond, VA	
Monterey Bay, CA*	Des Moines, IA	South Jersey, NJ*	Lancaster, PA	Charlottesville, VA	
Fresno, CA	Sioux City, IA	Newark, NJ	Pittsburgh, PA	Tri-Cities, WA	
Ventura County, CA	Davenport, IA	North Jersey, NJ*	State College, PA	Seattle, WA	
East Bay, CA*	Topeka, KA	Jersey Shore, NJ*	Erie, PA	Bellingham, WA	
San Francisco, CA	Wichita, KA	Central Jersey, NJ*	York, PA	Yakima, WA	
Central Coast, CA*	Lexington, KY	Albuquerque, NM	Scranton, PA	Spokane, WA	
Chico, CA	Bowling Green, KY	Santa Fe, NM	Reading, PA	Tacoma, WA	
San Diego, CA	Louisville, KY	Las Cruces, NM	Allentown, PA	Bellevue, WA	
Redding, CA	Lake Charles, LA	Farmington, NM	Philadelphia, PA	Wenatchee, WA	
Denver, CO	New Orleans, LA	Rochester, NY	Williamsport, PA	Olympia, WA	
Boulder, CO	Shreveport, LA	Poughkeepsie, NY	Newport, RI	Charleston, WV	
Northern CO., CO*	Baton Rouge, LA	Buffalo, NY	Providence, RI	Morgantown, WV	
Colarado Springs, CO	Lafayette, LA	Albany, NY	Greenville, SC	Wheeling, WV	
Western CO., CO*	Monroe, LA	Suffolk County, NY*	Charleston, SC	Huntington, WV	
New Haven, CT	Alexandria, LA	Westchester, NY*	Myrtle Beach, SC	Parkersburg, WV	
Hartford, CT	Portland, ME	Nassau County, NY*	Columbia, SC	Appleton, WI	
Wilmington, DE	Bangor, ME	Ithaca, NY	Florence, SC	Oshkosh, WI	
Dover, DE	Baltimore, MD	New York, NY	Pierre, SD	Green Bay, WI	
Gainesville, FL	Salisbury, MD	Syracuse, NY	Sioux Falls, SD	Milwaukee, WI	
West Palm Beach, FL	Cape Cod, MA*	Utica, NY	Rapid City, SD	Wausau, WI	
Ocala, FL	Worcester, MA	Binghamton, NY	Memphis, TN	Madison, WI	
Orlando, FL	Boston, MA	Charlotte, NC	Kingsport, TN	Eau Claire, WI	
Jacksonville, FL	Lowell, MA	Greenville, NC	Nashville, TN	Sheboygan, WI	
Sarasota, FL	Springfield, MA	Winston-Salem, NC	Knoxville, TN	La Crosse, WI	
Daytona Beach, FL	Detroit, MI	Fayetteville, NC	Chattanooga, TN	Casper, WY	
Tallahassee, FL	Ann Arbor, MI	Greensboro, NC	College Station, TX	Cheyenne, WY	
Fort Lauderdale, FL	Flint, MI	Wilmington, NC	Waco, TX	Calgary, AB	
Naples, FL	Grand Rapids, MI	Asheville, NC	Austin, TX	Edmonton, AB	
Miami, FL	Duluth, MN	Grand Forks, ND	Abilene, TX	Vancouver, BC	
Tampa Bay, FL	St. Cloud, MN	Fargo, ND	Laredo, TX	Kelowna, BC	
Panama City, FL	Jackson, MS	Bismarck, ND	Beaumont, TX	Winnipeg, MB	

Appendix 1.B

In this appendix, a number of robustness tests are performed. First, the determinants of social ties are re-estimated without log-transformation of the social ties variable. The results are presented in Table 1.B.1. There remains evidence of a significant relationship between student mobility/migration and social ties.

In Table 1.B.2, our main exercise is repeated with 2007 trade data rather than 2009 trade data. All other variables used are just as they were described in the data section.

Next, our benchmark estimation is repeated with the exception that we include a variable which captures the interacting effect between social ties and the border dummy variable. The results are presented in Table 1.B.3. This allows for the possibility that social ties affect trade in a fundamentally different manner when discussing trade within countries versus trade between countries. While the interaction between the border variable and social ties is not significant, the inclusion of the interaction term leads to a larger drop in our estimate of the border effect relative to our benchmark case. This result provides support to the central thesis of this chapter: that social ties are a very important feature which drive the fact that international borders reduce trade.

Finally, the border effect is also estimated using the methodology described by Bosquet and Boulhol (2013). To start, the standard gravity model in log-log form is exponentiated resulting in

$$X_{ij} = \exp\left(\alpha + \beta_1 \ln d_{ij} - \beta_2 Border_{ij} + \{\beta_3 \ln l_{ij}\} + \gamma_i + \gamma_j\right) + \varepsilon_{ij} \tag{7}$$

We first will illustrate how NBPML depends on scale and what Bosquet and Boulhol (2013) have done to eliminate scale dependence. The first order condition of the NBMPL estimator is as follows:

$$\sum_i \left(1-\rho \exp\left(X_i\beta\right)\right)^{-1}\left(y_i-\exp\left(X_i\beta\right)\right)X_i=0$$

ρ is the dispersion parameter, which dictates how the conditional variance relates to the conditional mean of X_{ij}. However, $\frac{var(y|x)}{E(y|x)}$ and hence ρ, depends on how the data is scaled. This is why the NBPML estimator generates scale dependent estimates. Bosquet and Boulhol (2013) show how ρ should be calculated to generate scale invariant estimates. The first step is to estimate the following using PPML:

(8)
$$\frac{\left(\widehat{\varepsilon}_{ij}\right)^2}{\widehat{X}_{ij}}=a+b\widehat{X}_{ij}+\upsilon_{ij}$$

In other words, the variance of the residuals is taken to be a linear combination of exports and the square of exports. After obtaining the relationship between the variance of the residuals and the dependent variable, define $\rho=\frac{b}{a}$. Bosquet and Boulhol (2013) prove that when the dispersion parameter is identified this way, changes in $\frac{var(y|x)}{E(y|x)}$ due to changes in scale are are removed. NBPML is implemented with $\rho=\frac{b}{a}$ as the dispersion parameter. The scale no longer affects the results. We use the stata code provided on Clément Bosquet's website.[22] The results are presented in Table 1.B.4

In this case $\Delta=3.09$. It is important to note that the border effect between the United States and Canada is not statistically different from 0 once social links are accounted for. In other words, the United States and Canada trade just as much as they should given the weak social ties between them. This is difficult to reconcile given that border costs due to factors other than social ties exist. However, this result provides confirmation that social ties account for a lot of the measured border effect (whatever the true border effect actually is).

[22]https://sites.google.com/site/clementbosquet/supplemental-material

Table 1.B.1

Dependent Variable: l_{ij}	
Constant	5.60×10^{-6} ***
	(6.78×10^{-7})
$ln(d_{ij})$	-2.51×10^{-7} ***
	9.48×10^{-8}
$ln(m_{ij})$	1.41×10^{-7} *
	(7.55×10^{-8})
$ln(School_{ij})$	3.46×10^{-7} ***
	(8.72×10^{-8})
$ComRel_{ij}$	-4.86×10^{-7}
	(3.18×10^{-7})
$ComEurope_{ij}$	-8.86×10^{-7}
	(1.24×10^{-6})
$ComLang_{ij}$	1.85×10^{-6} ***
	(5.19×10^{-7})
N	1125
Method	2SLS
R^2	0.37
RMSE	$9.2\times(10^{-7})$

*Heteroskedasticity robust standard errors are in parenthesis. Because data are dyadic in this section, standard errors are not clustered by partner pair. *-significant at 10%, **-significant at 5%, ***-signficant at 1%.*

Table 1.B.2

Dependent Variable: $\ln(X_{ij})$ 2007		
	(1)	(2)
Constant	26.1397***	30.586***
	(0.194)	(0.296)
$\ln(d_{ij})$	-1.17***	-0.712***
	(0.023)	(0.029)
Border	1.593***	0.574***
	(0.065)	(0.082)
$\ln(l_{ij})$	--	0.427***
		(0.0227)
Method	FGLS	FGLS
N	3306	3306
R^2	0.92	0.93
RMSE	0.5	0.46

*NB the constant for FGLS is a coefficient because after the transformation cons=cons*w where w is the weight. Fixed effects are not included for exposition, but are available by request however they are of limited use as they are referenced to an arbitrary category omission. Standard errors in are clustered by dyad. 10%, **-significant at 5%, ***-signficant at 1%.*

Table 1.B.3

	Dependent Variable: ln(Xij)			
	(1)	(2)	(3)	(4)
Constant	26.076***	31.116***	24.435***	30.233***
	(0.205)	(0.971)	(0.658)	(1.114)
$ln(d_{ij})$	-1.161***	-0.692***	-1.117***	-0.688
	(0.024)	(0.030)	(0.024)	(0.031)
$Border_{ij}$	1.505***	-0.350	1.415***	-0.25
	(0.063)	(0.958)	(0.071)	(0.932)
$ln(l_{ij})$	--	0.470***	--	0.470***
		(0.062)		(0.061)
$ln(l_{ij})$* $Border_{ij}$	--	-0.053	--	-0.044
		(0.0572)		(0.056)
$ComRel_{ij}$	--	--	0.446**	-0.103
			(0.222)	(0.207)
$ComEurope_{ij}$	--	--	3.083***	1.551***
			(0.703)	(0.587)
$ComLang_{ij}$	--	--	0.581	0.728
			(0.686)	(0.733)
Method	FGLS	FGLS	FGLS	FGLS
N	3306	3306	3306	3306
R^2	0.92	0.93	0.92	0.93
RMSE	0.51	0.47	0.51	0.47

*NB the constant for FGLS is a coefficient because after the transformation cons=cons*w where w is the weight. Fixed effects are not included for exposition, but are available by request however they are of limited use as they are referenced to an arbitrary category omission. Standard errors are clustered by dyad. 10%, **-significant at 5%, ***-signficant at 1%.*

Table 1.B.4

	Dependent Variable: X_{ij}	
	(1)	(2)
Constant	16.465***	20.598***
	(0.312)	(0.347)
$ln(d_{ij})$	-1.112***	-0.611***
	(0.023)	(0.031)
Border	1.112***	-0.016
	(0.058)	(0.077)
l_{ij}	--	0 .457***
		(0.024)
Method	$NBQGPML^{GLM}$	$NBQGPML^{GLM}$
N	3306	3306

*Dependent variable is exports from i to j in 2009 in levels, not logs. Fixed effects are not included above for brevity. Robust standard errors are in parentheses.***-significant at 1% level*

CHAPTER 2

Trust Formation and Trade

Abstract

Empirical evidence suggests that trust is very important for promoting trade between countries. Given the relative difficulty of formal international contract enforcement, informal mechanisms are important for ensuring that trade is honest and profitable. In this paper, trust between agents of different countries is established through community based sanctions. The efficacy of these community sanctions will depend on how many agents have decided to engage in trade with a particular country. The decisions of would-be international traders of a particular country are strategic complements. A norm of cooperative behaviour between two countries can only be established if individuals in those two countries interact frequently enough. Cooperative behaviour (and synonymously trust) is endogenous to the level of trade in our model. A coordination game between members of the same country occurs and suboptimally low levels of international trade are the result of a coordination failure.

2.1. Introduction

The amount of trust that exists between members of two countries significantly affects how much they trade. This was a key finding by Guiso, Sapienza, and Zingales (2009) who found that a one standard deviation increase in bilateral trust increases trade by 10% *ceteris paribus*.[1] The importance of trust for international trade has been further confirmed by Yu, Haan, and Beugelsdijk (2011), Lennon (2008), Den

[1]More specifically, a one standard deviation increase in trust from i to j increases $i's$ imports from j by 10%.

Butter and Mosch (2003), and others. This result is not surprising. In nearly every type of economic interaction, there exists a short-term temptation to behave in an opportunistic manner. Buyers are tempted not to deliver payment, sellers are tempted to deliver low-quality items when a high quality was promised, partners in a joint business venture are tempted to under-exert effort, and so forth. These temptations are arguably more problematic when talking about trade between individuals in different countries, where behaviour is difficult to monitor and screening is difficult. Without an established norm of trust and cooperation between individuals of different countries, would-be traders may be drawn into autarky. In this paper, we develop a simple game-theoretic model which addresses how trust and cooperation between individuals in different countries might be formed and how it interacts with how much they trade.

The importance of trust in establishing trade is a reflection of the weak international legal environment. With complete contracts and costless enforceability, trust in itself should not matter. An individual who is cheated by a foreigner, however, faces many hurdles in recouping losses. First, this is because judicial systems may be biased against foreign litigants. Former U.S. president James Madison famously said that "We well know, sir, that foreigners cannot get justice done in these courts..."[2] Bhattacharya, Galpin, and Haslem (2007) provide empirical evidence in this respect by showing that the market reaction when litigation is brought against a domestic firm is far less severe than the reaction when litigation is brought against a foreign firm. Second, collecting damages against foreign parties can be difficult absent the existence of effective bilateral recognition treaties. Turrini and Ypersele (2010) argue that the cost of using foreign legal systems is a plausible explanation for why individuals are more prone to trade with those of their own country. International arbitral institutions were designed to bypass these difficulties, however international

[2] Quote sourced from Clermont and Eisenberg (1996).

arbitration is costly.[3] Furthermore, some evidence exists which suggests that the presence of formal trade protecting institutions only has a modest impact on trade. This was the conclusion of Leeson (2008) who explores the effect of the New York Convention.[4]

What exactly is trust? In an economic context, trust is modelled as the decision to behave cooperatively in a repeated prisoner's dilemma. Simultaneous cooperation can yield payoffs which are to the mutual advantage of both players involved. However, if one does not believe that their opponent will behave cooperatively, they are better off by resorting to self-protecting strategies and will not cooperate themselves. Trust and the existence of a cooperative norm will be used interchangeably hereafter.

Trust can be established on a bilateral basis. Consider, for example, an exporter from the UK and a distributor from France. The French distributor must decide whether or not to exert a low or high effort on behalf of the UK principal. Low effort is less costly, but it will make the UK exporter's operation unprofitable. The UK exporter can refuse to deal with this French distributor in the future if low effort was exhibited. The French distributor will decide not to cheat the UK exporter (and trust is established) if the promise of future interaction is more profitable than the one time payoff of cheating. For honest behaviour to occur, frequent interaction is important.

In many business dealings, however, interactions are inherently infrequent and people change partners over time. In such settings, bilateral trust fails. But, people gossip. A buyer who receives poor quality goods will tell her friends or post negative online reviews, firms that are cheated by suppliers will contact managers of other firms in their social or business network, and so forth. McCaulay (1963)

[3] Antrás (2013) discusses that the cost of disputing $10,000 with the International Chamber of Commerce (ICC) would cost more than $5,000. Fewer than 800 arbitration requests were brought forward to the ICC in 2011.

[4] The goal of this treaty was to establish bilateral enforcement of foreign arbitral rewards.

discusses that "The way one behaves in a particular transaction, or series of transactions, will color his general business reputation ... Sellers who do not satisfy their customers become the subject of discussion in the gossip exchanged by purchasing agents and salesmen, at meetings of purchasing agents' associations and trade associations, or even at country clubs and social gatherings where members of top management meet..." (Quote sourced from Pyle, 2005). Indeed, empirical evidence exists with respect to the use of gossip about the behaviour of certain individuals in past business dealings. Pyle (2005) uses survey data on firms in five different transition countries. Nearly 35% of firms in this sample claim that they will know whether or not a particular customer had a dispute with another firm. The most important channels through which such information flows in that study are identified as social contacts between managers or through the membership in a trade association. Further evidence of the transmission of information on the past action's of others in a business setting can be found in Rooks, Tazelaar, and Snijders (2011), Nunlee (2005), McMillan and Woodruff (1999) and others. The availability of online review websites and online social networking reasonably implies that this sort of information flows more easily now that it ever has.

Furthermore, there are several case studies throughout history which document the use of collective punishment and ostracism in enforcing good behaviour in international trade. Discussing trade with countries in which there is a large ethnic Chinese community, Weidenbaum and Hughes (1996) state that "if a business owner violates an agreement, he is blacklisted. This is far worse than being sued, because the entire Chinese network will refrain from doing business with the guilty party."[5] Greif (1989) documents the role of multilateral enforcement in medieval European trade. Of the many original manuscripts they draw on, one example they cite is "Around 1055 it became known in Fustat that Abun ben Zedaka, an agent who

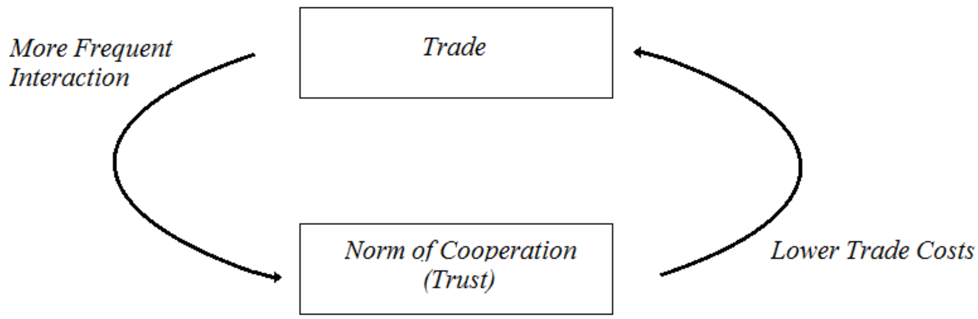
[5]Quote sourced from Rauch and Trindade (2002).

lived in Jerusalem, embezzled the money of a Maghribi trader. The response of the Maghribi traders was to cease any commercial relations with him. His bitter letter indicates that merchants as far away as Sicily had ostracized him." Additional case-study evidence of the use of multilateral punishment in trade can be found Clay (1997), Milgrom, North, and Weingast (1990), and others.

If trust is important for trade, and trust is established in part on a multilateral basis, then the decisions of would-be exporters of a particular country are strategically complimentary. Returning to the example of the French distributor and the UK exporter. Suppose several UK exporters have established themselves in France (through the payment of assorted sunk exporting costs). If the French distributor cheats a particular UK exporter, she may lose business from some or all the UK exporters who do business in France because they gossip amongst themselves. As a result of this, the more UK exporters that are established in France, the more likely the French distributor is to behave honestly towards any particular exporter. That is, the more UK exporters in France, the more deterring is the threat of losing future business from the UK. The ability of a UK exporter to induce cooperative behaviour on behalf of their opponent is therefore a function of how many UK businesses export to France.

In other words, trust causes trade and trade causes trust. This results in a coordination game with two equilibria. In one equilibrium, there is trust and trade. In the other, there is no trust and no trade. Many countries trade far less with each other than theory suggests they should. This "missing trade," in the context of our model, is the result of a coordination failure and being stuck in the 'bad' equilibrium. Furthermore, the model we present highlights the importance of trade missions as a coordination device or the use of export insurance schemes. Anything that establishes the "initial push" for trust to occur would support trade in absence of efficient legal mechanisms. An additional implication of our model is that it is

Figure 2.1



more difficult for small countries to establish trusting international relationships with large countries. For example, our model implies that a Chinese manufacturer would be more inclined to cheat a Maltese businessman than an American businessman. A coordinated punishment even from everybody in Malta would not entail a great loss of future profits. That is, smaller countries have less leverage in this respect. Further in this paper, we briefly discuss some evidence which suggests that this may indeed by the case. The logic of the main argument behind the model we present is illustrated in Figure 2.1.

This paper follows a more general, less frequently studied, notion that trade costs are endogenous to trade. Standard trade models à la Krugman and Melitz assume exogenous trade costs. It is reasonable to assume that the features required for trade to flourish, however, will only be created if trade exists in the first place. The framework we present can be used to deal with any number of these other costs of trade which are endogenous to trade itself.

The rest of this paper is organised as follows. In the next section, we highlight the related theoretical literature and discuss the contribution of this paper. In section 2.3, the model is presented. Section 2.4 concludes.

2.2. Related Literature

The literature on community enforced trust started with Kandori (1992). In that paper, individuals from two large populations are repeatedly matched to play a prisoner's dilemma *ad infinitum*. Mutual cooperation is sustained across these two populations through community enforced sanctions. That is, if an individual from population 1 cheats an individual from population 2, the cheating individual may face sanctions in the future from other parties in population 2 even though they were not cheated directed themselves. The author goes on to show a Folk Theorem in which the communities can sustain any mutually beneficial payoff.

Our paper is not the first which has modelled the use of community based sanctions for establishing honest trade. Greif (1993) demonstrates a model stylised to Medieval European trade in which a principal wishes to export using the service of an overseas agent. The principals of a given network can enforce honest behaviour on behalf of their overseas agents through the provision of a high enough wage and by collectively refusing to hire an agent who has cheated anybody in the past. Dixit (2003) presents a model in which a continuum of traders are randomly matched with each other. The actions of traders in one particular trade is imperfectly revealed to the rest of trader population. Even though the probability of meeting any given trader in the future is effectively 0, honest behaviour can still prevail through the threat of third party punishments. Dhillon and Rigolini (2011) develop a model where formal legal enforcement and informal community based sanctions coexist. Consumers (facing the possibility of being cheated by a firm) can invest in their connectivity which increases the probability they will hear about a firm's behaviour. Firms can bribe the government by lowering the probability they will face legal sanctions.

Araujo, Mion, and Ornelas (2012) endogenise the decision of how much to trade with a foreign agent when the international legal environment may be weak and when trust is needed for trade to be profitable. In their model, the exporter of one country must contract an importer of another, but importers are heterogenous with respect to their inclination to cheat. When the international legal environment is weak, exporters will start out by exporting only a little at first until they are adequately confident of their partner's type. When the legal environment is strong, however, exporters initially export greater volumes. Trust in that paper is private, however, and the level of trust between individuals of two countries does not depend on aggregate trade.

The contribution of this paper is three-fold. First, as far as we can tell in game-theoretic models with random matching and community based sanctions, the size of the two populations that interact is exogenous. However, it is a reasonable extension to explore that individuals in a certain market may choose whether or not to be involved in the interaction in the first place based on what they expect payoffs to be. Second, we propose an explanation for how trust is determined in the forum of international trade. Our model generates a result in which trust and aggregate trade are jointly determined. This, to our knowledge, has not been considered formally.

Finally, we propose a framework for dealing with trade costs which are endogenous to trade. This is not a topic which has been frequently studied, however it has been given some attention in the past. Anderson and Marcoullier (2005) present a model in which trade flows and trade insecurity interact. In their paper, agents simultaneously choose between devoting effort to trading enterprises and/or to engaging in predatory behaviour against those who trade. In this case, international security and international trade flows are determined together. Anderson (2009) and Anderson and Young (2006) present models in which trade endogenously affects the quality of contract enforcement. Our paper is similar to these studies in spirit. However, the mechanism through which trade costs and trade are jointly determined and the modelling framework differ.

2.3. Model

2.3.1. Setup. We consider a world with only two countries, Home (H) and Foreign (F). Each country is populated by a continuum of individuals of mass N_H and N_F respectively. The population in each country is partitioned into two sets: a set of merchants and a set of townspeople. Merchants make up a portion $0 < \phi < 1$ of each country's population. Merchants can only trade with townspeople; merchants do not trade with merchants and townspeople do not trade with townspeople. As such, the merchant-townsperson relationship can be thought of as a buyer-seller or an exporter-supplier relationship. After a match is made, an opportunity for trade is presented. We do not expand upon what this opportunity exactly is other than some sort of economic interaction in which there potentially exists a short-run temptation to behave in a dishonest manner. If both parties decide to behave in an honest manner,we say that trust is established.

Merchants must choose whether or not to setup a business venture in their own country and/or a business venture in the other country in which they will interact with the townspeople in that respective market. Townspeople are fixed in their respective countries. A merchant must bear a non-recoverable fixed startup cost of f_X if they operate in the opposite country and f_D if they decide to operate in their own country. Parameter restrictions of $\phi(N_H + N_F) \leq (1 - \phi) N_H$ and $\phi(N_H + N_F) \leq (1 - \phi) N_F$ are imposed such that the global population of merchants is less than the population of townspeople in either country. The population partition into two groups and the parameter restriction allows for us to evaluate the trading decisions of country H individuals and country F individuals independently.[6] The qualitative goals of this paper are not affected by these assumptions.

[6] Without the population partition, a battle-of-the-sexes type coordination game between country H and country F traders would result. That is, even if H and F traders want to trade with each other, they would have to coordinate on which country it would take place in. The parameter restriction ensures that an H merchant, for example, will decide to trade in F even if all F merchants trade in F.

There is strong evidence which suggests that individuals from the same country trust each other more than individuals of different countries. According to Eurobarometer survey data on bilateral trust, countries on average trust themselves far more than they do others. With very few exceptions, Europeans trust their own country the most. As such, by assumption, honest behaviour will always occur when a merchant trades with a townsperson of the same country. This can also be justified by noting that *intra*national legal institutions are more efficient than are *inter*national legal institutions. Once again, this assumption is not necessary but exists for simplification purposes. If trust were not exogenously established between members of the same country, then merchants would have to coordinate their actions in the domestic market as well.

When individuals of different countries interact, however, one or both parties might have a short-term incentive to behave dishonestly. Dishonesty can take the form of contract violation, failure to deliver a payment or a product, misrepresentation of merchandise quality, outright theft, and so forth. When individuals from different countries meet, unscrupulous behaviour can only be prevented through informal punishment mechanisms. That is, we do not incorporate any formal external mechanisms which monitor and prevent such behaviour on the international stage.

Time $t = \{-1, ..., \infty\}$ is discrete and payoffs in subsequent periods are discounted by a constant and common factor $\delta < 1$. All individuals live forever. A merchant is matched with one townsperson in each market in which they are active every period. For example, a country H merchant who operates both in country H and country F will interact with two townspeople in a particular period (one from each country). Merchants active in a particular market will be matched with a townsperson every period, but townspeople will not always be matched with merchants. Matching probabilities are uniform, *i.i.d.* and last for just one period. One could presume, of course, that individuals would actively try to direct their matches in order to establish long and trusting bilateral relationships. This notion is not incompatible if one interprets δ as the probability that a given match will last until the next period. That is, people will still care about the possibility of meeting a new and different partner even if matches can be directed. Dixit (2003) adopts the same assumption in a similar framework and a more detailed justification is provided there. Once a match is made, interaction takes place. The result of any particular match is perfectly revealed to the world.

We impose the simplifying assumption that the decision of where to be active can only be made at time $t = -1$ and that this decision is irreversible. In reality, individuals not involved in trade with the other country would reverse their decisions if they see honest and profitable trade flourishing. Likewise, individuals involved in trade would like to exit the export market if nothing but opportunism occurs. If the decision of merchants could constantly be re-evaluated, townspeople would be more inclined to behave honestly to attract future business opportunities. Because of the "anything goes" result of folk theorems for repeated games, tractable results of a dynamic coordination game would not exist in this context. We argue that a one-shot coordination game is a reduced form of a more realistic dynamic version. Even if locational decisions could constantly be re-evaluated, no single individual is able to establish honest behaviour on their own. That is, no merchant from one country would want to be the only one engaged in trade with the other. This is not without precedent. Anderson and Marcoullier (2005), for example, adopt this one-time decision assumption in their game of whether or not to be an international trader or a predator on international trade.

The timing of the model is summarised as follows:

Timing

$t = -1$. Merchants simultaneously and independently choose whether or not to engage in trade with the opposite country.

$t = 0$. Merchants are matched with townspeople in the market(s) in which they have decided to operate.

$t = 1$. Matched individuals decide between honest and dishonest behaviour if they are from different countries. Profitable trade will occur if matched individuals are from the same country.

$t = 2$. The result of the stage game is perfectly revealed to the world and the match is broken.

The events of time 0-2 will repeat indefinitely. We consider two cases. One in which all information about the payoffs is revealed before $t = -1$ and one in which all information is revealed between periods $t = -1$ and $t = 0$. The rest of the model is organised as follows. In section 2.3.2, we analyse the repeated trading game that occurs after the coordination game of where to operate. This allows us to ascertain the critical number of merchants needed to enforce honest international trade. In section 2.3.3, we analyse the coordination game exploring the case in which there is perfect information. In section 2.3.4 the coordination game with incomplete information is analysed. Section 2.4 concludes.

2.3.2. Repeated Trading Game. In this section, we identify the range of parameter values for which honesty can be sustained between individuals of different countries. As mentioned, bilateral honesty and trust are interchangeably used in this paper. Define λ and λ' as the fraction of country H and country F merchants respectively who have decided to engage in trade with the opposite country. In this section, λ and λ' are fixed having been determined in the coordination game played by merchants in the previous period. We focus only on interaction between merchants from country H and townspeople from country F. The results in the reverse case are identical. For a particular λ, the total mass of country H merchants who are engaged in trade with country F is $\lambda\phi N_H$. λ and λ' are common knowledge from the onset of the repeated trading game. The purpose of this section is to show that there exists some critical value of λ^* above which trust occurs and below which it does not. In other words, this problem is approached recursively. Only after we have identified the critical fraction of merchants needed to establish honesty can the coordination game be assessed. As discussed, trust and honesty are exogenously established between individuals of the same country.

When individuals of different countries meet, both parties must simultaneously decide whether or not to be honest or dishonest. Payoffs from this stage game are predicted below.

Merchant$_H$ \ Townsperson$_F$	Honest	Dishonest
Honest	$a,\ a$	$b,\ c$
Dishonest	$c,\ b$	$0,\ 0$

a represents the payoff of mutual honest trade, c is the payoff of being dishonest to an honest opponent and b is the payoff from playing honest when one's opponent is dishonest. When both players are dishonest, a mutual payoff of 0 is awarded which we interpret as being equivalent to a trade not taking place in the first place. For example, if a seller does not deliver goods and the buyer does not deliver payment, it would be the same as if they had never met. b is strictly negative which captures the notion that players prefer to be dishonest when their opponent is also being dishonest as a means of self-protection. a is strictly positive implying that mutual honesty is better than mutual dishonestly. c is also strictly positive which implies that being dishonest to an unsuspecting honest opponent is better than being dishonest to a dishonest opponent. We place a restriction of $-b > c$ which guarantees that mutual honesty yields a higher payoff than alternating between honesty and dishonesty. If $a < c$, the stage game is a prisoner's dilemma in which mutual dishonesty is the only Nash equilibrium in a one shot version.

Conditional on operating internationally, a country H merchant is matched with a country F townsperson every period. The probability that a country F townsperson is matched with a country H merchant is $\lambda \frac{\phi}{1-\phi} \frac{N_H}{N_F}$. We are only interested in whether or not mutual honest behaviour can be sustained on the equilibrium path. It is assumed for simplicity that mutual honesty will occur if the parameter values are such that it is supportable. Absent formal legal recourse, the most severe punishment that a player i can impose on some player j is to be dishonest. If player j expects to be punished, they will also respond with dishonesty. Hence, 0 is the minimax payoff of the stage game and it is the most severe punishment a player can ever be held to. Define $h_t(i)$ as the history available to player i at time t. This includes all of the past actions of every player for all $t \in [0, ..., t-1]$. The pure strategy of player σ_i, is a mapping from player $i's$ period t history to a period t action.

For certain parameter values, any number of strategy profiles or combinations of strategy profiles between individuals can sustain honesty. Because our question is simply when can honesty occur, we restrict attention to the strategy profile which punishes dishonesty in the most severe manner possible. Refer to this strategy profile as $\widehat{\sigma}$. If all players play according to $\widehat{\sigma}$ and perpetual honesty cannot be supported, no strategy profile $\sigma \neq \widehat{\sigma}$ can prevent dishonesty. *A fortiori* this must be true.

The most severe punishment mechanism available in this context is a community grim trigger strategy. Under this strategy profile, player i will behave honestly against their opponent player j so long player j has never been dishonest. If player j is dishonest only once, all opponents will hold j to their minimax payoff in all future matches. That is, all punishments are permanent and enforced by all members of a particular country. We will first check if $\widehat{\sigma}$ can enforce honest behaviour on behalf of country H merchants. Because of the perfect information assumption, the repeated game here is similar, but not identical, to a game between just two agents.

If a country H merchant wishes to behave honestly in the first trade, they will wish to behave honestly in all future subgames as the problem will be identical. Given that townspeople adhere to $\widehat{\sigma}$, honesty is supportable on behalf of the merchants if the following inequality holds (assuming that indifferent players opt to behave honestly):

$$\sum_{t=0}^{\infty} \delta^t a \geq c \tag{9}$$

Define $a_M^* = (1 - \delta)\, c$ as the critical payoff to honest trade above which merchants will wish to play honestly. For $a < a_M^*$, being dishonest just once and enduring a lifetime of punishment yields a higher payoff of mutual and perpetual honesty.

Townspeople will prefer mutual honesty if the following inequality holds:

$$a + \lambda \frac{\phi}{1-\phi} \frac{N_H}{N_F} \sum_{t=1}^{\infty} \delta^t a \geq c \tag{10}$$

The term $\lambda \frac{\phi}{1-\phi} \frac{N_H}{N_F} \sum_{t=1}^{\infty} \delta^t a$ is the driving force our argument. If a townsperson decides to cheat, this is what is foregone. When λ is very high, interactions with country H occur frequently and foregoing interaction will be very costly. The critical value $a = a_T^*$ above which townspeople will play honest is expressed as

$$a_T^* = \frac{(1-\delta)\, c}{(1-\delta) + \lambda \frac{\phi}{1-\phi} \frac{N_H}{N_F} \delta} \tag{11}$$

Both the discount factor δ and the probability that a country F townsperson meets a country H merchant $\lambda \frac{\phi}{1-\phi} \frac{N_H}{N_F}$ cannot be larger than one. As such, the denominator in equation 11 is less than 1, implying that a_M^* is weakly smaller than a_T^*. The intuition here is straightforward. Country H merchants interact with townspeople every period and the punishment that dishonesty would bring is large.

Country F townspeople only interact with country H merchants intermittently and the relative punishment from dishonesty is less severe. Hence, honesty on behalf of merchants will necessarily be enforceable if honesty is enforceable on behalf of townspeople.

It is clear that for values of $a \geq a_T^*$, a community grim trigger strategy is a subgame perfect equilibrium for both merchants and townspeople. Suppose a particular trader is in the punishment stage of the strategy. The grim trigger dictates that this player should always be dishonest because it is being played on behalf of their opponent. If a single trader plays honest in any particular period when their opponents are being dishonest, they will receive $b < 0$ rather than 0. Similarly, for values of $a \geq a_T^*$, there is no profitable one shot deviation in the honesty phase of the strategy because playing dishonest once will result in punishment forever, and for $a \geq a_T^*$ this is not worth it.

By rearranging equation 11, we can identify the critical value of λ above which mutual honesty is sustainable and below which it is not.

$$\begin{aligned} \lambda^* &= \left(\frac{c-a}{a}\right)\Delta \qquad (12) \\ \text{where } \Delta &= \frac{N_F}{N_H}\left(\frac{1-\delta}{\delta}\right)\left(\frac{1-\phi}{\phi}\right) > 0 \end{aligned}$$

International trade between country H merchants and country F townspeople will be honest if and only if $\lambda \geq \lambda^*$. The logic of this is as follows: when very few H merchants are trading with F, the probability a country F townsperson encounters a country H merchant is very small. The cost of foregoing future honest interaction is low because future business opportunities will seldom be presented. λ^* is increasing in N_F, the size of country F. If country F is small, just a handful of country H merchants will represent a large share of country $F's$ future business opportunities and one period of dishonesty will entail a large future loss. λ^* is also decreasing in the patience level δ and increasing in the relative payoff from dishonesty $\frac{c-a}{a}$.

2.3.3. Complete Information Trading Game. Knowing the critical value of λ needed for trust to be established, merchants must simultaneously decide whether to operate in their own country, the opposite country, or both. Once again, we focus only on country H merchants as country F is isomorphic. The decision of whether or not to operate domestically will first be addressed. Let D be the payoff from each domestic interaction which will yield a lifetime payoff of $\frac{D}{1-\delta}$ to merchants. If this lifetime payoff is greater (less) than the fixed start-up cost f_D, all (no) merchants will operate in the domestic market. Note that if we did not assume that domestic interactions are always profitable, the decision to operate in the domestic market is identical to the decision of operating in the foreign market. As it is straightforward in our model given the assumptions, we will hereafter ignore the decision of whether or not to sell domestically.

A merchant from country H will only wish to operate in country F if honest trade is profitable. The payoff to country H merchants from engaging in international trade or not is expressed below. If $\lambda < \lambda^*$, honesty will not occur, and this is known. All merchants who engage in international trade will immediately respond with dishonesty as a means of self protection.

$$\begin{aligned} \pi\left(Trade\ with\ F\right) &= \begin{cases} \frac{a}{1-\delta} - f_X\ if\ \lambda \geq \lambda^* \\ -f_X\ otherwise \end{cases} \\ \pi\left(No\ Trade\ with\ F\right) &= 0 \end{aligned} \tag{13}$$

We will first consider the case in which merchants are perfectly informed about all parameter values before making their decisions. It is clear that for some parameter values, merchants will never wish to engage in international trade, not matter how many others do. If $\frac{a}{1-\delta} - f_X$ is negative, international trade is not profitable even if trust can be established. This can occur for a very high start-up cost, low levels of patience, a small payoff from honest international trade or any combination thereof. A dominant strategy of refraining from trade with F will also occur if trust cannot be established altogether, even if $\lambda = 1$. This situation can arise if the relative payoff to dishonesty is very high, if players are impatient, or if country F is much larger than country H. Define $\underline{a}$ as the critical value of honest trade below which all merchants have a dominant strategy not to engage in international trade. Note that a social planner would have all Home merchants involved in the foreign market for values of $a > \underline{a}$. $\underline{a}$ must be strictly positive and can be expressed as

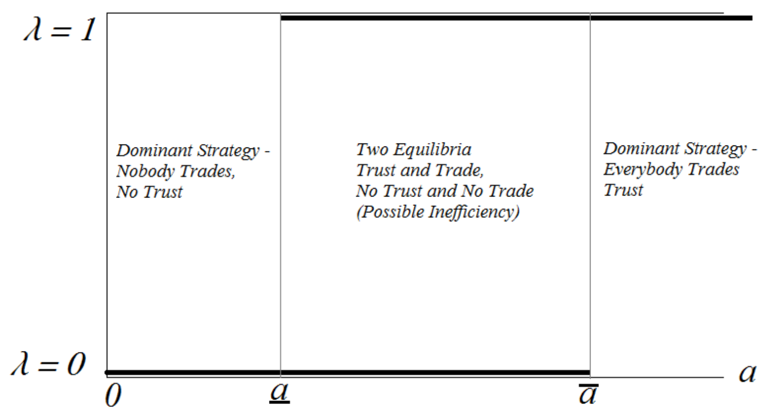
$$\underline{a} = \max\left\{ f_X \left(1 - \delta\right), \ \frac{\Delta c}{\Delta + 1} \right\} \tag{14}$$

Similarly, engaging in trade with F will be a dominant strategy for certain parameter values. This will occur if $\lambda^* \leq 0$, in which case a single merchant can enjoy honest international trade even if nobody from their country follows suit. Given that δ and ϕ are assumed to be strictly less than one, this can only occur if $a \geq c = \overline{a}$. In other words, trading with F will be a dominant strategy if the trading game is not a prisoner's dilemma. In the case where $\underline{a} \geq \overline{a}$, there is no coordination game. All merchants will have a dominant strategy of operating abroad or a dominant strategy of not operating abroad. We will not consider this case hereafter and will assume that $\overline{a} > \underline{a}$.

For values of $a \in (\underline{a}, \ \overline{a})$, honest international trade will only occur if a strictly positive mass of merchants choose to participate. There are two pure strategy Nash equilibrium in this parameter range.[7] There is an equilibrium in which no merchant trades with the other country. In this equilibrium, trust is not established. It is clear that there does not exist any profitable unilateral deviation because a single

[7] We do not consider mixed strategy Nash equilibrium. We deal with a continuum of agents. A mixed strategy will establish trust with probability 1 or 0 by the law of large numbers. Merchants will therefore only be indifferent and willing to randomise if $\frac{a}{1-\delta} - f_X$ is exactly 0.

Figure 2.2



merchant who engages in international trade given that nobody else does will receive $-f_X < 0$ rather than 0. There is also an equilibrium in which all merchants engage in international trade and trust is established. It is also clear that there does not exist any profitable unilateral deviation because the single merchant who does not participate in international trade given that everybody else does will receive 0 rather than $\frac{a}{1-\delta} - f_X > 0$. Hence, trust and trade are jointly determined and both are driven by whether or not merchants believe that others will trade abroad. This result suggests that low levels of trade (and low levels of trust) are the result of being stuck in the "bad" equilibrium Even if there are large gains from international trade to be had, complete home bias occurs because a single agent cannot establish trust unilaterally. If trade does not occur for values of $a \in (\underline{a}, \overline{a})$, the outcome is inefficient. The equilibrium values of λ for different values of a are presented in Figure 2.2.

2.3.4. Incomplete Information Trading Game. In this section, we will perturb the coordination game by introducing incomplete information. This is done for two reasons. First, the results of the previous section are driven entirely by beliefs. An individual H merchant will engage in trade with F if they believe that enough other H merchants believe that enough other H merchants (*ad infinitum*) will engage in trade with F. They will not engage in trade with F in the opposite case. Second, there are multiple equilibria for a range of parameter values. Comparative statics cannot be performed because behaviour is not directly pinned down. Eliminating complete information will yield a unique equilibrium correspondence for any set of parameter values and simple comparative statics cannot be analysed.

Thus far, merchants have been perfectly informed about the payoffs to honest trade with those in the opposite country. Geographical or linguistic differences between countries make it unrealistic to assume that the payoff to honest trade will be known until trade actually takes place. For example, an exporter *ex ante* will not know precisely how profitable it will be to sell in a particular country before trade actually commences. We consider the case in which there is uncertainty about a. The true value of a is not realised until after the coordination game takes place, all fixed costs are incurred, and trading relationships begin. Imperfect information does not extend to other parameter values. The qualitative implications do not depend on the exact nature of uncertainty, only that there is no longer common knowledge about the true state of the world.

Incomplete information was first introduced into coordination games by Carlsson and van Damme (1993). Analysis in this section draws upon the extensions of Heinemann (2002) and Morris and Shin (1999). These authors analyse the coordination game between a continuum of speculators who must simultaneously decide whether or not to attack a pegged currency of a country whose economic fundamentals are not perfectly known. This currency attack is only a success if enough speculators attack. While our analysis is similar, we are able to explicitly solve for the critical threshold needed for coordination to be successful due to its derivation in the section above. Our model is a specific case of the general global games framework outlined by Morris and Shin (2003). Morris and Shin (2003) identify 5 regularity conditions which ensure that there exists a unique equilibrium. Our model satisfies these conditions.[8]

Suppose that the true value of a is drawn uniformly from a commonly known interval $(0,\ \infty)$. That is, merchants hold a diffuse and improper prior over the true value of a before receiving any signal. All merchants receive a noisy signal $x_i = a + \varepsilon_i$ about the true payoff to trading with F, where a is the true value and ε_i is idiosyncratic to merchant i. ε_i is drawn uniformly and independently from the interval $[-\varphi,\ \varphi]$ where $\varphi \leq \underline{a}$.[9] The equilibrium concept employed is a monotone, or switching point, equilibrium in which a player takes a particular action if and only if that player receives a signal above some threshold. That is, a merchant from H will trade with F only if they receive a signal that is optimistic enough.

Define I_{x^*} as the strategy profile in which all merchants trade with F if and only if they receive a signal greater than some value x^*. If this strategy is adopted by all merchants, the fraction of merchants who engage in international trade for a particular value of a between $x^* - \varphi$ and $x^* + \varphi$ is described below. If $a < x^* - \varphi$, then all merchants will receive a signal less than x^* and $\lambda = 0$ and if $a > x^* + \varphi$, then all merchants will receive a signal greater than x^* and $\lambda = 1$. The fraction of H merchants who go ahead with trade in F is

$$\lambda = \int_{x^*}^{a+\varphi} \frac{1}{2\varphi} dx = \frac{a + \varphi - x^*}{2\varphi} \tag{15}$$

Trust will be established only if $\lambda \geq \lambda^*$ where λ^* is described in equation 12. When deciding whether or not to engage in trade with F, a particular merchant will

---

[8]The conditions are A1: Action Monotonicity, A2: State Monotonicity, A3: Strict Laplacian State Monotonicity, A4: Limit Dominance, and A5: Continuity. Note for A3, this requires that there is a unique a^* which solves $\int_{\lambda=0}^{1} p(\lambda, a^*)\, d\lambda = 0$ where $p(\lambda, a)$ is the payoff of engaging in international trade minus the payoff from not engaging in international trade. When evaluated, this integral becomes $\frac{a(1+\Delta)-c\Delta}{1-\delta} - f_X$. A3 is satisfied by noting this expression is negative (positive) for sufficiently small (large) values of a and it is strictly and continuously increasing in a.

[9]$\varphi \leq \underline{a}$ is assumed for simplicity such that the bounds in the following integrals do not have to be altered.

be concerned with the probability that at least a portion λ^* other merchants receive a signal greater than x^*. This will only occur if the true value is high enough such that the support of the distribution of signals guarantees that at least a fraction λ^* other merchants receive a signal $x \geq x^*$. Let a^* be the critical value of a above which enough merchants receive an optimistic signal to establish trust. a^* is defined as the positive value of a which solves the following expression:

$$\frac{a^* + \varphi - x^*}{2\varphi} = \lambda^* (a^*) \tag{16}$$

$$\Leftrightarrow$$

$$a^* - 2\varphi\lambda^* (a^*) = x^* - \varphi \tag{17}$$

where $\lambda^* (a^*)$ is described in equation 12 evaluated at a^*. Hence, a merchant is only concerned with the probability that $a \geq a^*$. Conditional on receiving a signal x_i, merchant i will construct a posterior distribution over the true value of a which will be uniform on the interval $[x_i - \varphi,\ x_i + \varphi]$. Because the payoff from not trading with F is 0, merchants will trade in F if the expected payoff from not doing so is not negative. Given that everybody else operates internationally with a signal above x^*, a merchant with a signal x_i will receive an expected payoff from trading with F equal to the following expression:

$$u (x_i, I_{x^*}) = \int_{a^*}^{x_i+\varphi} \frac{a}{1-\delta} \frac{1}{2\varphi} da - f_X \tag{18}$$

The task now is to find the unique equilibrium value x^* below which no merchant will engage in trade with F and above which they will. Consider the case of merchant i who receives a signal x_i. This merchant knows that everybody will engage in international trade only if they receive a signal greater than x^*. If $x_i < x^*$ and merchant i wishes to engage in trade with F or if $x_i > x^*$ and merchant i elects not to trade with F, this particular x^* cannot be the equilibrium switching point as profitable deviations will exist. As can be seen in equation 18, $u(x_i,\ I_{x^*})$ is strictly and continuously increasing in x_i. This is both because the expected payoff conditional on trust be establish and the posterior probability that trust is established in the first place is higher when merchant i receives a higher signal.

Now consider the marginal merchant who has a signal exactly equal to $\widehat{x}^*$, where $\widehat{x}^*$ is one candidate value of the equilibrium switching point. This merchant will receive an expected payoff of $u(\widehat{x}^*, I_{\widehat{x}^*})$. If $u(\widehat{x}^*, I_{\widehat{x}^*})$ is strictly positive, there will exist a signal $x' < \widehat{x}^*$ such that $u(x', I_{\widehat{x}^*})$ is also positive. This is because $u(x_i, I_{\widehat{x}^*})$ is continuously and strictly increasing in x_i. Therefore, switching actions around a signal $\widehat{x}^*$ such that $u(\widehat{x}^*, I_{\widehat{x}^*}) > 0$ cannot be an equilibrium because a merchant with a signal very slightly below $\widehat{x}^*$ will wish to trade with F (and our equilibrium concept dictates only those with $x_i > \widehat{x}^*$ would do so). Now consider a signal $\widetilde{x}^*$ such that $u(\widetilde{x}^*, I_{\widetilde{x}^*})$ is strictly negative. By the same logic, switching around a signal $\widetilde{x}^*$ cannot be an equilibrium. There will be a signal x'' such that a merchant with a signal equal to $x'' > \widetilde{x}^*$ will not want to trade with F. Therefore, the equilibrium switching strategy is the signal which solves the equation below.

$$u(x^*, I_{x^*}) = \int_{a^*}^{x^*+\varphi} \frac{a}{1-\delta}\frac{1}{2\varphi}da = f_X \tag{19}$$

That is, the unique x^* will exist where the marginal merchant is exactly indifferent between the two actions. No merchant will wish to deviate from the strategy which dictates trading with F for signals above x^* and refraining for signals below x^*. Any merchant with a signal $x < x^*$ will receive a negative expected payoff from trading with F and any merchant with a signal $x > x^*$ will receive a positive expected payoff from trading with F. Because there is a unique x^*, there will also be a unique a^* that generates honest and trust trade between the two countries.

In order to derive straightforward comparative statics implications, we will explore this equilibrium correspondence as the noise about the true value of a vanishes. The amount of noise is not what drives the uniqueness in global games, only that there does not exist common knowledge about the fundamentals. Even as φ tends to zero, common knowledge about the state of the world is never fully recovered. There will always be a "grain of doubt" in the words of Morris and Shin (1998) about what everybody knows.

By rearranging equation 16, we can see that $(1-\lambda^*(a^*)) = (x^*+\varphi-a^*)/2\varphi$. From the perspective of the marginal merchant with a signal equal to x^*, this is the probability that is assigned to trust being established. Using this, we can evaluate and make use of the following integrals:

$$\int_{a^*}^{x^*+\varphi} \frac{a^*}{1-\delta}\frac{1}{2\varphi}da = \frac{(x^*+\varphi-a^*)}{2\varphi}\frac{a^*}{1-\delta} = (1-\lambda^*(a^*))\frac{a^*}{1-\delta} \tag{20}$$

$$\int_{a^*}^{x^*+\varphi} \frac{(x^*+\varphi)}{1-\delta}\frac{1}{2\varphi}da = (1-\lambda^*(a^*))\frac{(x^*+\varphi)}{1-\delta} \tag{21}$$

$u(x^*,\ I_{x^*})$ is strictly increasing in a. Therefore, the following inequalities must hold:

(22)
$$\int_{a^*}^{x^*+\varphi} \frac{(x^*+\varphi)}{1-\delta}\frac{1}{2\varphi}da \geq \int_{a^*}^{x^*+\varphi} \frac{a}{1-\delta}\frac{1}{2\varphi}da \geq \int_{a^*}^{x^*+\varphi} \frac{a^*}{1-\delta}\frac{1}{2\varphi}da \ \forall\ a \in (a^*,\ x^*+\varphi)$$

From the evaluated integrals discussed in equations 21, 19 and 20, this can be re-expressed as

$$(1-\lambda^*(a^*))\frac{x^*+\varphi}{1-\delta} \geq f_X \geq (1-\lambda^*(a^*))\frac{a^*}{1-\delta} \tag{23}$$

In the limit as φ goes to zero, x^* will converge to a^* as can be seen in equation 17. An application of the squeeze theorem yields the equilibrium value of a^*, and by extension the equilibrium value of $x^*=a^*$, as $\varphi \to 0$. The equilibrium $a^*=x^*$

is given by the solution to the following equation:

$$(1-\lambda^{*}(a^{*}))\frac{a^{*}}{1-\delta}=f_{X} \tag{24}$$

Note that $(1-\lambda^{*}(a^{*}))\frac{a}{1-\delta}$ is the expected payoff from trading in F to the merchant who has a signal exactly equal to x^{*}. Recall that by definition of $\underline{a}$, either $\lambda^{*}(\underline{a})$ is greater than one or $\frac{a}{1-\delta}$ is less than f_X. Therefore, a^{*} must strictly be above $\underline{a}$ because any merchant with a signal $x\leq\underline{a}$ will expect the payoff of international trade to be less than f_X. Further, recall that by definition of $\overline{a}$, $\lambda(\overline{a})=0$. Because of the assumption that $\overline{a}>\underline{a}$, (that is, $\overline{a}>f_X(1-\delta)$), we know that any merchant with a signal $x\geq\overline{a}$ will expect that international trade yields a payoff higher than f_X. Therefore, a^{*} must be strictly below $\overline{a}$. Given the parameter assumptions, this implies that there will always be the possibility for inefficiently low values of international trade for certain values of a.

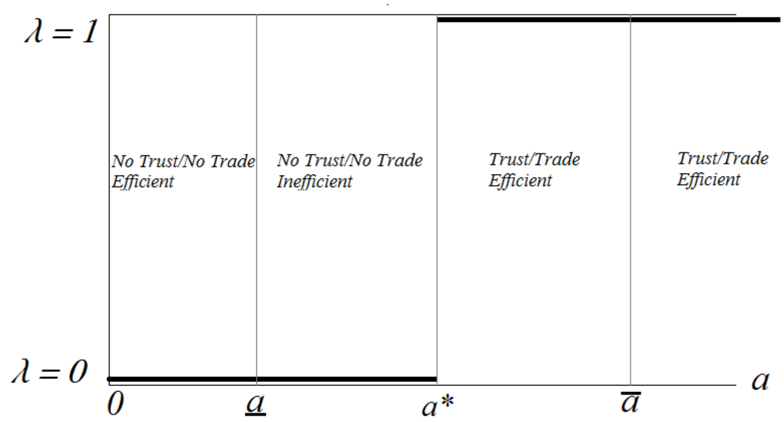
Given this straightforward correspondence, we can explicitly solve for the equilibrium value of $x^{*}=a^{*}$ by plugging equation 12 (evaluated at $a=a^{*}$) into equation 24.

$$x^{*}=a^{*}=\frac{(1-\delta)f_X+c\Delta}{1+\Delta} \tag{25}$$

All merchants $x_i>x^{*}$ will engage in international trade. Trust will be established for $a\geq a^{*}$. The fraction of H merchants who elect to go ahead and trade with F in the perturbed version of the game is illustrated in Figure 2.3. There is a range of parameter values for which inefficiency occurs. This happens for values of a between $\underline{a}$ and a^{*}. In this parameter range, international trade does not occur even though successfully coordinating on trade would make all parties better off.

We are now able to present the following comparative statics results. If the critical value a^{*} increases, the level of trade between H and F will weakly decrease.

Figure 2.3



This is because the realisation of a needed to induce merchants into engaging in international trade will be higher. This comparative statics exercise also yields welfare implications. Because the outcome is inefficient where $a \in [\underline{a},\ a^*]$, any factors which act to reduce a^* will also weakly improve welfare.[10]

$$\frac{\partial a^*}{\partial f_X} = \frac{1-\delta}{1+\Delta} > 0 \tag{26}$$

$$\frac{\partial a^*}{\partial \delta} = \frac{-\Delta}{(1+\Delta)^2}\frac{c - f_X(1-\delta)}{\delta(1-\delta)} - \frac{f_X}{1+\Delta} < 0 \tag{27}$$

$$\frac{\partial a^*}{\partial c} = \frac{\Delta}{1+\Delta} > 0 \tag{28}$$

$$\frac{\partial a^*}{\partial \frac{N_F}{N_H}} = \frac{\Delta}{(1+\Delta)^2}\frac{c - f_X(1-\delta)}{\frac{N_F}{N_H}} > 0 \tag{29}$$

[10] Furthermore, for $a \in [a^*,\ \infty)$, a decrease in f_X or an increase in δ will improve welfare because the payoff from engaging in international trade is higher. For $a \in [0,\ a^*)$, everybody deterministically receives a payoff of zero in the limit as $\varphi \to 0$ and parameters do not affect welfare other than by changing a^*.

The level of trade between two countries is weakly decreasing in the fixed start-up cost. The intuition here is straightforward. A higher fixed cost lowers the payoff from honest international trade conditional on trust being established. The change in the fixed cost does not affect the probability that honesty is established in the first place. The value of a needed to induce H merchants to trade with F, therefore, is weakly increasing in the fixed start-up cost.

An increase in δ will decrease the value of a needed to induce international trade. As can be seen in equation 27, the above derivative will be negative if $\frac{c}{1-\delta} > f_X$ because Δ, c, f_X, δ and $(1-\delta)$ are all positive. Given our assumption that $\overline{a} > \underline{a}$, this will be the case because $\overline{a} = c$ and $\underline{a} \geq f_X (1-\delta)$. An increase in patience will have two effects which work in the same direction. A higher δ implies that townspeople are more inclined to behave honestly, and hence the probability that enough agents will engage in trade with F for trust to be established is higher. A higher δ also implies that the lifetime payoff honest international trade conditional on trust being established, will be also be higher.

An increase in the payoff from cheating an honest opponent, c, increases the value of a needed for international trade to occur. This is the case because Δ is strictly positive. The payoff of dishonesty does not affect the payoff of honest trade, but it does increase the number of merchants required for honest trade to be established in the first place.

By the same logic which tells us that $\frac{\partial a^*}{\partial \delta} < 0$, we can see that an increase in the relative population $\frac{N_F}{N_H}$ will increase the value of a needed for international trade to occur. The intuition is straightforward. The cost of losing one's reputation with a particular country is not very deterring if that particular country is very small. Small countries are an unimportant share of future business. An individual with a short-term incentive to cheat is much more likely to do so when facing somebody from a small country. This yields the prediction that individuals from small countries are more inclined to behave in an honest manner (because other countries are important to them), but they are also more likely to be the victims of dishonesty (because they are not important to large countries).

Indeed, there is some evidence which supports this. We explore this by looking at trust between countries in the European Union. Trust data is taken from Table 1 in the appendix of Guiso, Sapienza, and Zingales (2009). This data is based on the Eurobarometer survey. The survey question asks "I would like to ask you a question about how much trust you have in people from various countries. For each, please tell me whether you have a lot of trust, some trust, not very much trust or no trust at all." The possible answers are 1 - "no trust at all," 2 - "not very much trust," 3 - "some trust," and 4 - "a lot of trust." The trust from country i to j is calculated as the average response of individuals in country i. Of course this survey deals with all individuals rather than only those engaged in international trade. But, one can presume that business dealings are one of the main mechanisms through which people of different countries interact (that is, behaviour in international trade is one driver of these bilateral opinions).

Because the units of this measure of trust do not mean much in themselves, and because different cultures may have different ideas about the definition of trust, the trust variable is standardised for each i. The standardised trust variable is hence a measure of relative trust exhibit by i. After standardisation, $Trust_{ii}$ is deleted and the following is estimated using OLS: $Trust_{ij} = \alpha_0 + \alpha_i \ln d_{ij} + \alpha_2 PartnerLarger_{ij} + \nu_{ij}$. The results are presented in Table 2.1. $PartnerLarger_{ij}$ is a dummy variable which takes a value of 1 if j is more populous than i (we would expect less trust) and it takes a value of 0 if i is more populous than j, and d_{ij} is physical distance between i and j.[11]

[11]Data on distance and population is taken from CEPII gravity model dataset.

Table 2.1

Dependent Variable: $Trust_{ij}$ (Standardised by i)	
Constant	*4.091****
	(0.690)
$ln(d_{ij})$	*-0.572****
	(0.094)
$PartnerLarger_{ij}$	*-0.289****
	(0.103)
Method	*OLS*
N	*207*
R^2	*.173*
RMSE	*.769*

****-significant at 1% level. Standard errors clustered by dyad. The countries included are Austria, Belgium, United Kingdom, Denmark, Netherlands, Finland, France, Germany Greece, Ireland, Italy, Norway, Portugal, Spain and Sweden. Three data points are missing. Country fixed effects are not included.*

As can be seen, smaller countries trust larger countries significantly less (at the 1% confidence level). This result is suggestive, and it is what is expected given the model presented. That is, this result could in part be driven by the notion that larger countries are less inclined to behave in an honest manner in a business setting with those from smaller countries. This result is, of course, with its issues and should not be taken as indicative.[12]

2.4. Conclusion

In this paper, we have presented a game-theoretic model of international trade which focuses on the formation and role of trust. Our results imply that trust is

[12]The result is only significant when trust is standardised. While standardisation is arguably the most reasonable way to treat the data, this puts the robustness into question. Furthermore, as indicated by the rather low R-squared, a huge number of factors are at play in determining trust between countries. Issues such as common language, religion, history of war, and so on are not accounted for. See Guiso, Sapienza, and Zingales (2009) for more detail on the determinants of trust.

a necessary condition for trade and that trade is a necessary condition for trust. International trade will be honest and profitable in the absence of effective legal institutions so long as traders can successfully coordinate their actions.

Foremost, this model highlights the importance of trade missions for solving suboptimal levels of trade between countries. A government sponsored trade mission would serve as a coordination device that gives the "initial push" necessary for a norm of cooperation to be established. Guiso, Sapienza, and Zingales (2009) show that trust is more important for highly differentiated goods. In other words, it is easier for the buyer of a car to be "ripped off" than would be the buyer of wheat. Trade missions should be most effective in these sort of industries. Trade missions between countries with very different or inadequate legal institutions, in which trust is perhaps more important for trade, would also be beneficial.

Furthermore, this model illustrates the importance of export insurance schemes. The UK's Export Insurance Policy is one example of this. This policy "...insures an exporter against the risk of not being paid under an export contract or of not being able to recover the costs of performing that contract..."[13] In the context of our model, this would be akin to lowering f_X conditional on honesty not being established. This would lower $\underline{a}$, the value of a below which no traders trade abroad, in the context of the complete information coordination game. This would lower a^*, the value of a needed for trust and honesty to be established in the game without complete information. Finally, while all actions are globally observable in our model, this is not the case in reality. With imperfect observability, higher levels of informedness would ease the development of trust because those that cheat could not easily hide their actions. Institutions which facilitate gossip, such as trade associations or public repositories of performance reviews, would help establish trust between individuals of different countries.

[13]Quoted from www.gov.uk/export-insurance-policy

The simple framework we have presented may be valuable to future research on endogenous trade costs. For example, rather than the seeking to determine when trust is established, one could focus on the political economy of whether to remove tariff barriers. As more importers in a particular industry purchase from those in other countries, the incentive for removing trade barriers would increase. Using the global games perturbation, comparative statics could be performed on a number of interesting parameters in the framework presented.

CHAPTER 3

The Costs of Independence: An Application to The Basque Country

Abstract

Several sub-national units around Europe are vying for political independence. The demand for independence is particularly strong in the Basque Country. In this chapter, we seek to quantify one potential welfare cost to the Basque Country of politically separating from the rest of Spain. The current trade relationship between the Basque Country and the rest of Spain is very strong. However, national borders have been found to greatly reduce economic interaction. By imposing a border effect where one did not previously exist may imply serious welfare consequences for an independent Basque state. We calibrate a three-region model featuring firm heterogeneity in order to assess this. If the cost of interacting between the Basque Country and the rest of Spain were equal to the cost of interacting between our benchmark comparison of Portugal and Spain, the Basque Country would experience a decline in their real income of more than 12%. This is accounting for the fact, in the time period we consider, that the wealthier Basque Country will no longer have to subsidise the rest of Spain.

N.B. This chapter is based on a joint work with David Comerford and Sevi Mora Rodríguez. The unique contribution of this chapter beyond the joint paper is the application to the Basque Country.

3.1. Introduction

A strong pressure exists for full political independence of the Basque Country, an autonomous community in the northeast of Spain of more than 2 million people. Despite already enjoying a degree of autonomy under the current Spanish constitution, the demand for complete political separation from the rest of Spain is apparent. In the 2012 Basque parliamentary elections, the separatist coalition Euskal Herria Bildu took control of 21 of the 75 parliamentary seats. This is in addition to the 27 seats held by the pro-independence, albeit less ardent, Basque National Party. The 2013 Euskobarómetro survey, a poll implemented by sociologists at the University of the Basque Country, indicates that if a referendum on independence were to be held, 39% would vote in favour of political separation and 34% would not. Furthermore, 54% of the respondents in this survey favour holding such a referendum in the first place, as opposed to 27% against. *It is a real possibility*, that the Basque Country will one day be an independent state, particularly given the growing pressure for independence referenda elsewhere in Spain and around Europe.

The relative costs and benefits of separation are heavily debated. It is possible that those in an independent Basque state would benefit from having a government which is "closer to the people." It is also possible, however, that Basque separation would lead to many forgone benefits that political unification brings. Larger countries can take advantage of economies of scale in fixed-cost public good provision, fiscal transfers in a unified country can smooth idiosyncratic production shocks, and political unification prevents inefficient tax competition over mobile factors of production. Unfortunately, it is very difficult to predict what would happen if the Basque Country does indeed become a separate state. This is partly due to the fact that there are no historical instances of political disintegration which one can reasonably compare. Changes in political borders throughout history have been associated with war, colonisation and decolonisation, and massive institutional and economic transformation. That is, the set of confounding factors present in any one particular occurrence of political separation would not be the same for the political separation of the Basque Country.

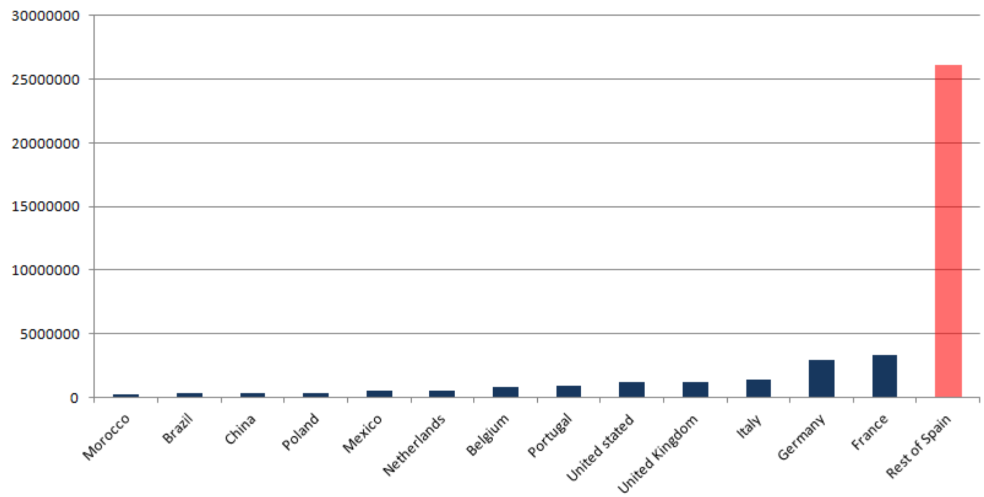
Political separation might lead to any number of economic costs or benefits.[1] The purpose of this paper, however, is not to comprehensively weigh all of the possible costs and benefits of independence of the Basque Country. In this paper, we identify and quantify a potential cost of separation that the Basque Country could quite reasonably experience. The logic of our argument is based on the following two points:

1. The Basque Country currently trades a lot with the rest of Spain.

The Basque Country's economy is arguably built around the ease with which it can buy and sell with those from the rest of Spain. According to the Basque Country's regional accounts, exports of goods and services to the rest of Spain accounted for 37% of its GDP in 2005 . Imports from the rest of Spain as a fraction of GDP was equal to 45%. When considering just exports in goods (due to data availability), the Basque Country exported close to 9 times more to the rest of Spain than it did to France, its next closest trading partner. This is quite surprising given that the Basque Country also borders France, where there too is a large community of those who identify themselves as being of Basque heritage. Gil-Pareja, Llorca-Vivero, and Martínez-Serrano (2006), using the traditional specification of the gravity model, show that after controlling for distance and economic size, the Basque Country trades 12-16 times more with the rest of Spain than it does with other OECD countries. The Basque Country's exports to their top 15 partners (including the rest of Spain) is depicted in Figure 3.1 below.

[1]Political separation can even affect the spatial distribution of economic activity. Redding and Sturm (2008), for example, show that following the division of Germany, the population distribution in West Germany shifted away from the East/West German border. This was due to a sharp decline in relative market access.

Figure 3.1



The vertical axis is exports in thousands of Euro. Trade with the rest of Spain is taken taken from c-intereg. Trade with other countries is taken from EUSTAT, the Basque statistical office. Data is for 2007.

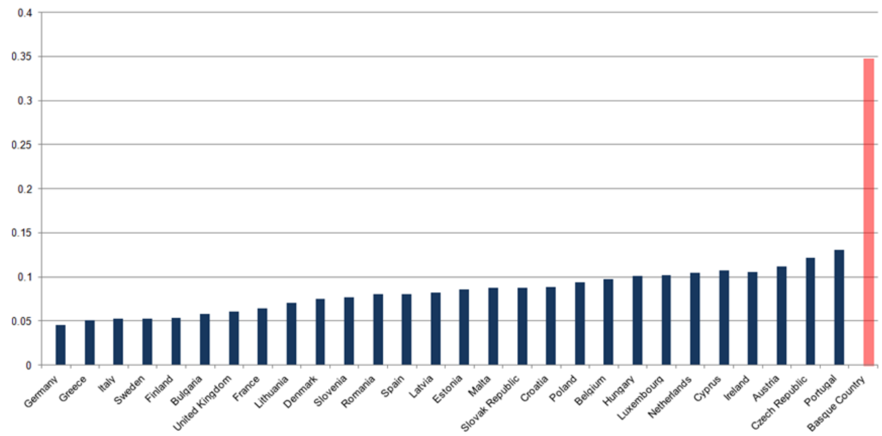
2. National borders reduce trade.

The large magnitude with which borders reduce trade has been heavily studied.[2] To reiterate from chapter one, Anderson and van Wincoop (2003) and Feenstra (2002) show that the border between the United States and Canada reduces trade on average by a factor of about 5. When based on observable factors, the political boundary between these two countries is very innocuous.

Is it possible that the Basque Country's trade relationship with the rest of Spain is driven by factors which are orthogonal to political unification? That is, could an independent Basque state plausibly enjoy the same trade relationship with the rest of Spain that it does today? When one compares the concentration of trade around the European Union (as seen in Figure 3.2), an independent Basque Country with an unchanged trade relationship with the rest of Spain would be a huge anomaly. The very high level of trade concentration seen in the Basque Country can only be

[2] See McCallum (1995) and Anderson van Wincoop (2003) for North America, Gil-Pareja, Llorca-Vivero, Martínez-Serrano, and Oliver-Alonso (2005) and Requena and Llano (2010) for Spain, Nitsch (2000) and Chen (2004) for Europe, and scores of others.

Figure 3.2

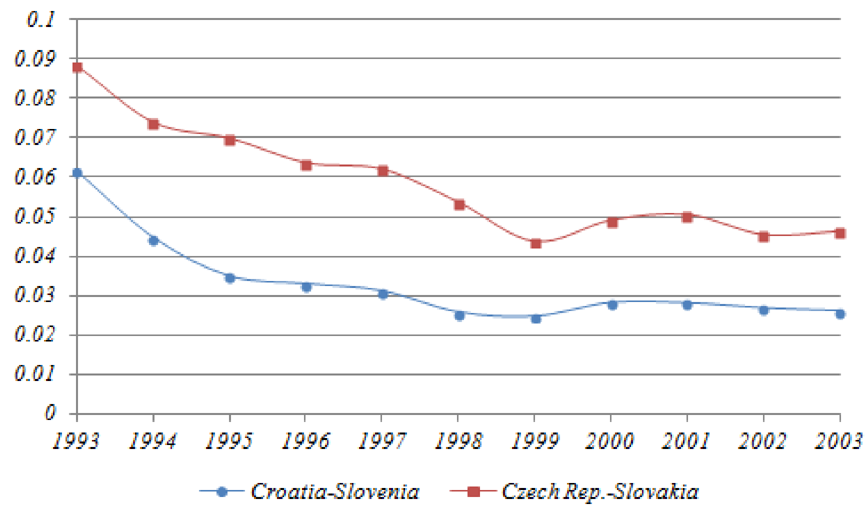


The index is calculated as $\sum_{j=1}^{N}\left(x_j^h\right)^2$. *International trade data is from the IMF direction of trade statistics. The Basque Country's trade is taken from EUSTAT, the Basque statistical office, for Basque trade with other countries. Basque trade with Spain is taken from c-intereg.*

reconciled in one of two ways. First, perhaps the Basque Country concentrates its trade so much with the rest of Spain because there is something intrinsically *very* different about the relationship between these two regions which naturally leads to a huge concentration of interaction. It would be hard to argue this. The degree cultural and linguistic similarity between an independent Basque state and the rest of Spain would not be all that different than it is between other country pairs around Europe. For example, Austria has Germany, Belgium has France, Ireland has the UK, and so forth. This leaves us with the second option; that the Basque Country trades so much with the rest of Spain because they are politically unified.

When examining other instances of political separation in Europe, there is suggestive evidence that economic disintegration will occur. The evolution of the trade relationship between the Czech Republic and Slovakia and between Croatia and Slovenia, once political unified countries whose transitions were *relatively* smooth, from shortly after separation to 10 years later is illustrated in Figure 3.3.

Figure 3.3



Vertical axis is $(exports_{hj} + exports_{jh}) \ / \ (GDP_h + GDP_j)$. *Exports are taken from the IMF DOTS and GDPs are taken from the World Bank WDI*

If political independence makes trade more difficult between the Basque Country and the rest of Spain, the welfare loss of creating a national border where there once was not may be very large. It is this cost of independence which we seek to quantify in this paper. We find that under reasonable assumptions, real income in the Basque country could fall by more than 12% as result of creating border effect where one did not exist before.

How exactly might political separation inhibit trade between the Basque Country and the rest of Spain? It is important to note that the motivation behind political separation is not to maintain the *status quo*. The very point of becoming independent is to impose a set of policies which are different. If Basque independence leads to a divergence in commercial or legal regulation, the cost of interacting across the Basque-Spanish border will increase. Turrini and Ypersele (2010) discuss that differences in judicial systems is a key reason why national borders decrease interaction as much as they do. Chen (2004) further shows that technical barriers to trade (country specific standards and regulations) are a key reason why borders in the EU decrease trade so much. While political power in Spain is not centralised, political unification does, to some extent, provide regulatory and legal homogeneity that could well be lost.

Secondly, it is possible that creating a national boundary between the Basque Country and the rest of Spain would inhibit the flow of people. As discussed in chapter 1, mobility is important for trade in that it facilitates the formation of social connections between regions. While a principal goal of the European Union has been to increase mobility across national borders, barriers to migration still exist. Belot and Ederveen (2012) discuss how these barriers still exist in the EU. They argue that individuals are less likely to migrate across national barriers due to a "...lack of recognition of foreign qualifications, the lack of transferability of pension rights, etc." In 2011, about 20% of the population in the Basque Country was comprised of those born elsewhere in Spain. However, only 5% of the total Spanish population is comprised of those born in the *entire* rest of the European Union.[3] Furthermore, it is conceivable that an independent Basque State would more adamantly pursue policies which seek to further grow the distinct Basque culture. For example, it is more costly to migrate to a country where a different language is spoken.

Next, and more subtle, externalities are internalised within a political union. Suppose, for example, a proposal to build a high speed rail connection between Bilbao and Madrid. This would promote trade between the Basque Country and the rest of Spain and would yield mutual benefits to both. Without unification, political coordination would be more difficult and a tragedy of the commons may result. That is, Basque welfare would no longer be in the objective function of those who make political decisions in the rest of Spain and *vice versa*. This explanation as to why borders decrease trade has not to our knowledge been formally explored, but may be an interesting topic of future research.

[3] The Basque figure comes from Eustat, the Spanish figure comes from Eurostat.

Finally, it is true that Castilian Spanish is the most common language spoken in the Basque Country. However, will this be true in the future if the Basque Country becomes independent? In part due to policies implemented by the autonomous government, the use of Basque is unambiguously on the rise. In 1991, only 12.1% of those aged between 16 and 24 spoke Basque as much as or more than Castilian. In 2001, this figure rose to 18.7% and by 2011 it was 26.7%.[4] It is conceivable that an independent Basque State would try to grow the use of Basque even more than it does today. Indeed, these factors which may increase transaction costs would feed back into each other. That is, less interaction between an independent Basque Country and the rest of Spain will decrease the incentives for policy homogeneity, social connectivity, the use of Castilian, and so forth. This will, in turn, lead to less interaction once again, *ad infinitum*. This is the topic of the second chapter of this thesis.

These new potential barriers to trade would develop over different time horizons. Regulatory and legal divergence may well happen immediately. Linguistic divergence and lower social connectivity may take a generation or two. Reasonably specifying the dynamics of trade costs over time, however, is not possible. As such, we restrict our attention to quantifying the effects of the border in the long run after the full effect of political separation on trade barriers has occurred. How long can we expect the new steady state to be reached? While only suggestive, some insight can be gathered from the study by Head, Mayer, and Ries (2010) who look at bilateral trade in the aftermath of decolonialisation. They document a steady decline and then a levelling off in bilateral trade over the course of four decades between former colony and coloniser.

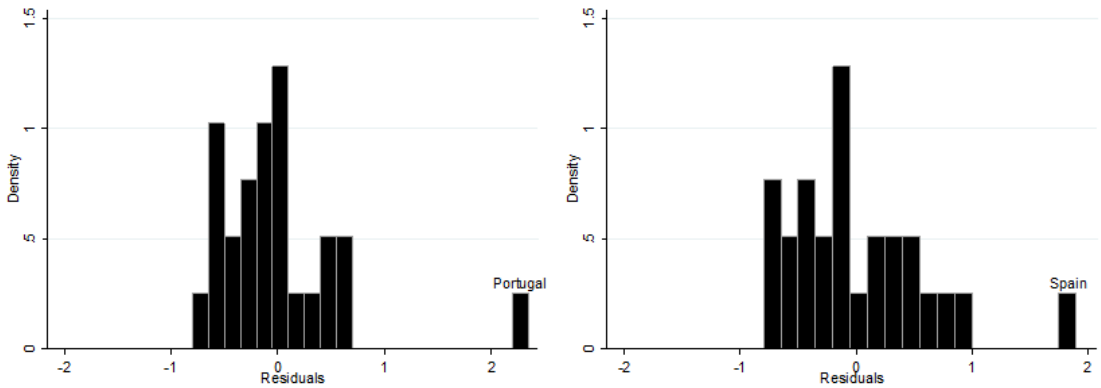
In this paper, the all-inclusive cost of interacting between those of different regions will be referred to as the effective "distance." Of course, it is impossible to say exactly

[4]Source: Department of Culture, Sociolinguistic Survey 2011.

what the effective distance will be between an independent Basque Country and the rest of Spain. However, we can use the effective distance between Spain and a different country as a benchmark for which we can compare.

We argue that effective distance between Spain and Portugal provides the most reasonable comparison for which our welfare statements can be benchmarked. That is, we assess the welfare implications of increasing the distance between the Basque Country and the rest of Spain to what it is between Spain and Portugal. But why Portugal? First, and most obviously, Portugal and Spain are geographically very close. Continental Portugal shares a larger border with Spain, the only land border it has, than it does with the sea. Second, relative to many other country pairs in the EU, Spain and Portugal are culturally similar. Both countries are overwhelmingly Roman Catholic, there is a degree of mutual intelligibility between Portuguese and Spanish, there were long spells of political unification between these countries over the past two millennia, and so forth. Moreover, the Spanish region of Galicia is arguably more culturally similar to Portugal than it is to the rest of Spain. To further illustrate the degree of similarity between these countries, according to the 2011 Barómetro de Opinión Hispano-Luso a poll undertaken by the University of Salamanca, 46% of Portuguese and 40% of Spanish claim to support a hypothetical federal union between Spain and Portugal. Finally, both countries are subject to the rules and regulations set forth by the European Union and are members of the Schengen agreement, as would presumably would also be true for the Basque country. In other words, the institutions which facilitate trade between Spain and Portugal would be the same institutions which would facilitate trade between an independent Basque Country and the rest of Spain. Indeed, as one would presume, Spain is by far Portugal's closest trading partner and Portugal is by far Spain's closest trading partner. This can be seen in Figure 3.4. The only other plausible comparison is the effective distance between France and Spain. Our calibrations indicate, however,

Figure 3.4



Trade flows are taken from the IMF DOTS. GDPs are taken from the World Bank WDI. This illustrates the residual distribution from a regression $\ln(Exports_{hj}) = b_0 + b_1 GDP_j$. *In the left panel, we consider Spain's exports to each country in the EU27. In the right panel, we consider Portugal's exports to each country of the EU27*

that France and Spain share a larger distance than do Spain and Portugal. Using the distance between Spain and France as a counterfactual would imply even starker welfare implications for an independent Basque Country.[5]

Of course, we cannot say that this is a perfect comparison nor should we claim to know what will happen in the future. Perhaps the distance between the Basque Country and rest of Spain will never be as high as it is between Spain and Portugal. But, is it also not possible that the Basque Country and the rest of Spain end up being even farther apart? Perhaps an independent Basque country would try to seek policies which further sets itself apart from the rest of Spain. What is important is that we have established a benchmark. In the framework provided, one could easily make their own conclusions regarding the welfare effects of Basque separation. The welfare implications of Basque separation is shown for any number of possible distances with the rest of Spain. One who argues that the Basque Country's distance

[5]As will be seen subsequently, the calibrated distance between Spain and Portugal is 2.3. Using the same parameterisation, the calibrated distance between Spain and France is about 2.5. This is using data from the OECD STAN and EBOPS2002 database for trade in goods and services respectively.

will increase only 1/10th of the way to Portugal's distance can point to the results of this paper.

The rest of this paper is organised as follows. In section 3.2 we present a standard model of international trade which is stylised to the question we seek to answer. In section 3.3, the data and methodology is presented and we calibrate the distance between Portugal and Spain and the distance between the Basque Country and the rest of Spain. We then assess the welfare implications of increasing the distance between the Basque Country and the rest of Spain to what it is between Spain and Portugal. Section 4 concludes.

3.2. Model

3.2.1. Setup. To model this issue, we use the framework developed by Melitz (2003). This framework, which extends the more traditional trade models by including firm heterogeneity, is the arguable workhouse model of international trade. The particular choice of which modelling framework to use is fairly inconsequential. Arkolakis, Costinot, and Rodríguez-Clare (2012) show that for a wide class of trade models, the underlying welfare gains from trade are driven only by the share of total expenditure on domestic production and the elasticity of trade with respect to trade costs. Appropriate parameterisation, therefore, is arguably much more important than the particular modelling framework implemented.

We consider a world of three regions. These regions are indexed by j, h, and R. j and h respectively represent the Basque country and the rest of Spain in one calibration, and Portugal and Spain in the other. R represents the rest of the world, which we take to be exogenous. Each region is populated by a continuum of workers of mass N_j, N_h and N_R in j, h, and R respectively. Labour is supplied inelastically. As is of course realistic, labour productivity will not necessarily be the same everywhere and we allow for the possibility of income redistribution to account for Basque transfers to the rest of Spain. Firms produce in an environment of monopolistic competition using labour as the only input. Firms are heterogenous with respect to their productivity. Exporting firms must bear a higher cost for selling outside of their own region. In line with empirical evidence, only the most productive will be able to sell across the borders of the region in which they are based.

3.2.2. Demand and Production. All individuals have the following utility function:

$$U = \left[\int_{i \in \Omega} (q_i)^{\frac{\theta-1}{\theta}} \, di \right]^{\frac{\theta}{\theta-1}} \tag{30}$$

Ω denotes the full set of varieties available to a consumer, which are produced either in one's own region or abroad. $\theta > 1$ is the elasticity of substitution between varieties. Utility maximisation with respect to income leads to the following total demand function for variety i in country j :

$$q_i = \left(\frac{p_i}{P_j} \right)^{-\theta} \left(\frac{Y_j}{P_j} \right) \tag{31}$$

p_i is the nominal price of variety i, Y_j is after transfer income in region j and P_j is the price index in region j, which measures the weighted price level in j of all available varieties. (Y_j/P_j) is the real wage in country j, which is the welfare level in region j. In general, we will focus on an h firm selling in j for exposition. All other expressions are isomorphic.

Every firm is characterised by an idiosyncratic productivity parameter ϕ. When a firm starts up, it draws ϕ from a distribution which is common to all regions. A firm will only produce if ϕ is large enough such that it will be productive enough to profitably produce in at least one market. In order to provide tractability, we assume that ϕ is drawn from a Pareto distribution $F(\phi) = 1 - \left(\frac{\phi}{b}\right)^{-k}$ where $k > \theta - 1$.

Empirical evidence by Axtell (2001) and others suggests that the distribution of firm sizes can reasonably be approximated by such a specification. Because firms in different regions face different conditions, the *ex post* distribution of firms who are active will be different across markets.

For the purposes of selling in region j, a firm from region h must bear a variable cost and a fixed cost each period. This firm's variable cost is expressed as $q_j^h W_h \frac{\delta_{hj}}{\phi}$. q_j^h is the amount an h firm sells in j, $\frac{1}{\phi}$ is the unit labour requirement, and W_h is the nominal wage in market h. δ_{hj} represents the distance between h and j. As is standard, we assume that $\delta_{hh} = 1 \ \forall \ h \neq j$ and that distances are symmetric, $\delta_{hj} = \delta_{jh}$. Papers which use Melitz-type type models typically assume that the fixed cost of exporting is independent of market size and distance. This assumption, however, yields a peculiar property. As would be clear below, assuming that the fixed cost of production is independent of market size will imply that only the most productive firms are able to export to *small* countries. In the data, however, small countries are unambiguously the ones that tend to import the most as a percentage of their GDP. We also specify fixed costs such that they are a function of distance. Many of the potential reasons as to why an independent Basque Country would trade less with the rest of Spain are presumably because of higher fixed costs. That is, it would likely be more complicated for a Spanish firm to maintain a presence in an independent Basque Country where regulations and the legal environment would be different. To operate in region j, an h firm must hire a fixed number of $c\delta_{hj}\frac{Y_j}{P_j}$ workers. This specification greatly simplifies analysis. The per-period profit function of a firm from h selling in j can be expressed as follows.

$$\pi_j^h = p_i q_j^h - \left[q_j^h W_h \frac{\delta_{hj}}{\phi} + c\delta_{hj} \frac{Y_j}{P_j} W_h \right] \tag{32}$$

After inserting equation 31 into the profit function and taking the first order condition, the profit maximising price and quantity for the purposes of market j can be expressed as

$$p_i = \left(\frac{\theta}{\theta-1}\right) W_h \frac{\delta_{hj}}{\phi} \tag{33}$$

$$q_i = \left(\frac{\theta}{\theta-1}\right)^{\theta} \left(\frac{\phi}{\delta_{hj}}\right)^{\theta} \left(\frac{W_h}{P_j}\right)^{-\theta} \frac{Y_j}{P_j} \tag{34}$$

The per-period profit and per-period revenue, respectively, from selling in market j are as follows:

$$\pi_j^h(\phi) = \left[\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-\theta} - c\delta_{hj}\right] W_h \frac{Y_j}{P_j} \tag{35}$$

$$r_j^h(\phi) = \theta\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{1-\theta} Y_j$$

where $\Theta = \frac{(\theta-1)^{\theta-1}}{\theta^{\theta}}$. Profits are increasing in how productive the firm is. It is clear that if ϕ is low enough, it will not be profitable to export to market j. The productivity threshold above which it is profitable for the firm to sell in j and below which it is not is then

$$\Phi_j^h = \left(\frac{c}{\Theta}\right)^{\frac{1}{\theta-1}} \left(\delta_{hj} \frac{P_h}{P_j} \frac{W_h}{P_h}\right)^{\frac{\theta}{\theta-1}} \tag{36}$$

This productivity threshold is higher the greater is the distance and the more expensive inputs are and it is decreasing in the price index in region j. Any change in δ_{hj} will therefore change the distribution of firms that are active in a particular region. That is, as the distance between h and j grows, only the most productive h firms will still be able to sell in market j. As we discussed, due to our specification of fixed costs, the size of a particular market does not explicitly affect the the productivity threshold insofar as it does not affect other variables. We suppose that $\Phi_h^h < \Phi_j^h <$

Φ_R^h. That is, it is easiest to sell in one's own region and it is easier for h to sell in j than it is in the rest of the world. This assumption is checked in the calibration.

The total value of exports from region h to j can be expressed as

$$X_j^h = M_h \frac{1-F(\Phi_j^h)}{1-F(\Phi_h^h)} \int_{\Phi_j^h}^{\infty} r_j^h(\phi) \frac{dF(\phi)}{1-F(\Phi_j^h)} \tag{37}$$
$$= cM_h \frac{W_h}{P_h} \left(\frac{P_h}{P_j} \delta_{hj} \right)^{1-\mu} Y_j \left(\frac{1}{\theta} - \frac{1}{\mu} \right)^{-1}$$

where $\mu = \frac{k\theta}{\theta-1}$. M_h is the mass of firms who are active in region h and $\frac{1-F(\Phi_j^h)}{1-F(\Phi_h^h)}$ is the fraction of active h firms who are productive enough to operate in region j. The elasticity of trade with respect to trade costs, which is the most important parameter governing the gains/losses from changes in distance, is $1-\mu$.

3.2.3. Entry and Exit. Once a firm is active, it will survive to the next period with an exogenous probability β. Before starting a firm, however, a sunk amount of labour $\widetilde{c}$ must be hired at a total cost $\widetilde{c}W_h$. Once this sunk cost has been paid, a potential firm will receive its productivity draw from the known distribution $f(\phi)$. If M^e is the mass of entrants in each period, a mass $\left(1 - F\left(\Phi_h^h\right)\right) M^e$ will receive a productivity draw favourable enough to proceed with production. Firms will be created up to the point in which the expected value of a firm is equal to the sunk entry cost. That is,

$$\sum_{t=0}^{\infty} \beta^t \,[\text{Expected Profit}] = W_h \tilde{c} \tag{38}$$

$$\sum_{t=0}^{\infty} \beta^t \begin{bmatrix} \int_{\Phi_h^h}^{\infty} \pi_h^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} + \int_{\Phi_j^h}^{\infty} \pi_j^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} \\ + \int_{\Phi_R^h}^{\infty} \pi_R^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} \end{bmatrix} = W_h \tilde{c} \tag{39}$$

Expected profit can be expressed as follows:

$$\int_{\Phi_h^h}^{\infty} \pi_h^h(\phi) \frac{f(\phi)}{1 - F\left(\Phi_h^h\right)} + \int_{\Phi_j^h}^{\infty} \pi_j^h(\phi) \frac{f(\phi)}{1 - F\left(\Phi_h^h\right)} + \int_{\Phi_R^h}^{\infty} \pi_R^h(\phi) \frac{f(\phi)}{1 - F\left(\Phi_h^h\right)} \tag{40}$$

$$= \quad cW_h \left[\frac{1}{\theta} - \frac{1}{\mu} \right]^{-1} \frac{1}{\mu} \frac{D_h}{P_h}$$

D_h is the effective demand facing a firm in h which can be expressed as

$$D_h = P_h \left\{ \frac{Y_h}{P_h} + \left(\frac{P_j}{P_h} \right)^{\mu} (\delta_{hj})^{1-\mu} \frac{Y_j}{P_j} + \left(\frac{P_R}{P_h} \right)^{\mu} (\delta_{hR})^{1-\mu} \frac{Y_R}{P_R} \right\} \tag{41}$$

In the steady state, the number of firms that successfully enter the market must be equal to the number of firms that exogenously exit the market. That is, the number of firms that enter each period will be equal to

$$M^e = \frac{(1 - \beta)}{1 - F\left(\Phi_h^h\right)} M_h \tag{42}$$

3.2.4. Labour Market. The number of effective workers in region h is equal to $S_h = N_h A_h$ where N_h is the population of h (from the data) and A_h is the productivity of labour. Labour is utilised both in production and for creating firms. The labour that is demanded by an individual firm with a productivity ϕ for the purposes of production is

$$\widetilde{L}_j^h = q_i \frac{\delta_{hR}}{\phi} + c\delta_{hj} \frac{Y_j}{P_j} = (\theta - 1)\, \Theta \left(\frac{\phi}{\delta_{hj}} \right)^{\theta - 1} \left(\frac{W_h}{P_j} \right)^{-\theta} \frac{Y_j}{P_j} + c\delta_{hj} \frac{Y_j}{P_j} \tag{43}$$

The total labour demanded in region h for the purposes of production is then

$$\widetilde{L}^h = M_h \left(\begin{array}{c} \int_{\Phi_h^h}^{\infty} L_h^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} + \int_{\Phi_j^h}^{\infty} L_j^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} \\ + \int_{\Phi_R^h}^{\infty} L_R^h(\phi) \frac{f(\phi)}{1-F\left(\Phi_h^h\right)} \end{array} \right) = M_h c \left[\frac{1}{\theta} - \frac{1}{\mu} \right]^{-1} \left(1 - \frac{1}{\mu} \right) \frac{D_h}{P_h} \tag{44}$$

This expression does not depend on the wage, but the number of firms active in h does. Labour demanded for the purposes of firm creation is equal to the number of entrants, $\frac{(1-\beta)}{1-F\left(\Phi_h^h\right)} M_h$ times the sunk cost of entry $\tilde{c}$. Total labour demand is therefore

$$L_h = M_h \left\{ c \left[\frac{1}{\theta} - \frac{1}{\mu} \right]^{-1} \left(1 - \frac{1}{\mu} \right) \frac{D_h}{P_h} + \widetilde{c} \frac{(1-\beta)}{1 - F\left(\Phi_h^h\right)} \right\} \tag{45}$$

In equilibrium, labour supply in h will be equal to labour demand in h.

3.2.5. Redistribution. We allow for redistribution between h and j. While there has been modest redistribution to and from the rest of the EU, we do not consider this for simplicity and we have no basis to claim what would happen to this redistribution if the Basque country were to became independent. Total income in region h, before any transfers have been paid, is equal to the wage times the number of effective workers, $Y_h = S_h W_h$. We define F as the percentage of $j's$ income that is redistributed between h and j. Income in each region can then be expressed as

$$\begin{aligned} Y_j &= (1-F) S_j W_j \\ Y_h &= S_h W_h + F S_j W_j \end{aligned} \tag{46}$$

In the case of the Basque Country, F will be equal to 0.6% under political unification and will be equal to 0 under independence.

3.2.6. Balanced Payments. In order to close the model, we set global supply equal to global demand by imposing global balance of payments. We impose balance of payments in h and j, which necessarily implies an isomorphic balance of payment condition in R.

$$\begin{aligned} FS_jW_j + X_j^h + X_R^h &= X_h^j + X_h^R \\ X_h^j + X_R^j - FS_jW_j &= X_j^h + X_j^R \end{aligned} \tag{47}$$

3.2.7. Equilibrium. In equilibrium, the following conditions must hold. The first is that the value of creating a new firm in each region is zero. We thus have two zero profit conditions.

$$\begin{aligned} (1 - F(\Phi_h^h)) \times \frac{\bar{\pi}^h}{1-\beta} - W_h\tilde{c} &= 0 \\ (1 - F(\Phi_j^j)) \times \frac{\bar{\pi}^j}{1-\beta} - W_j\tilde{c} &= 0 \end{aligned} \tag{48}$$

These expressions can be rearranged and expressed as

$$\begin{aligned} \left(\frac{W_h}{P_h}\right)^{-\mu} \frac{D_h}{P_h} &= \frac{\widetilde{c}\,(1-\beta)}{cb^k} \left(\frac{c}{\Theta}\right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \\ \left(\frac{W_j}{P_j}\right)^{-\mu} \frac{D_j}{P_j} &= \frac{\widetilde{c}\,(1-\beta)}{cb^k} \left(\frac{c}{\Theta}\right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \end{aligned} \tag{49}$$

Second, labour supply must be equal to labour demand in each country. The labour market equilibrium condition can be expressed as

$$\begin{aligned} \left(\frac{1}{\theta} - \frac{1}{\mu}\right) S_h &= cM_h \frac{D_h}{P_h} \\ \left(\frac{1}{\theta} - \frac{1}{\mu}\right) S_j &= cM_j \frac{D_j}{P_j} \end{aligned} \tag{50}$$

Next, incomes are redistributed between h and j

$$Y_j = (1-F)S_jW_j \tag{51}$$
$$Y_h = S_hW_h + FS_jW_j$$

Finally, global balance of payments are imposed. As discussed, balanced payment conditions in h and j imply that payments are balanced in R.

$$\frac{FS_jW_j}{c}\left(\frac{1}{\theta}-\frac{1}{\mu}\right)+M_h\frac{W_h}{P_h}\left\{\left(\frac{P_h}{P_j}\delta_{hj}\right)^{1-\mu}Y_j+\left(\frac{P_h}{P_R}\delta_{hR}\right)^{1-\mu}Y_R\right\} \tag{52}$$
$$=Y_h\left\{M_j\frac{W_j}{P_j}\left(\frac{P_j}{P_h}\delta_{hj}\right)^{1-\mu}+M_R\frac{W_R}{P_R}\left(\frac{P_R}{P_h}\delta_{hR}\right)^{1-\mu}\right\}$$

$$M_j\frac{W_j}{P_j}\left\{\left(\frac{P_j}{P_h}\delta_{hj}\right)^{1-\mu}Y_h+\left(\frac{P_j}{P_R}\delta_{jR}\right)^{1-\mu}Y_R\right\}-\frac{FS_jW_j}{c}\left(\frac{1}{\theta}-\frac{1}{\mu}\right) \tag{53}$$
$$=Y_j\left\{M_h\frac{W_h}{P_h}\left(\frac{P_h}{P_j}\delta_{hj}\right)^{1-\mu}+M_R\frac{W_R}{P_R}\left(\frac{P_R}{P_j}\delta_{jR}\right)^{1-\mu}\right\}$$

There are 10 equations, 10 endogenous variables $\{W_h,\ W_j,\ P_h,\ P_j,\ M_h,\ M_j,\ D_h,\ D_j,\ Y_j,\ Y_h\}$ and 17 parameters $\{\theta,\ k,\ \delta_{hj},\ \delta_{hR},\ \delta_{jR},\ c,\ \widetilde{c},\ b,\ \beta,\ S_h,\ S_j,\ S_R,\ Y_R,\ D_R,\ M_R,\ P_R,\ W_R\}$. Calibrating so many parameters, most of which are not estimable by any reasonable means and cannot simply be adapted from the literature, would be a monumental task. However, this system can greatly be simplified by making a number of innocuous substitutions and by bundling together certain parameters that are not important for the question posed by this paper. The substitutions that are made to this system are as follows, where $i \in \{h,\ j,\ R\}$:

$w_i = \frac{W_i}{P_i}$	$y_i = \frac{Y_i}{P_i}$	$d_i = \frac{D_i}{P_i}$
$Q_{hj} = \frac{P_h}{P_j}$	$Q_{hR} = \frac{P_h}{P_R}$	$s_j = \frac{S_j}{S_h}$
$w_i = \widetilde{w}_i c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$		
$d_i = \widetilde{d}_i c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$		
$y_i = \widetilde{y}_i c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$		
$M_i = \widetilde{M}_i c^{\frac{\mu-\theta}{\theta(1-\mu)}-1} B^{-\frac{1}{1-\mu}} S_h^{\frac{1}{1-\mu}}$		
$Q_{hR} = \widetilde{Q}_{hR} \frac{M_R w_R}{y_R}^{-\frac{1}{2\mu-1}}$		
$\Delta_h = \delta_{hR}^{1-\mu} \widetilde{y}_R \left(\frac{\widetilde{M}_R \widetilde{w}_R}{\widetilde{y}_R}\right)^{\frac{\mu}{2\mu-1}}$		
$\Delta_h = \delta_{jR}^{1-\mu} \widetilde{y}_R \left(\frac{\widetilde{M}_R \widetilde{w}_R}{\widetilde{y}_R}\right)^{\frac{\mu}{2\mu-1}}$		
$S_h = 1$		

By making these substitutions, the absolute magnitude of our endogenous variables cannot be recovered in the calibration. However, no information is lost. First, we are only interested in the real values of our endogenous variables. Further, the relative values of all the variables that we care about are entirely unaffected. The equilibrium conditions after these substitutions have been made can be found in Appendix 3.A. The endogenous variables in the new system are $\tilde{y}_h$, $\tilde{y}_j$, $\tilde{w}_h$, $\tilde{w}_j$, Q_{hj}, $\tilde{Q}_{hR}$, $\tilde{M}_h$, $\tilde{M}_j$, $\tilde{d}_h$, and $\tilde{d}_j$. The remaining parameters are θ, k, δ_{hj}, Δ_h, Δ_j, and s_j. As discussed θ is the elasticity of substitution between varieties and k is the Pareto shape parameter that governs the distribution of firm productivities. Δ_h and Δ_j capture the relationship between h and j with the rest of the world and s_j is the ratio of the effective population in j to the effective population in h.

3.3. Calibration

3.3.1. Methodology. The parameters which must be calibrated are θ, k, δ_{hj}, Δ_h, Δ_j, and s_j. θ is the elasticity of substitution between varieties and k governs the productivity distribution of firms. As they have been well studied, we draw on the literature to select parameter values of θ and k. The values of δ_{hj}, Δ_h, Δ_j, and

s_j are the result of matching the implied values generated by our model with the data.

The literature provides a wide range of estimates of θ, and perhaps a narrower range of estimates for k. Many numerical exercises which use Melitz-type models use a value of $\theta = 3.8$ as reported by Bernard, Eaton, Jensen, and Kortum (2003) who seek to match the size and productivity advantage of American firms that export relative to those that do not. This parameter value was used in Ghironi and Melitz (2005), Davis and Harrigan (2011), and Bernard, Redding, and Schott (2007), and many others.

With a value of θ in hand, k can be recovered by looking at the distribution of firm revenues. The distribution of revenues is an amalgamation of the elasticity of substitution and of the distribution of firm productivities. We follow the strategy of Demidova (2005, working paper version) in order to select k. In our model, the standard deviation of the log of domestic sales is $S.D. (\ln Revenue) = \frac{\theta-1}{k}$. In Bernard, Eaton, Jensen, and Kortum (2003), the standard deviation of log domestic sales in their simulated data is 0.84. This yields $k = 3.3$. Many other papers have used values of k in the ballpark of this. See Davis and Harrigan (2011), Ghironi and Melitz (2005), Demidova (2005), Felbermayr, Jung, and Larch (2012) and many others. This is a reasonable parameterisation of k based on the observable distribution of firm productivities. Mayer and Ottaviano (2007), for example, estimate the Pareto shape parameter for manufacturing firms and find that $k = 2.55$ in France and $k = 3$ in Italy.

Even though are parameterisation of k and θ are conventional, do they yield reasonable welfare implications? Arkolakis, Costinot, and Rodriguez-Clare (2012) show that in a standard trade models (*i.e.* Melitz, Krugman and Eaton-Kortum type models), the welfare implications of changing the costs of trade are driven by the share of domestically-produced products in aggregate expenditures and the elasticity of trade with respect to trade costs. In the former case, we are constrained by what is observed in the data. Based on trade flows, production and price indices, Simonovska and Waugh (2012) estimates a trade elasticity of -3.41 for Melitz-type models.[6] The elasticity of trade in our model is $1-k\frac{\theta}{\theta-1}$. Given this parameterisation, this implies a trade elasticity of -3.48. The elasticity of trade that is parameterised in this study is well in line with the most recent estimates.

In order to select the remaining parameters, we replicate the relationship between h, j, and R based on four values in the data. The data we choose to match is based on the trade flows between h, j and R and the relative economic sizes of h and j. The targets that are used are

Targets		
(1)	**Interaction h and j**	$\frac{X_j^h+X_h^j}{GDP_h+GDP_j}$
(2)	**Total trade in h**	$\frac{X_j^h+X_h^j+X_R^h+X_h^R}{GDP_h}$
(3)	**Total trade in j**	$\frac{X_j^h+X_h^j+X_R^j+X_j^R}{GDP_j}$
(4)	**GDP ratio**	$\frac{GDP_h}{GDP_j}$

The equations for these values as implied by the model can be found in appendix 3.B. The calibration algorithm is described as follows. In order to find an equilibrium for any particular set of parameters in the system of equations described in appendix 3.A, the Newton-Rhapson root-finding algorithm is applied. Define T_M as the value of the targets as generated in the model. The goal is to find the set of parameters which generates the same values which are found in the data, define the targets in the data T_D. Further let $Y = T_D - T_M$, which is how far away we are from the values in the data we wish to match. Y is perturbed with respect to each of the parameter values, which yields a square matrix X (4 elements of T_M and 4 parameters). Based on the effect of these perturbations, N represents how

[6]Simonovska and Waugh (2011) provide a new framework for estimating trade elasticities which provides lower estimates of trade elasticities than previously thought. Their recent papers, including Simonovska and Waugh (2012), have already gathered much attention.

many times the parameters must be perturbed such that $Y = 0$, that is, $N = X^{-1}Y$. Because this assumes that each successive perturbation will linearly affect T_M, and because the system is non-linear, this is applied iteratively until $T_D = T_M$.[7]

3.3.2. Data. Analysis is based around the year 2005. The use of later years would lead to results which are confounded by the economic turmoil that Spain subsequently endured. We require data on GDP, trade and fiscal transfers between the rest of Spain and the Basque Country. All data is based around each region's economic accounts data. GDP and total exports and imports with the rest of the world are taken from EUSTAT for the Basque country, Statistics Portugal for Portugal, and the Instituto Nacional de Estadística for Spain. The Basque economic accounts data also provide estimates of the Basque Country's exports and imports to the rest of Spain. As far as trade between Spain and Portugal, bilateral trade figures are taken from the Portuguese Central Bank's balance of payments. All trade figures refer to trade in both goods and services. It is not possible to use data on the Spain-Portugal trading relationship from Spanish sources as they did not release their trade figures in services with Portugal in 2005.

A few minor adjustments are made to the data to increase consistency across sources. First, the Basque Country reports a GDP which is slightly different than what is reported by the Spanish or European statistical offices. The Basque Country's trade data as a percentage of GDP is taken from the Basque statistical office, and this percentage is applied to the GDP which is reported by Eurostat (where regional GDPs in Spain 'add up'). Second, Portugal's trade figures as reported in their balance of payments (where data on trade with Spain exists), do not perfectly line up with what is reported in their national accounts. Portugal's trade with Spain as a percentage of total trade is taken from the balance of payments data and this percentage is applied to what is reported in their national accounts. These

[7] All numerical work is done in Gauss.

Table 3.1

	h - R.O.Spain, j - Basque	h - Spain, j - Portugal
GDP_h	853,323	909,298
GDP_j	55,975	154,269
X^h_j	25,210	16,928
X^j_h	20,985	10,351
X^R_j	14,965	40,263
X^j_R	15,942	32,317
X^R_h	266,324	270,938
X^h_R	217,445	216,459

Values are in millions of Euro

adjustments are very minor and have a negligible effect on the results. Descriptive statistics are presented in Table 3.1 above.

Finally, the Basque Country's net fiscal transfers to the rest of Spain in 2005 are taken from the Instituto de Estudios Fiscales. The Basque Country, on net, transferred an amount equal to 0.6% of their GDP in 2005 according to this source.

3.3.3. Baseline Calibration. In this subsection, we calibrate the remaining parameters, δ, Δ_h, Δ_j, and s_j, for Spain and Portugal and rest of Spain and the Basque Country. The results of this calibration can be seen in Table 3.2.

Note that the distance between Spain and Portugal is much higher than is the distance between Spain and the Basque Country. The large size of this difference is more or less what would be expected. Despite being a third of the size of Portugal, the Basque country exports and imports far more to the rest of Spain, even in absolute terms, than Portugal. This is not because the Basque Country has fewer

Table 3.2

		Spain (h) - Portugal (j)		
	Calibrated parameters	*Targets*	*Model*	*Data*
$\delta_{Spain\text{-}Portugal}$	*2.336*	*Interaction h and j*	*0.027*	*0.027*
Δ_h	*0.047*	*Total Trade in h*	*0.566*	*0.566*
Δ_j	*0.018*	*Total Trade in j*	*0.647*	*0.647*
s_j	*0.205*	*GDP ratio*	*5.894*	*5.894*
		Rest of Spain (h) - Basque Country (j)		
	Calibrated parameters	*Targets*	*Model*	*Data*
$\delta_{R.O.Spain\text{-}Basque}$	*1.527*	*Interaction h and j*	*0.051*	*0.051*
Δ_h	*0.051*	*Total Trade in h*	*0.621*	*0.621*
Δ_j	*0.019*	*Total Trade in j*	*1.377*	*1.377*
s_j	*0.081*	*GDP ratio*	*15.245*	*15.245*

outside options than does Portugal (which would lead to a lot of trade even if the distance were high); as a percentage of GDP, the Basque country trades more with the rest of the world than does Portugal.

This calibration also implies the relative efficiencies of labour. Recall that $s_j = \frac{N_j A_j}{N_h A_h}$ where N is population and A is efficiency of labour. The implied ratio of labour efficiency, A_j/A_h is 1.58 for the Basque Country and the rest of Spain and 0.84 for Spain and Portugal.

3.3.4. Counterfactual. Now we proceed to presenting the main result of this paper, which is to identify the welfare implications of increasing the distance between the Basque Country and the rest of Spain to what it is between Portugal and Spain. The results of this counterfactual exercise is presented in Table 3.3. It is important to reiterate that after making the aforementioned substitutions, the actual values that result from this calibration do not have any direct economic interpretation. Only ratios and changes are interpretable in this respect. We therefore only discuss the relative values of incomes and productivity thresholds when imposing our

Table 3.3

	(1) - Baseline (δ = 1.527 F = 0.6%)	**(2) - Changing Distance** (δ = 2.336 F =0 .6%)	**Change**	**(3) - Changing Distance and Transfars** (δ = 2.336, F = 0)	**Change**
y_j	100%	86.71%	-13.29%	87.28%	-12.72%
y_h	2022.74%	2009.60%	-0.65%	2008.84%	-0.687%
$(X^j{}_h + X^h{}_j)/GDP_j$	82.53%	25.15%	-57.38 % pts	25.18%	-57.34 % pts
$(X^j{}_R + X^R{}_j)/GDP_j$	55.22%	73.01%	+17.8 % pts	73.14%	+ 17.92 % pts
$\Phi^j{}_j$	--	--	-17.59%	--	-17.54%
$\Phi^j{}_h$	--	--	+62.63%	--	+62.85%
$\Phi^j{}_R$	--	--	-8.17%	--	-8.05%

% Changes may not add due to rounding.

counterfactual exercise. y_j is normalised to 100% in the baseline calibration and y_h is expressed in terms which are relative to y_j as found in the calibration. Column one presents the baseline calibration, which is calibrated to match the relationship between the Basque Country and the rest of Spain as it currently stands (as is also shown in Table 3.2). Column two shows what would happen to trade, the productivity thresholds and real incomes as a result of increasing the distance between the Basque Country and the rest of Spain to what it is between Spain and Portugal. The final column illustrates what will happen when fiscal transfers are also eliminated in addition to increasing distances. The change presented in the second two columns refer to the change relative to the baseline case.

First note that increasing the distance between the Basque Country and the rest of Spain greatly increases the productivity threshold required to sell in the rest of Spain. A firm, with a given productivity, may no longer find it profitable to export to the rest of the Spanish market due to the higher fixed and variable costs. The Basque Country's trade with the Spain as a percentage of its GDP falls by a factor of more than 3. This predicted effect on trade is well in line with the literature relating to how much national borders decrease economic interaction. Recall from chapter 1 that canonical results of the U.S.-Canada border effect indicate that the U.S.-Canada border decreases trade by a factor of about 5. That is, the trade disintegration that is predicted in this paper as a result of imposing a national border where one once did not exist is not anomalous in any sense.

Because each market has become more fragmented, it will be easier for less productive firms to sell in their domestic market as they are more sheltered from outside competition. This can be seen by the decrease in the productivity threshold required to profitably sell in one's own domestic market. The average productivity of firms who sell in market j and the nominal wage in market j will be lower as a result. It is also worth noting that the productivity threshold required to export to the rest of the world also falls. This is because the nominal wage in j falls, decreasing the cost of selling in any market for any particular trade cost or productivity. Because of this lower productivity threshold with the rest of the world, the Basque Country will trade more with the rest of the world. The Basque Country's total trade as a percentage of GDP falls from about 137% to about 98%, a factor of about 0.28. The total trade of the Basque Country falls by a larger factor, close to 0.38, because GDP has also simultaneously fallen.[8]

Most importantly, the real income of the Basque Country falls by 13.29% as a result of increasing the distance with the rest of Spain. This loss in welfare is driven by a number of channels. First, nominal wages are lower because the average firm is smaller. Second, the average productivity of firms that sell in the Basque country is also lower. Because of constant price markups over marginal cost, this implies that the average nominal price in the Basque country will be higher. While not generally true, the model employed here typically implies that consumers will also enjoy a

[8]This is using the change in gross national income as a proxy for the change in GDP.

lower product variety. See Melitz (2003) for a discussion of this. The number of varieties that would be available is not directly recoverable in this paper.

The real income in the rest of Spain would also fall for identical reasons. The loss in welfare would be far lower for the rest of Spain, however. An independent Basque country would lose out on easy interaction with a market more than 15 times the size of its own. The Basque Country is far less important to the rest of Spain, however. The total loss to all of Spain, including the Basque Country, is nearly 14%.

Distance is not the only thing that would change in an independent Basque Country, however. The Basque Country would be able to retain all of their own income, which is not currently the case. As can clearly be seen by comparing columns 2 and 3, changing transfers does not change the trade relationships by any amount worth expounding upon. The welfare losses of the Basque Country, however, will partly be mitigated. Rather than experiencing a decline in real income of 13.29%, the Basque Country's real income would fall by 12.72%. The loss to the rest of Spain would be slightly larger after removing these transfers.

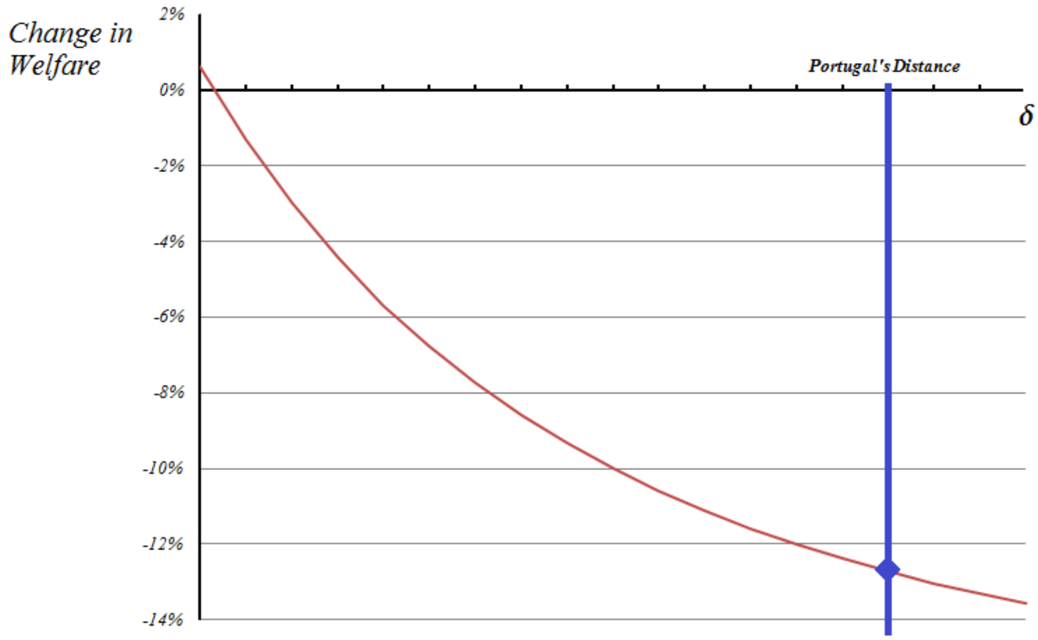
While the trade disintegration that we predict from imposing a national border where it once did not exist is well in line with the literature, can we say the same about the welfare implications? Computable general equilibrium models which seek to quantify the welfare implications of trade liberalisation lead to a wide range of conclusions. The seminal work by Eaton and Kortum (2002), for example, would imply a welfare loss to the Basque Country lower than what is estimated here. Recent research, however, have put these results into question. Simonovska and Waugh (2011) demonstrate that Eaton and Kortum (2002)'s methodology is biased in finite samples. Simonovska and Waugh (2011)'s methodology implies trade elasticities which result in much greater gains from trade in which they claim that "this difference doubles the welfare gains from international trade." When one looks at the empirical evidence of the effect of trade on income, we could conclude that our estimates of the welfare loss to an independent Basque Country are not overstated. Feyrer (2009) estimates that the elasticity of trade with respect to income per capita is 1/2. Previous studies have generated even higher elasticities. In our calibration exercise, total trade in the Basque Country falls by about 38%. We estimate that real income falls by 13%. In any case, quantifying gains from trade is a topic on the frontier of economic research. While future research may imply different welfare implications, the most "up-to-date" parameterisation has been utilised in this paper and our results are not at odds with empirical evidence.

All we have done so far is to present a reasonable benchmark. It is important to describe the welfare implications of Basque independence for different distances. The change in real income for the Basque Country after removing transfers for different values of distance is seen in Figure 3.3.

Indeed, if the distance between an independent Basque Country and the rest of Spain is the same as it is under political dependence, the Basque Country will be unequivocally better off. The Basque Country no longer has to pay transfers and can still enjoy the same level of market integration as before. As is clear, however, even a very small increase in distance will eliminate the benefit of retaining the relatively small transfers that were once paid to the rest of Spain. Where exactly an independent Basque Country ends up on this curve in a few generations is a matter which can debated. However, we believe that it would be more difficult to make a case against it being close to what it is between Spain and Portugal.

It is important to note, however, that the loss in welfare is most severe when talking about the initial increases in distance. That is, increasing distance by the first 10% is more detrimental than increasing distance by the last 10%. This, in itself, is an interesting resulting. Even if the Basque Country's distance will never reach Portugal's distance, most of the welfare losses will have already been incurred.

Figure 3.5



This figure shows the change in real income for the Basque Country for different values of δ after the transfer is removed. The point where the vertical and horizontal axes cross is the initial distance between the Basque Country and the rest of Spain

Increasing δ by just a bit more does not matter so much. The shape of this curve is driven, at least in part, by firm selection and the distribution of firm productivities. Empirically, and in the parameterised version of this model, there are many more less productive firms than there are productive firms. If, for example, δ increased from 1.5 to 1.6, far fewer firms will no longer be able to export than if δ had increased from 2 to 2.1. In other words, the superstars will export no matter what.

3.4. Conclusion

In this paper, we have assessed the potential cost of market fragmentation that would likely result if the Basque Country became independent from the rest of Spain. We find that under reasonable assumptions and parameterisations, the effect of an increase the Basque Country's effective distance with the rest of Spain would result in a real income loss of more than 12%. We have thus far been silent about any normative statements or policy prescriptions. This is because the goal of this paper is not necessarily to make a judgment about the relative merits of Basque independence. The purpose of this paper is to quantify a potentially very large welfare loss that might be incurred if Basque separation goes through.

The mechanism behind the welfare loss is largely due to the extensive margin of trade. That is, increasing trade costs will change the distribution of Basque firms that can sell in the rest of Spain and the distribution of rest of Spain firms that can sell in the Basque Country. Firms in each region will be more sheltered from competition if political separation takes place. Low productivity firms that did not find it profitable to produce under political unification will now be able to. The average productivity and firm size in each region will decrease, leading to lower wages and higher average prices. The effect of trade deterioration with the rest of Spain is partly mitigated because an independent Basque Country would trade more with the rest of the world. As discussed, however, the net welfare effect is substantially negative. The key results of this paper (the trade deterioration resulting from imposing a national border and the associate welfare losses) are not at odds with the empirical literature.

A clear implication that can be drawn from this paper is what *should* be done if the Basque Country separates. An economy which is well integrated with the rest of Spain is important for the mutual benefit of everybody involved. Increasing the difficulty of economic transaction between the Basque Country and the rest of Spain would entail substantial welfare losses, far more so for the Basque Country. For pecuniary losses not to be severe, regulatory and legal coordination between the Basque Country and a Spain without the Basque Country needs to occur. Furthermore, policies which promote the maintenance of social ties between both countries would be important. For example, policies which guarantee mutual recognition of qualifications would dampen the possible decreased mobility between the two countries.

Appendix 3.A

The equilibrium conditions after bundling together certain parameters and making a series of substitutions are as follows:

$$
\begin{aligned}
(1)\ 0 &= 1 - \frac{\tilde{y}_h + \delta^{1-\mu} Q_{hj}^{-\mu} \tilde{y}_j + \Delta_h \tilde{Q}_{hR}^{-\mu}}{\tilde{d}_h} \\
(2)\ 0 &= 1 - \frac{\tilde{y}_j + \delta^{1-\mu} Q_{hj}^{\mu} \tilde{y}_h + \Delta_j \tilde{Q}_{hR}^{-\mu} Q_{hj}^{\mu}}{\tilde{d}_j} \\
(3)\ 0 &= 1 - \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \Theta^{-\frac{\mu}{\theta}} \tilde{w}_h^{\mu} / \tilde{d}_h \\
(4)\ 0 &= 1 - \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \Theta^{-\frac{\mu}{\theta}} \tilde{w}_j^{\mu} / \tilde{d}_j \\
(5)\ 0 &= 1 - \tilde{d}_h \tilde{M}_h \left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1} \\
(6)\ 0 &= 1 - \tilde{d}_j \tilde{M}_j \frac{1}{s_j} \left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1} \\
(7)\ 0 &= 1 - \frac{\tilde{w}_h Q_{hj} + F s_j \tilde{w}_j}{\tilde{y}_h Q_{hj}} \\
(8)\ 0 &= 1 - \frac{(1-F) s_j \tilde{w}_j}{\tilde{y}_j} \\
(9)\ 0 &= 1 - \frac{\tilde{y}_h \left(\tilde{M}_j \tilde{w}_j Q_{hj}^{\mu-1} \delta^{1-\mu} + \tilde{Q}_{hR}^{\mu-1} \Delta_h\right)}{F \tilde{M}_j \tilde{w}_j \tilde{d}_j \frac{1}{Q_{hj}} + \tilde{M}_h \tilde{w}_h \left(Q_{hj}^{-\mu} \delta^{1-\mu} \tilde{y}_j + \tilde{Q}_{hR}^{-\mu} \Delta_h\right)} \\
(10)\ 0 &= 1 - \frac{\tilde{y}_j \left(\tilde{M}_h \tilde{w}_h Q_{hj}^{1-\mu} \delta^{1-\mu} + \left(\frac{Q_{hj}}{\tilde{Q}_{hR}}\right)^{1-\mu} \Delta_j\right)}{\tilde{M}_j \tilde{w}_j \left(Q_{hj}^{\mu} \delta^{1-\mu} \tilde{y}_h + \left(\frac{\tilde{Q}_{hR}}{Q_{hj}}\right)^{-\mu} \Delta_j - F \tilde{d}_j\right)}
\end{aligned}
$$

Appendix 3.B

The equations for the targets as implied by the model are presented below.

GDP ratio - $\frac{GDP_h}{GDP_j}$

$$\frac{\widetilde{w}_h}{\widetilde{w}_j} Q_{hj} \frac{1}{s_j}$$

Interaction h and j - $\frac{X_j^h + X_h^h}{S_j W_j + S_h W_h}$

$$\left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1} \left(\delta_{hj}\right)^{1-\mu} \left[\frac{\widetilde{M}_h \widetilde{w}_h \left(Q_{hj}\right)^{1-\mu} \widetilde{y}_j + \widetilde{M}_j \widetilde{w}_j \left(Q_{hj}\right)^{\mu} \widetilde{y}_h}{\widetilde{w}_h Q_{hj} + s_j \widetilde{w}_j}\right]$$

Total trade in h - $\frac{X_{hj} + X_{jh} + X_{hR} + X_{Rh}}{S_h W_h}$

$$\left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1} \frac{\widetilde{M}_h \widetilde{w}_h \left(Q_{hj}\right)^{-\mu} \left(\delta_{hj}\right)^{1-\mu} \widetilde{y}_j + \widetilde{M}_j \widetilde{w}_j \left(Q_{hj}\right)^{\mu-1} \left(\delta_{hj}\right)^{1-\mu} \widetilde{y}_h + \widetilde{M}_h \widetilde{w}_h \left(\tilde{Q}_{hR}\right)^{-\mu} \Delta_h + \left(\tilde{Q}_{hR}\right)^{\mu-1} \Delta_h \widetilde{y}_h}{\widetilde{w}_h}$$

Total trade in j - $\frac{X_{hj} + X_{jh} + X_{jR} + X_{Rj}}{S_j W_j}$

$$\left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1} \frac{\widetilde{M}_h \widetilde{w}_h \left(Q_{hj}\right)^{1-\mu} \left(\delta_{hj}\right)^{1-\mu} \widetilde{y}_j + \widetilde{M}_j \widetilde{w}_j \left(Q_{hj}\right)^{\mu} \left(\delta_{hj}\right)^{1-\mu} y_h + \widetilde{M}_j \widetilde{w}_j \Delta_j \left(\frac{\widetilde{Q}_{hR}}{Q_{hj}}\right)^{-\mu} + \Delta_j \left(\frac{\widetilde{Q}_{hR}}{Q_{hj}}\right)^{\mu-1} \widetilde{y}_j}{s_j \widetilde{w}_j}$$

Bibliography

Antràs, Pol. "Contracts and the Global Organization oF Production." CREI Lectures in Macroeconomics (2013).

Anderson, James E., and Eric Van Wincoop. "Gravity with Gravitas: A Solution to the Border Puzzle." The American Economic Review 93, no. 1 (2003): 170-192.

Anderson, James E., and Douglas Marcouiller. "Anarchy and Autarky: Endogenous Predation as a Barrier to Trade." International Economic Review 46, no. 1 (2005): 189-213.

Anderson, James E., and Leslie Young. "Trade and Contract Enforcement." Contributions in Economic Analysis & Policy 5, no. 1 (2006).

Anderson, James E. "Does Trade Foster Contract Enforcement?" Economic theory 41, no. 1 (2009): 105-130.

Araujo, Luis, Giordano Mion, and Emanuel Ornelas. "Institutions and Export Dynamics." National Bank of Belgium Working Paper 220 (2012).

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez-Clare. "New Trade Models, Same Old Gains?." American Economic Review 102, no. 1 (2012): 94-130.

Axtell, Robert L. "Zipf distribution of US firm sizes." Science 293, no. 5536 (2001): 1818-1820.

Belot, Michèle, and Sjef Ederveen. "Cultural Barriers in Migration Between OECD Countries." Journal of Population Economics 25, no. 3 (2012): 1077-1105.

Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum. "Plants and Productivity in International Trade." American Economic Review (2003): 1268-1290.

Blumenstock, Joshua E. "Using Mobile Phone Data to Measure the Ties Between Nations." In Proceedings of the 2011 iConference, (2011): 195-202.

Bhattacharya, Utpal, Neal Galpin, and Bruce Haslem. "The Home Court Advantage in International Corporate Litigation." Journal of Law and Economics 50, no. 4 (2007): 625-660.

Bosquet, Clément, and Hervé Boulhol. "Applying the GLM Variance Assumption to Overcome the Scale-Dependence of the Negative Binomial QGPML Estimator." Econometric Reviews (2013).

Bratti, Massimiliano, Luca De Benedictis, and Gianluca Santoni. "On the Pro-Trade Effects of Immigrants." Institute for the Study of Labor, no. 6628 (2011).

Campbell, John Y., Karine Medeiros, and Luis M. Viceira. "Global Currency Hedging." The Journal of Finance 65, no. 1 (2010): 87-121.

Carlsson, Hans, and Eric Van Damme. "Global Games and Equilibrium Selection." Econometrica: Journal of the Econometric Society (1993): 989-1018.

Chen, Natalie. "Intra-national Versus International Trade in the European Union: Why Do National Borders Matter?" Journal of International Economics 63, no. 1 (2004): 93-118.

Clay, Karen. "Trade Without Law: Private-Order Institutions in Mexican California." Journal of Law, Economics, and Organization 13, no. 1 (1997): 202-231.

Clermont, Kevin M., and Theodore Eisenberg. "Xenophilia in American courts." Harvard Law Review 109, no. 5 (1996): 1120-1143.

Combes, Pierre-Philippe, Miren Lafourcade, and Thierry Mayer. "The Trade-Creating Effects of Business and Social Networks: Evidence from France." Journal of International Economics 66, no. 1 (2005): 1-29.

Davis, Donald R., and James Harrigan. "Good Jobs, Bad Jobs, and Trade Liberalization." Journal of International Economics 84, no. 1 (2011): 26-36.

Den Butter, Frank AG, and Robert HJ Mosch. "Trade, Trust and Transaction Costs." Tinbergen Institute Discussion Paper (2003)

Demidova, Svetlana. "Productivity Improvements and Falling Trade Costs: Boon or Bane." International Economic Review 49, no. 4 (2008): 1437-1462. ***2005 working paper version***

Dixit, Avinash. "Trade Expansion and Contract Enforcement." Journal of Political Economy 111, no. 6 (2003): 1293-1317.

Dhillon, Amrita, and Jamele Rigolini. "Development and the Interaction of Enforcement Institutions." Journal of Public Economics 95, no. 1 (2011): 79-87.

Dunlevy, James A., and William K. Hutchinson. "The Impact of Immigration on American Import Trade in the Late Nineteenth and Early Twentieth Centuries." Journal of Economic History 59, no. 4 (1999): 1043-1062.

Eaton, Jonathan, and Samuel Kortum. "Technology, Geography, and Trade." Econometrica 70, no. 5 (2002): 1741-1779.

Feenstra, Robert C. "Border Effects and the Gravity Equation: Consistent Methods for Estimation." Scottish Journal of Political Economy 49, no. 5 (2002): 491-506.

Felbermayr, Gabriel J., and Farid Toubal. "Revisiting the Trade-Migration Nexus: Evidence from New OECD Data." World Development 40, no. 5 (2012): 928-937.

Feyrer, James. "Trade and Income–Exploiting Time Series in Geography." National Bureau of Economic Research no. w14910 (2009).

Felbermayr, Gabriel, Benjamin Jung, and Mario Larch. "Tariffs and Welfare in New Trade Theory Models." University of Tübingen Working Papers in Economics and Finance no. 41 (2012).

Garín-Muñoz, Teresa, and Teodosio Perez-Amaral. "Econometric Modelling of Spanish Very Long Distance International Calling." Information Economics and Policy 10, no. 2 (1998): 237-252.

Ghironi, Fabio, and Marc J. Melitz. "International Trade and Macroeconomic Dynamics with Heterogeneous Firms." The Quarterly Journal of Economics 120, no. 3 (2005): 865-915.

Garmendia, Aitor, Carlos Llano, Asier Minondo, and Francisco Requena. "Networks and the Disappearance of the Intranational Home Bias." Economics Letters 116, no. 2 (2012): 178-182.

Gould, David M. "Immigrant Links to the Home Country: Empirical Implications for US Bilateral Trade Flows." The Review of Economics and Statistics (1994): 302-316.

Gen, Murat, Masood Gheasi, Peter Nijkamp, and Jacques Poot. "The Impact of Immigration on International Trade: a Meta-analysis." IZA Discussion Paper, no. 6145 (2011).

Gil-Pareja, Salvador, Rafael Llorca-Vivero, and José A. Martínez-Serrano, and Josep Oliver-Alonso. "The Border Effect in Spain." The World Economy 28, no. 11 (2005): 1617-1631.

Gil-Pareja, Salvador, Rafael Llorca-Vivero, and José A. Martínez-Serrano. "The Border Effect in Spain: the Basque Country Case." Regional Studies 40, no. 4 (2006): 335-345.

Greif, Avner. "Reputation and Coalitions in Medieval Trade: Evidence on the Maghribi Traders." Journal of Economic History 49, no. 4 (1989): 857-882.

Greif, Avner. "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition." The American Economic Review (1993): 525-548.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. "Cultural Biases in Economic Exchange?." The Quarterly Journal of Economics 124, no. 3 (2009): 1095-1131.

Head, Keith, Thierry Mayer, and John Ries. "The erosion of colonial trade linkages after independence." Journal of International Economics 81, no. 1 (2010): 1-14.

Heinemann, Frank. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks: Comment." The American Economic Review 90, no. 1 (2000): 316-318.

Helliwell, John F. "National Borders, Trade and Migration." Pacific Economic Review 2, no. 3 (1997): 165-185.

Hatzigeorgiou, Andreas. "The Contribution of Migrants in Enhancing Foreign Trade" in Open for Business: Migrant Entrepreneurship in OECD Countries Chapter 12, (2010)

Hillberry, Russell, and David Hummels. "Trade Responses to Geographic Frictions: A Decomposition Using Micro-data." European Economic Review 52, no. 3 (2008): 527-550.

Huang, Rocco R. "Distance and Trade: Disentangling Unfamiliarity Fffects and Transport Cost Effects." European Economic Review 51, no. 1 (2007): 161-181.

Kandori, Michihiro. "Social Norms and Community Enforcement." The Review of Economic Studies 59, no. 1 (1992): 63-80.

Kurant, Maciej, Minas Gjoka, Yan Wang, Zack Almquist, Carter Butts, and Athina Markopoulo. "Coarse-Grained Topology Estimation via Graph Sampling." Proceedings of ACM SIGCOMM Workshop on Online Social Networks (2012)

Leeson, Peter T. "How Important is State Enforcement for Trade?" American Law and Economics Review 10, no. 1 (2008): 61-89.

Lennon, Carolina. "Trade in Services and Trade in Goods: Differences and Complementarities." Paris School of Economics Working Paper, no. 52 (2008).

Macaulay, Stewart. "Non-Contractual Relations in Business: A Preliminary Study." American Sociological Review (1963): 55-67.

Mayer, Thierry, and Gianmarco IP Ottaviano. "The Happy Few: The Internationalisation of European Firms." Bruegel blueprint series 3 (2007): 1-81.

Melitz, Marc J. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." Econometrica 71, no. 6 (2003): 1695-1725.

Martínez-Zarzoso, Inmaculada. "The Log of Gravity Revisited." Applied Economics 45, no. 3 (2013): 311-327.

Matsuo, Miwa, and Hiroyuki Ishise. "The US-Canada Border Effect: Smaller Than Previously Thought and Becoming Smaller." Mid-America Transport Center Report, no. 473 (2012)

McCallum, John. "National Borders Matter: Canada-US regional Trade Patterns." The American Economic Review 85, no. 3 (1995): 615-623.

McMillan, John, and Christopher Woodruff. "Interfirm Relationships and Informal Credit in Vietnam." The Quarterly Journal of Economics 114, no. 4 (1999): 1285-1320.

Milgrom, Paul R., and Douglass C. North. "The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs." Economics & Politics 2, no. 1 (1990): 1-23.

Millimet, Daniel L., and Thomas Osang. "Do State Borders Matter for US Intranational Trade? The Role of History and Internal Migration." Canadian Journal of Economics/Revue canadienne d'économique 40, no. 1 (2007): 93-126.

Morris, Stephen, and Hyun Song Shin. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." American Economic Review (1998): 587-597.

Morris, Stephen, and Hyun Song Shin. "Global Games: Theory and Applications." Econometric Society Monographs 35 (2003): 56-114.

Murat, Marina. "Out of sight, not out of mind. Education networks and international trade." DEMB Working Paper Series, no. 2 (2012)

Nitsch, Volker. "National Borders and International Trade: Evidence From the European Union." Canadian Journal of Economics/Revue canadienne d'économique 33, no. 4 (2000): 1091-1105.

Nunlee, Martin Phenix. "The Control of Intra-channel Opportunism Through the Use of Inter-channel Communication." Industrial Marketing Management 34, no. 5 (2005): 515-525.

Obstfeld, Maurice, and Kenneth Rogoff. "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" In NBER Macroeconomics Annual 2000, Volume 15, pp. 339-412. MIT press, (2001)

Peri, Giovanni, and Francisco Requena-Silvente. "The Trade Creation Effect of Immigrants: Evidence from the Remarkable Case of Spain." Canadian Journal of Economics/Revue canadienne d'économique 43, no. 4 (2010): 1433-1459.

Perkins, Richard, and Eric Neumayer. "The Ties That Bind: the Role of Migrants in the Uneven Geography of International Telephone Traffic." Global networks 13, no. 1 (2013): 79-100.

Prior, John, Kevin Eagan, Laura Blake, Sylvia Hurtado, Jennifer Berdan, and Matthew Case. "The American Freshman: National Norms Fall 2012." CIRP (2012)

Pyle, William. "Contractual Disputes and the Channels for Interfirm Communication." Journal of Law, Economics, and Organization 21, no. 2 (2005): 547-575.

Rauch, James E., and Vitor Trindade. "Ethnic Chinese Networks in International Trade." Review of Economics and Statistics 84, no. 1 (2002): 116-130.

Redding, Stephen and Daniel Sturm. "The Costs of Remoteness: Evidence from German Division and Reunification." American Economic Review, 98 no. 5 (2008): 1766-1797.

Requena, Francisco, and Carlos Llano. "The Border Effects in Spain: an Industry-level Analysis." Empirica 37, no. 4 (2010): 455-476.

Rooks, Gerrit, Frits Tazelaar, and Chris Snijders. "Gossip and Reputation in Business Networks." European Sociological Review 27, no. 1 (2011): 90-106.

Rose, Andrew K., and Tom D. Stanley. "A Meta-Analysis of the Effect of Common Currencies on International Trade." Journal of Economic Surveys 19, no. 3 (2005): 347-365.

Rossi-Hansberg, Esteban. "A Spatial Theory of Trade." American Economic Review 95, no. 5 (2005): 1464-1491.

Silva, JMC Santos, and Silvana Tenreyro. "The Log of Gravity." The Review of Economics and Statistics 88, no. 4 (2006): 641-658.

Simonovska, Ina, and Michael E. Waugh. "The Elasticity of Trade: Estimates and Evidence." National Bureau of Economic Research, no. w16796 (2011)

Simonovska, Ina, and Michael Waugh. "Different Trade Models, Different Trade Elasticities?" Society for Economic Dynamics, Meeting Paper 618 (2012)

Shepherd, Ben. "The Gravity Model of International Trade: A User Guide." ARTNeT Gravity Modeling Initiative (2013)

Turrini, Alessandro, and Tanguy van Ypersele. "Traders, courts, and the border effect puzzle." Regional Science and Urban Economics 40, no. 2 (2010): 81-91.

Wagner, Don, Keith Head, and John Ries. "Immigration and the Trade of Provinces." Scottish Journal of Political Economy 49, no. 5 (2002): 507-525.

Weidenbaum, Murray, and Samuel Hughes. "The Bamboo Network." New York: The Free Press, (1996)

Wooldridge, Jeffrey M. "Introductory Econometrics: a Modern Approach" Cengage Learning, (2012)

Tadesse, Bedassa, and Roger White. "Do African Immigrants Enhance Their Home Nations' Trade With Their Hosts?." The Journal of Developing Areas 47, no. 2 (2013): 199-228.

Yi, Kei-Mu. "Can Multistage Production Explain the Home Bias in Trade?" The American Economic Review (2010): 364-393.

Yu, Shu, Jakob de Haan, and Sjoerd Beugelsdijk. "Trade, Trust and Institutions," No. 3571. CESifo working paper: Trade Policy, (2011)